MINUTES OF THE 44TH MEETING

OF THE

SENATE

Date	**:**	**10th April 2021**
Time	**:**	**10.30 A.M**
Venue	**:**	**Virtual through Google Meet (https://meet.google.com/tnm-gxpv-pov?hs=224)**

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY DESIGN AND MANUFACTURING, KANCHEEPURAM

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ANNEXURES

MINUTES OF THE 44th MEETING OF THE SENATE

Date	**:**	**10th April 2021**
Time	**:**	**10.30 A.M**
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Members Present:

1. Prof. Banshidhar Majhi, Director and Chairman
2. Mr. A Chidambaram, Registrar & Secretary
3. Prof. V Krishna Nandivada
4. Prof. Ram Bilas Pachori
5. Prof. GK Anantha Suresh
6. Prof. R Chandrashekar
7. Dr. Manoj Choudhury
8. Dr. Shankar Venugopal
9. Dr. V Chandramouliswaran
10. Dr. G Venkatesh
11. Dr. Binsu J Kailath, Dean Academics
12. Dr. Sudhir Varadarajan, Dean DII
13. Dr. M. Sreekumar, Dean FA
14. Dr. Naveen Kumar Vats, Dean SA
15. Dr. M.D. Selvaraj, Dean SR
16. Dr. V. Masilamani, HoD, CSE
17. Dr. Priyanka Kokil, HoD, ECE
18. Dr. B. Raja, HoD, ME
19. Dr. Shalu M.A., HoD, BSH

AGENDA

<table>
<tr><td rowspan="2">2021-44-Senate-01</td><td>Nomination of New Senate members.</td></tr>
<tr><td>The Senate membership is normally for a period of 2 years. However, some of the existing members have served for more than 5 years’ period. Therefore, with due approval of Chairman, BoG, the following members have been nominated as members of the Senate:

Academic Experts:
1. Prof. V Krishna Nandivada
Dept. of Computer Science and Engineering, IIT Madras.
2. Prof. Ram Bilas Pachori
Dept. of Electrical Engineering, IIT Indore.
3. Prof. G K. Anantha Suresh,
Dept. of Mechanical Engineering, IISC, Bangalore.
4. Prof. R Chandrashekar,
Dean Academics and Faculty In charge Computing, IIIT Bangalore.
Industry Experts
1. Dr. Manoj Choudhury
Global Head- Strategic Initiatives and Emerging Technologies
TATA Consultancy Services.
2. Dr. Shankar Venugopal
Vice President, Mahindra and Mahindra
3. Dr. V Chandramouliswaran
Global Senior Executive
PayPal Inc, Chennai.
4. Dr. G. Venkatesh, Industry Professor, IIT Madras</td></tr>
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The following members have completed their service and the Institute has been greatly benefitted by their expertise and suggestions.

1. Prof. Jagadeesh Kumar V
Dept. of Electrical Engineering, IIT Madras.
2. Prof. P Chandramouli
Dept of Mechanical Engineering, IIT Madras.
3. Prof. Krishnamoorthy Sivalingam
Dept. of Computer Science and Engineering, IIT Madras.

Industry Experts

1. Dr. Anand Laxmanan
M/s Erricsson
2. Dr. Sathya Prasad
M/s Ashok Leyland

Senate may kindly consider welcoming the distinguished new Senate members. Senate may further consider appreciating the service rendered by the outgoing members during their service as members of the Senate.

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All the new members were introduced by the Chairman Senate and the Senate extended warm welcome to all the new members. The Senate further appreciated the services rendered by the outgoing members.

The Chairman Senate has given a detailed presentation about the Institute including its growth over the last 13 years, the mandate of the academic programmes offered, mission and vision, increase in funded projects in the recent years, measures adopted for taking Institute to next level etc. The Senate had detailed deliberation on all the points including the placement statistics of the UG/DD/PG students.

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<tr><td rowspan="3">2021-44-Senate-02</td><td colspan="3">To confirm the Minutes of the 43rd meeting of the Senate held on 19th September 2020</td></tr>
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The Minutes of 43rd Meeting of the Senate held on 19th September 2020 was circulated to all members. No comments/suggestions were received from the members.

Senate may kindly confirm the Minutes of the 43rd meeting of the Senate placed as ***ANNEXURE A.***

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<tr><td colspan="3">The Senate confirmed the Minutes of its 43rd meeting held on 19th September, 2021 and the same is given as ANNEXURE A.</td></tr>
<tr><td rowspan="4">2021-44-Senate-03</td><td colspan="3">Action Taken Report on the decision of 43rd meeting of the Senate held on 19th September 2020</td></tr>
<tr><td colspan="3">The action taken report of the institute on the decision of the Senate is as under:</td></tr>
<tr><td rowspan="2">2020-43-Senate-04</td><td colspan="2">Design Spine Curriculum and Syllabus:</td></tr>
<tr><td>(i) The Senate after due consideration accorded approval to introduce new design spine for B.Tech. and Minor/Honours in Product Design from 2020 batch.</td><td>(i) A max of 20% B.Tech. students will be given an option to pursue Minor/Honors in Product Design at the end of the 5th Semester The minor requirement will include a set of 6 design electives (2 in each semester between semesters 6-8), full-semester internship in the 7th semester and product development</td></tr>
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			oriented project in the 8th semester under SIDI. A max of 10 students will be given the option to pursue M. Des. as a Dual Degree at the end of the 5th Sem. They will complete the B.Tech. regular courses until 6th semester and do the M. Des. program between semesters 7-10.
		(ii) The curriculum and syllabus for the M. Des. program should be presented before the Senate for further consideration.	(ii) Advertisement for M Des. program has been released and online application portal is open for admission to M. Des program for Jul 2021 session. The syllabus for the program is placed as separate agenda for consideration of the Senate.
		(iii) School of Interdisciplinary Design and Innovation may be formed by attracting right faculty.	(iii) An advertisement for faculty recruitment in specific areas of design (on contract and regular) is likely to be released in the first week of May 2021.
		(iv) The nature of Ph.D. program would be presented for consideration of the Senate	(iv) It is proposed to start a PhD program in Interdisciplinary Design from Jul 2021. The number of candidates per faculty under regular category will be as per the Institute guidelines. The program will follow the guidelines of the existing PhD program, except for entry criteria. In line with the interdisciplinary character, the program will be open for post graduates from different streams - science, engineering, design, architecture, management - willing to pursue PhD in Design. The selection will be based on a design aptitude test and an interview conducted by the institute. Those without a design background will be expected to take 6 M.Des courses.
	2020-43-Senate-05	**Creation of School of Interdisciplinary Design and Innovation:**	
		The Senate approved the proposal of creation of School of Interdisciplinary Design and Innovation.	School of Interdisciplinary Design and Innovation (SIDI) has been created and Dr. Sudhir Varadarajan has been appointed as Head, SIDI. In addition, four of the faculty members have opted SIDI as the Dept. they would like to be associated with.
	2020-43-Senate-07	**Convening of 8th Convocation of the institute:**	
		The Senate approved the list of graduands for awarding the degree in the convocation ceremony	8th Convocation of the Institute was held on 31st October 2020 successfully through virtual mode and degrees were awarded to 306 graduands.

		scheduled on 31st October 2020 at 10.30 am.	The event was graced by Dr. Kasturirangan, former Chairman ISRO as Chief Guest and Sh. Arun Jain, CEO and MD Intellect Design Arena, Chennai as Guest of Honour.
	2020-43-Senate-08	**To discuss and approve the list of Prize winners in the 8th Convocation:**	
		The Senate approved the list of prize winners for distributing the prizes in the convocation ceremony.	Medals and certificates were awarded to the eligible prize winners.
	2020-43-Senate-09	**New Elective Course:**	
		The Senate approved the course titled "Introductory Quantum Science for Engineers" as new elective course	This new elective Course is being offered from Jan 2021 semester.
	2020-43-Senate-10	**Institute Challenge Project:**	
		The Senate appreciated and approved the proposal of Institute Challenge Project and advised the Institute to explore the possibility for getting sponsorship from Industry.	Due to pandemic, this will be taken up in the next academic year.
	2020-43-Senate-11	**Academic Calendar for first year PG students for the semester Jul-Nov 2020:**	
		The Senate advised the Institute to maintain constant learning pace and the classes should be engaged by the faculty rather than sending recorded lectures. The Senate further advised the Institute to reduce the contents and take classes on Saturdays.	In line with directions of the Senate, classes were conducted. All the exams have been conducted through online mode and results have been declared.
	2020-43-Senate-12	**Student Intake for the year 2020-21:**	
		The Senate approved the intake of 375 students under B.Tech. Program and 84 students under M.Tech. program	A separate agenda on the actual admission status is placed for kind information of the Senate.
	2020-43-Senate-16	**General Guidelines: Admission, Performance and Time Schedule for Ph.D. Scholars:**	
		The Senate advised the Institute to constitute a committee to look into the guidelines. The Senate further advised the Institute to interact with faculty and evaluate the procedures followed by other institutes. A revised guideline to be presented before the senate in its next meeting.	In line with direction of the Senate, a committee was constituted and based on recommendation of the committee, a revised Guidelines have been formulated and a separate agenda on this matter is placed for kind consideration of the Senate.
	2020-43-Senate-17	**Seeking Senate advice in scheduling of 1st and 2nd Semester Classes of 2020 admission B.Tech. batch:**	
		The Senate approved the proposal and advised the institute to modify in line with guidelines issued by MoE.	First semester for the 2020 batch commenced from 01.12.2020 and examination were completed on 08.03.2021. The second semester for the students commenced from 30.03.2021.
	The Senate noted the action taken by the institute.		

2021-44-Senate-04	**Approval for Course Curriculum and Syllabus for the new M.Des. program**
	In the 43rd Senate meeting, an agenda item concerning Design spine curriculum and syllabus was placed for the kind consideration of the Senate. The proposal, inter alia, includes offering M. Des program in line with IIT Bombay and IIITDM Jabalpur. The Senate, after due deliberation, approved the proposal and advised the institute to place the curriculum and syllabus for the M. Des. Program. In line with direction of the Senate, a detailed curriculum and syllabus has been prepared by the institute and is placed as **Annexure B**. The key principle of the curriculum inter alia includes the following: 1. **Student and Practice-centered learning:** a) A two-week foundation courses at the beginning of the program to help students rediscover their creative selves, set goals and take ownership for their learning. b) The program lays strong emphasis on experiential learning and whole-body engagement through sketching, model making, and reflexive narratives to cultivate the qualities of presence, responsiveness and improvisation in a context (learning-by-doing: 60% credits; theory: 40% credits) 2. **Integration of design with technology and business:** a) Exposure to digital tools and AI for collaborative design. b) Emerging technologies (Kinetic Art, Electric Vehicles, Wearables, Context Aware). c) Strategic management of design & innovation and Product-Service Systems. 3. **Thrust on Product Innovation**: Vertically integrated projects across semesters to encourage product innovation *Senate may kindly consider and approve the course Curriculum and syllabus for the M.Des. program.*
	Dr Sudhir Varadarajan, Head SIDI has briefed the Senate about the salient features and details of the course curriculum recommended by the Design Advisory Council. The Senate enquired about the availability of faculty members with expertise in Design and it was informed that the Institute is in the process of recruitment of faculty for the Design School. And for Fine Arts related courses, External Faculty Members would be engaged. Senate also enquired regarding the final project if a prototype will be developed as mentioned in the curriculum and it was informed that the same is expected as part of the M Des programme. The Senate pointed out the error in the LTPC structure given for the Foundation for integrated product design course. The error is corrected as 2 1 0 3 in the ANNEXURE B attached herewith. Senate also advised to have all the Annexures clearly numbered and accordingly, all the Annexures are correctly marked in the minutes. ***The Senate, after deliberation, approved the course Curriculum and syllabus for the M.Des. program and the same is given in ANNEXURE B.***
2021-44-Senate-05	**Admission to M. Des. (Integrated Product Design) for Jul 2021 session**
	In the 43rd Senate meeting, the Senate approved the introduction new M.Des. program commencing from July, 2021. Accordingly, the institute has formulated eligibility criteria and selection norms of the program and the details are as under: **1. Eligibility Criteria** **a) Category 1: Regular with CEED**

A. Bachelor degree in Engineering/Design/Architecture (under 10+2+4 yrs regular) with minimum of 60% marks (55% marks in case of SC/ST/ PwD) or equivalent grades in the qualifying degree.
B. The Candidate should have qualified through Common Entrance Examination for design for 2021 (CEED 2021)
C. Candidates under this category are eligible for Assistantship as per MoE Norms.

b) Category 2: Self/Sponsored/Industry Person/ QIP without CEED

A. The candidate under this category must have Bachelor degree in Engineering/Design/Architecture (under 10+2+4 yrs regular) with minimum of 60% marks (55% marks in case of SC/ST/PwD) or equivalent grades in the qualifying degree.
B. He/she shall be a regular employee with continuous service of at least 2 years in R&D organization, industry, academic/institution, Govt. organization etc. and engaged in professional design work. Sponsored candidates are requested to submit sponsorship letter in a prescribed format from the employer along with application.
C. The mode of selection under this category is based on written test and/or interview conducted by the institute.

2. Selection process:

A. In case of candidates having valid CEED score, a category-wise merit list would be prepared based on the CEED score of the eligible candidates and **called for interview.**
B. In case of Self/Sponsored/Industry/QIP persons without CEED score, the selection shall be **based on written test and/or interview** conducted by the institute. It is mandatory for these candidates to attend both written test and interview for qualifying the admission process. Syllabus will be communicated with candidates to be called for written test and interview.

3. Seat Matrix:

Programs	Gen	EWS	OBC(NC)	SC	ST	Total
M.Des. (with CEED)	5	1	2	1	1	10
M.Des. (Self-OR-Industry Sponsored /QIP - without CEED)	6	1	2	1	0	10
Total	**11**	**2**	**4**	**2**	**1**	**20**

In addition, it is proposed to admit another 10 students in B Tech-M Des Dual Degree program from the B Tech Students of the Institute. This would be effective from 2022 onwards (2020 admission batch students).

4. Fees Structure:

A. The fees payable by the candidates who are joining with CEED score will be at par with regular M. Tech program.
B. In case of students joining under Self / Sponsored / Industry / QIP, the tuition fee would be Rs. 50,000/- per semester. The details are as under:

I. Institute Fees	Amount	
Particulars	**with CEED**	**Self-OR-Industry Sponsored / QIP**
A. One time Fees:	5,000	5,000
B. Semester Fees:		
Tuition fee	25,000*	50,000
Other fee	5,000	5,000
C. Medical Insurance Premium (per annum)	450	450
Total [A+B+C]	**35,450**	**60,450**
II. Hostel Fees		
Hostel Fees & Mess Charges per semester	**29,200**	**29,200**
Total	**64,650**	**89,650**

**SC/ST students admitted under CEED are exempted from payment of tuition fee irrespective of their parental income*
**Tuition fee of Rs 25000 per semester for first year and Rs 30000 per semester for second year*
In order to give wide publicity and adequate time to the candidates, the Institute with due approval of the Chairman, Senate has released the advertisement and been inviting online applications.

In addition, the above norms have been suitably incorporated in the existing M.Tech. ordinance and a copy of revised M.Tech./M. Des. ordinance is placed as **ANNEXURE C** for consideration of the Senate.

Senate may kindly consider to ratify the approval accorded by the Chairman Senate concerning norms for admission along with invitation of application for the new M.Des program. Senate may further consider to approve the revised Ordinance suitably incorporating the provisions of M.Tech./M.Des. norms.

The Senate noted the eligibility criteria and the selection process to be adopted by the institute for M.Des admission. Senate suggested to increase the intake to 30 and it was informed that all PG programmes of the Institute has an intake of 15-20 and Institute would like to have the same for M Des as well to begin with. Senate further enquired if all the candidates who applies for admission to M Des programme against the current advertisement would be called for Interview and it was informed that Institute wishes to do the same for the first batch. The admission procedure would be reviewed and submitted to Senate subsequently. It was also informed that the Hostel Fees would be split into fixed and variable (Advance Mess Charges) components and presented in the Fees Statement when released to the students.

The Senate further perused the M Tech/M Des Ordinance and advised the institute to modify the O1 and O1(a) with respect to minimum percentile requirement for GATE and CEED respectively.

Accordingly, O1 is corrected as follows:

Candidates who have qualified for the award of the Bachelor's degree in Engineering / Technology or Master's degree in Science from educational Institutions approved by AICTE/UGC/Government and who have a valid GATE (Graduate Aptitude Test in Engineering) score are eligible to apply for admission to the M.Tech programme. Graduates from IITs/IIITs/NITs with minimum CGPA of 8 out of 10 for GC and 7.5 out of 10 in case of SC/STs are eligible for admission without GATE Score.

and O1(a) is corrected as follows:

Candidates who have qualified for the award of the Bachelor's degree in Engineering /

	Technology/Design/ Architecture from educational Institutions approved by AICTE/UGC/Government and who have a valid CEED (Common Entrance Exam for Design) score are eligible to apply for admission to the M. Des. programme. ***The Senate, after deliberation, ratified the approval accorded by the Chairman Senate towards norms for admission and the release of the call for application for the new M.Des program.*** ***Senate further approved the revised Ordinance of M.Tech./M.Des. program given as ANNEXURE C.***
2021-44-Senate-06	**Constitution of Board of Studies**

The Senate in its earlier meeting, advised the Institute to constitute Board of Studies to deliberate on all academic matters before placing the proposal before the Senate. In line with suggestion of the Senate, the Institute with the due approval of the Chairman, Senate constituted Board of Studies in each department comprising department as well as with external experts as members.

The Terms and Conditions towards constitution of BoS is as under:

1. The Board of Studies shall meet as and when necessary, but at least twice in a year.
2. The BoS of each department shall consist of the following persons:

Heads of the Departments of the Institute	Chairperson
All Professors other than the Deans or Heads of the Departments	Member
Two persons from amongst educationists of repute or persons from another field related to the activities of the Institute who are not in service of the Institute, nominated by Director	Member
Two persons who are not members of teaching staff co-opted by the Senate for their specialized knowledge	Member
Director	Invitee
Dean (Academics)	Invitee

3. **Term:**
   The term of office of members shall be for a period of two years from the date of nomination.
4. **Functions and Duties of Board of Studies**
   The Board of Studies of a department in the institute shall provide suitable guidance on:
   a) Preparation of curriculum for the program, keeping in mind, the Program Educational Objectives.
   b) Preparation of syllabi for various courses based on the course outcomes, program outcomes and the objectives of the program, interest of the stakeholders and national requirement for consideration and approval of the Academic Council;
   c) Suggestion towards methodologies for innovative teaching and evaluation techniques;
   d) Updation of state-of-the-art research, adoption of technology enabled teaching learning methodologies and other best academic practices in the curriculum and syllabus.
5. **Honorarium for external experts:**
   Rs. 3000/- for each meeting.

In line with the norms, the members of Board of Studies have been constituted in each department and the details of the same are placed as ***ANNEXURE D*** *for kind perusal of the Senate.*

	The Senate perused the proposal and cautioned that the BoS should not result in the Departments operating in silos and the Interdisciplinary nature of the Institute should not get diluted. ***And the Senate also urged to constitute a Senate subcommittee by including both Senate members as well as external experts to advise on course curriculum of individual Departments as well as the common and interdisciplinary courses. Senate advised that such a subcommittee will be able to holistically to look into the academic matters and guide the Institute as per its mandate of interdisciplinary nature. The report of the committee along with its recommendations may be placed before the Senate for approval.*** ***It is resolved that a Senate Subcommittee for the same would be constituted very shortly.***
2021-44-Senate-07	**Revised curriculum for B Tech 2020 Batch**
	In the 41st meeting of the Senate, the Senate accorded provisional approval for updating the curriculum and syllabus for the B Tech 2020 batch. Internal Curriculum Revision Committee was constituted with about 20 faculty members from all Departments which made thorough deliberations and formulated the curriculum and the same was placed in the 41st Senate meeting. Based on the inputs received from the 41st Senate, the committee had further deliberations and came up with the revised curriculum incorporating the Design Vertical as approved by the 43rd Senate. The revised curriculum as presented below is submitted for the kind perusal and approval of the Senate. In order to formulate the PROFESSIONAL CORE and ELECTIVE courses pertinent to a Department, based on the advice of the Senate and with the approval of the Chairman, the Board of Studies has been formed for each department comprising of external experts from both Academia and Industry. The Senate may kindly note that due to the pandemic, the 2020 admission process through JoSAA/CSAB was finished in November only. In order to complete both the first and second semesters by July 2021, special academic calendar was prepared for 2020 batch which was approved by 43rd Senate with 70 working days in each semester and all Saturdays as instructional days. The first semester was completed by 10th March and the second semester started from 30th March. The curriculum and the syllabus of the 2nd semester courses for each Dept. as approved the respective BoS and the Chairman, Senate is given as Annexure E-I for the kind perusal and ratification of the Senate. The BoS for the CS Dept was held on 12th March 2021, for EC Dept. on 17th March 2021 and the for ME Dept on 12th and 16th March 2021. All the suggestions and comments provided by the respective BoS have been incorporated in the Department Curriculum and the same has been placed as Annexure E-II for CS Dept. and Annexure E-III for the ME Dept. The Senate may kindly peruse and consider the revised curricula for approval. The TEMPLATE of the revised curriculum applicable from the 2020 batch is given below for the kind approval of the Senate. Each Department has incorporated the suggestions and comments provided by the respective BoS in the template and the same is given in the Annexures E-II and E-III.

Semester wise Credit Distribution										
Course Category	**Credits**									
Semesters	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**Total**	**%**
Basic Science Course (BSC)	**8.5**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**12.5**	**7.6**
Science Elective Course (SEC)	**0**	**4**	**4**	**4**	**0**	**0**	**0**	**0**	**12**	**7.3**
Basic Engineering Course (BEC)	**11.5**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**15.5**	**9.4**
Design Course (DSC)	**3**	**3**	**3**	**3**	**3**	**3**	**0**	**0**	**18**	**10.9**
IT Skill Course (ITC)	**0**	**6**	**0**	**0**	**4**	**0**	**0**	**0**	**10**	**6.1**
Professional Core Course (PCC)	**0**	**4**	**16**	**16**	**13**	**0**	**0**	**0**	**49**	**29.7**
Professional Elective Course (PEC)	**0**	**0**	**0**	**0**	**4**	**8**	**0**	**0**	**12**	**7.3**
Elective Course (ELC)	**0**	**0**	**0**	**0**	**0**	**8**	**12**	**4**	**24**	**14.5**
Humanities and Social Science Course (HSC)	**2**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**4**	**2.4**
Professional Career Development (PCD)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**8**	**8**	**4.8**
Total	**25**	**25**	**23**	**23**	**24**	**21**	**12**	**12**	**165**	**100**
Cumulative Credits	**25**	**50**	**73**	**96**	**120**	**141**	**153**	**165**	**165**	**100**

Salient Features of the 2020 Curriculum

- SIX Design Courses as approved by the Senate and the BoG
- THREE IT courses
- Professional Core Course to start from 2nd semester (Branch change at the end of 1st semester)
- Syllabus of core engineering courses to have 25% weightage for Problem Based Learning with exposure to hands-on detailed design & manufacturing skills.
- Provision to have 2 / 3 / 4 hours lab sessions based on the requirement of each course
- 8/9 ELECTIVES
- To earn the Degree from a Dept, student has to complete all CORE courses and 2/3 ELECTIVES offered by the parent Dept.
- Remaining 6 electives can be chosen from any category by the student as per his/her interest.
- Every Programme will have Programme Educational Objectives and Outcomes
- Every Course will have Learning objectives and Learning Outcomes.
- Students have the option to continue 3 months internship to project from May-Dec.
- Summer Internship to be awarded PASS/FAIL grade.
- Students can opt for an Industry/Academia/Research Lab Internship supervised by Institute faculty in collaboration with the lab by submitting project proposals duly approved by both Internal and External Guides. Departmental Committee should scrutinize such proposals on merit and quality and scope of proposed work.
- As 7th Semester has only Electives, Depts. can offer those online or choose from NPTEL OR shift to 8th Semester
- Students may choose to do Elective courses of equivalent credits in place of project.
- Students can upgrade to Dual Degree Programme in the specializations offered by the Departments and approved by the Senate during the 5th semester
- Core and Electives are to be preferably of L-T-P-C 3-1-0-4.
- Electives with practice component to be 3-0-2-4 or 2-0-4-4; crediting only the theory part is not permitted.
- Maximum credits permissible to be earned from NPTEL courses as Free Electives will be 8.
- The Dept. Electives and Specialization/Minor Electives are to be In-House courses.
- Additional credits to be earned for Honors will be 12 credits in the new curriculum, equivalent to 3 courses.
- Students can earn a MINOR offered by another Department if THREE (12 credits) Courses are credited from a single vertical of that Dept.
- Students can earn a SPECIALIZATION offered by the parent Department if THREE (12 credits) Courses are credited from a single vertical of that Dept.
- MINOR/SPECIALIZATION Verticals available for the students should be released by each Dept. before the beginning of the 4th Semester of a batch.

	• Students changing MINOR/SPECIALIZATION after crediting a few courses in one, are to complete all 3 courses in the new minor, courses done in previous minor will remain in the grade sheet.
	The Senate was apprised about the salient features of revised course curriculum for B.Tech 2020 batch. Detailed aspects of Department courses were briefed by the respective Heads. Senate advised to plan for offering Finance related M Tech CS programme as it would be really beneficial for the Industries. It was informed that Institute would plan to offer elective courses on similar lines to begin with and plan to initiate M Tech programme as more faculty members are inducted into the CSE Department. ***As AI has unlimited applications in various fields of Engineering, the Senate urged to identify Industries working in AI relevant to the respective programmes and collaborate with them and establish partnership.*** ***The Senate has also urged that every programme offered by the Institute should ensure both the depth and breadth in the relevant field of Engineering.*** ***The Senate enquired regarding offering courses on Controls, Optimization and Signal Processing for students in the B Tech in Mechanical Engineering programme and it was informed that such courses are part of B Tech in Smart Manufacturing and can be taken as electives by the students of B Tech ME.*** ***The Senate advised to group all the Electives together and not specifically as Programme specific Electives and Free Electives. A student crediting the 2/3 Electives as specified by the respective Dept. will be eligible for the Degree of that Dept. Any student taking four courses offered by the Dept. from same vertical will be eligible for the specialization (of that vertical) offered by the parent Dept. Further any student taking three courses from same vertical of another Dept. will be eligible for the Minor from that Dept. Also, neither the Minor nor Specialization will be mentioned in the Degree Certificate, it will be reflected only in the grade sheet.*** ***The Senate perused the second semester curriculum and course contents and ratified the approval accorded by the Chairman, Senate for the same. The curriculum and course contents are given in ANNEXURE E-I.*** ***The entire curriculum and course contents of each B Tech programme applicable from 2020 batch is given in Annexure E. The curriculum and course contents of the programmes offered by the Dept. of ECE was placed in the Senate as Table Item 2021-44- Senate-17(2). As all the curricula was discussed together during the Senate meeting, the curriculum and course contents of Dept. of ECE is also included along with this item.*** ***The B Tech programmes offered by the Institute are listed below of which Sl. No. 2 alone will be offered from the 2021 Batch.*** ***1. B Tech in Computer Science and Engineering (ANNEXURE E-II-A)*** ***2. B Tech in Computer Science and Engineering with major in Artificial Intelligence (ANNEXURE E-II-B)*** ***3. B Tech in Electronics and Communication Engineering (ANNEXURE E-III-A)*** ***4. B Tech in Mechanical Engineering (ANNEXURE E-IV-A)*** ***5. B Tech in Smart Manufacturing (ANNEXURE E-IV-B)*** ***The curricula with syllabi for all the programmes and courses are given in ANNEXUREs E-II, III and IV as listed above.*** ***The Senate has granted approval for the revised B Tech Curriculum for all the programmes that is effective from the 2020 Batch.***

2021-44-Senate-08	**Revised curriculum for M Tech 2021 Batch**

Institute at present offers four M Tech programmes, two from ME Dept and two from ECE Dept., namely M Tech in Mechanical Engineering with Specialization in Mechanical System Design, M Tech in ME with Specialization in Smart Manufacturing, M Tech in ECE with specialization in Electronics Systems Design and M Tech in ECE with Specialization in Communication Systems Design. These programmes were originally M Des programmes which were renamed as M Tech (without any change in curricula) as the same was found to be more appropriate with respect to course structure and contents.

The 41st Senate has granted approval to offer M Tech in Computer Science and Engineering and M Tech in Power Electronic System Design from 2021 batch. Accordingly, it was found necessary to revise the existing M Tech programmes in addition to starting the new ones. The Mechanical Department has revised the curricula of both the M Tech programmes. ECE Dept. proposes to offer three M Tech Programmes: M Tech in ECE with Specialization in Communication Systems, M Tech in ECE with specialization in Microelectronics and VLSI Systems and M Tech in Power Electronic System Design. The curricula and the course contents of all the above M Tech programmes have been placed for the approval of the respective BoS and the same has been presented as **Annexure E-II** for the CS Dept. and **E-III** for the ME Dept.

Salient Features of the M.Tech 2021 Curriculum

- M.Tech CSE - 15 seats
- M.Tech CSE (Specialization: Data Science and Artificial Intelligence) - 15 seats
- A total of 5 core courses and 5 elective courses each with 4 credits
- Three core courses and two elective courses in Sem 1 along with 1 or 2 Practice courses
- Two core courses and three elective courses in Sem 2 along with 1 or 2 Practice courses
- The project would start in summer and continue throughout the second year
- One Department/Specialization specific Design course to align to industry needs

Semester wise Credit Distribution							
Category	**Credits**						
Semester	**S1**	**S2**	**Summer**	**S3**	**S4**	**Total**	**%**
Professional Core Course (PCC)	**15**	**11**	**0**	**0**	**0**	**26**	**29.5**
Elective Course (ELC)	**8**	**12**	**0**	**0**	**0**	**20**	**22.7**
Professional Career Development (PCD)	**0**	**0**	**10**	**16**	**16**	**42**	**47.7**
Total	**23**	**23**	**10**	**16**	**16**	**88**	**100**
Cumulative Credits	**23**	**46**	**56**	**72**	**88**	**88**	**100**

The Senate was apprised of the existing and new M Tech programmes offered by the Institute.

The Senate urged to have close collaboration with Industries in Chennai and Bangalore with respect to M Tech programmes, their final year projects and offering Elective courses relevant to Industries.

The curriculum for M Tech Programme on M Tech in ME with specialization in AI and Robotics was placed as the table item 2021-44- Senate-17(1). As all the programmes were discussed together during the Senate meeting, the curriculum for the same is also included herewith.

The M Tech programmes offered by the Institute form 2021 are listed below:

	1. M Tech in CSE (ANNEXURE E-II-C) *2. M Tech in CSE with Specialization Data Science and Artificial Intelligence (ANNEXURE E-II-D)* *3. M Tech in ECE with Specialization in Communication Systems (ANNEXURE E-III-B)* *4. M Tech in ECE with Specialization in Microelectronics and VLSI Systems (ANNEXURE E-III-C)* *5. M Tech in Power Electronic System Design (ANNEXURE E-III-D)* *6. M Tech in ME with Specialization in Mechanical System Design (ANNEXURE E-IV-C)* *7. M Tech in ME with Specialization in Smart Manufacturing (ANNEXURE E-IV-D)* *8. M Tech in ME with Specialization in AI and Robotics (ANNEXURE E-IV-E)* ***The curricula and syllabi for all the above programmes in Sl. Nos. 1- 7 are given in ANNEXURE E-II-C to E-IV-D as listed above while the curriculum for Sl. No. 8 is given in ANNEXURE E-IV-E.*** ***The Senate perused the revised curriculum for M Tech 2021 Batch and after deliberation approved the curricula and syllabi for all the programmes as given in Annexure E.*** ***The Elective courses proposed by the Departments are presented as* 2021-44- Senate-17(3).**
2021-44-Senate-09	**Approval for New Electives**
	The Department of Basic Sciences and Humanities has proposed following 3 new elective courses with due approval from the Departmental Academic Committee (DAC).

Sl. No	Course Name	Course Code	Faculty Name	Dept. offering
1.	Engineering Optics	PH2000	Dr. Vivek Kumar/ Dr. Debolina Misra	PHY
2.	Waves and Vibrations	PH2001	Dr. Naveen Kumar/ Dr. Tapas Sil	PHY
3.	Physics of Materials	PH2002	Dr. Anushree P Khandale/ Dr. Ashok Kumar Reddy Y	PHY
4.	An introduction to Cryptography	MAT503	Dr. M. Subramani	MAT
5.	Materials Design for Sensor Systems	PHY5XX	Dr. Y. Ashok Kumar Reddy	PHY
6.	Optical Fiber Sensors	ELE558	Dr. Srijith K	ECE

The details of the above courses are placed as **ANNEXURE-F.**

The Senate perused the new electives and after deliberation approved the elective courses given in ANNEXURE F.

2021-44-Senate-10	**Admission Status of the year 2020-21**

The status of student admission under B Tech Programmes through JoSAA/CSAB and M Tech Programmes through CCMT along with Ph D admissions for the year 2020-21 is as under:

a) Abstract of admission:

Degree	Sanctioned Strength	No. of Students Joined	No. of Vacant seats
B. Tech			
JoSAA	360	352	8
DASA	15	6	9
B Tech Total	**375**	**358**	**17**
M. Tech			
CCMT	80	65	15
DASA	4	0	4
M Tech Total	**84**	**65**	**19**
Total	**459**	**423**	**36**

b) Degree-wise Admission:

B Tech	No. of. Students Admitted	M Tech	No. of. Students Admitted	Total
CS	121	CDS	14	**423**
EC	121	EDS	17	
ME1	78	MDS	19	
ME2	38	SMT	15	
Total	**358**		**65**	

c) Rank Details:

Branch	**OP**
	Opening – Closing Rank
Computer Science and Engineering	8686 – 17727
Electronics and Communication Engineering	18955 -27835
Mechanical Engineering	19914 – 44183
Smart Manufacturing	24066 – 50030

d) Ph.D. admission;

Ph D			
Department	**Admission Jul 2020**	**Admission Jan 2021**	**Total**
CS	1	4	5
EC	6	7	13
ME	8	2	10
PH	-	1	1
MA	1	-	1
Total	**16**	**14**	**30**

Category wise data of admission are given in **ANNEXURE G.**

The Senate took note of the admission status for the year 2020-21.

2021-44-Senate-11

Participation in Study in India Program of the Government to attract Foreign Students

The provisions of NEP 2019, inter alia includes attracting foreign students and to make the country as educational hub.

Under Study in India Program of the Government, the Institutions of National Importance are admitted as a member institution to offer admission to students from various foreign countries. The scheme is implemented by EdCIL, a Mini Ratna PSU under the control of Ministry of Education. It is also submitted that IIITM Gwalior and IIITDM Jabalpur (offering) are member institutions under Study in India program and offering 58 seats in 5 courses and 30 seats in 9 courses respectively.

In line with the mandate provided under NEP 2020, the Institute has become member institute under Study in India program and courses to be offered by the Institute and the eligibility criteria fixed by the institute are as under:

Program	**Details of Seats/ Eligibility criteria/Annual Fees**
B.Tech.	**a. Total Number of Seats: 25** Computer Science and Engineering: 10 Electronics and Communication Engineering:5 Mechanical Engineering: 5 Smart Manufacturing: 5 **b. Eligibility criteria**: 10+2 in Physics, Chemistry and Maths with minimum 60% score **c. Additional Criteria:** SAT Level I with minimum valid score or SAT level II with minimum valid score or JEE main with minimum valid score. **d. Annual Fee**: Tuition Fee: 4500 USD Total Fees: 5500 USD
M.Tech.	**a. Total Number of Seats:16** **ECE: 8** Communication system Design: 4 Electronics system Design: 4 **Mechanical: 8** Mechanical system Design: 4 Smart Manufacturing: 4 **b. Eligibility Criteria:** As per existing norms GRE with minimum score of 280/or Valid GATE score **Additional Criteria:** IELTS with minimum valid score or TOEFL with minimum valid score **c. Annual Fee**: Tuition Fee: 4000USD Total Fees: 5000 USD

	Ph.D.	**a. Total Seats: 3** One each in areas of CSE; ECE and Mechanical **b. Eligibility criteria** As per existing norms c. **Annual Fee**: Tuition Fee: 3500 USD Total Fees: 4500 USD

It is pertinent to mention that the seats are to be offered on supernumerary basis.

As the institute is required to provide all relevant information in the Study in India portal, the Institute with the approval of Chairman Senate has submitted all relevant information.

The Senate, after deliberation, ratified the approval accorded by the Chairman Senate towards participation of the institute under Study in India program of the Government for admission of foreign students as per prescribed norms

2021-44-Senate-12

General Guidelines: Admission, Performance and Time Schedule for Ph.D. Scholars.

In the 43rd meeting of the Senate, an agenda item concerning General Guidelines- Admission, Performance and Time Schedule for Ph.D. Scholars was placed for kind consideration of the Senate.

The Senate, after careful perusal of the item, advised the institute to constitute a committee to look into the proposed guidelines. The Senate further advised that the committee may interact with faculty; evaluate procedures followed by other institutions and place a revised proposal in the next meeting.

In line with direction of the Senate, a committee was constituted by the institute vide its OM dated 16.10.2020 under the Chairmanship of Prof. SP Venkatesan comprising Dr. Sudhir Varadharan, Dean (Design, Innovation and Incubation), Dr. Binsu J Kailath, Dean (Academics), Dr MD Selvaraj, Dean (SRICC) as members and Joint Registrar (Acad) as member secretary. The committee convened its meeting on 28.10.2020 and 16.11.2020 and held deliberation with various stakeholders.

Based on this, revised guidelines have been formulated by the committee and the salient features of the revised guidelines are:

a) Registration for 20 credits in each semester by the scholars comprising 16 Research credit; 2 credits for seminar and technical writing and 2 credits for TA performance.
b) Scholars who are completing their research/thesis work with 3.5-4 years will be considered for rewarding with pre-doctoral fellowship for the remaining period for publication of additional research papers.
c) Monetary grant upto Rs.1.0 lakh for attending workshops; publication of papers; membership to professional bodies etc.
d) Request for RKA scheme will be considered only after completion of 3 years subject to publication of at least 2 SCI publications.
e) JRF/SRF working in Projects having duration of two years or more shall be given an opportunity to enroll for Ph.D program. These scholars, after completion of their project duration, will normally be eligible for fellowship for further period of one year from the institute and additional period of one year is subject to satisfactory performance and recommendation of the DC in this regard.

A copy of the Guidelines is placed as **ANNEXURE H** for kind perusal of the Senate.

These guidelines with the approval of the Chairman, Senate has been circulated all for implementation.

	The Senate approved the proposal.
2021-44-Senate-13	**Approval for Rules on updation of “I” Grade**
	At present, students have been awarded “I” Grade if they miss Quizzes/assignments/projects due to valid reasons. It has been found that the students miss to complete missing part and the grade remains as I till the final semester. It is therefore proposed to formulate the following rules towards updation of I Grade. 1. Faculty would be submitting marks scored by such students in the portal with grade as I before the grade submission deadline. The results will be declared with I grade in respective courses for such students. The faculty members will be sending email to such students to complete the missing part within three weeks after the results are announced. 2. As such students complete the missing part, the faculty members should complete the evaluation, and grades be awarded following the same cut-off as approved by the Class Committee for the rest of the students in the class. The updated grade should be submitted in the portal within one month from the date of results announcement of the semester. 3. Any student who misses to complete any of the required part within three weeks will be evaluated based on the remaining components alone (by considering “0” being scored for the missed part) and grades be awarded following the same cut-off as approved by the Class Committee for the rest of the students in the class. The updated grade should be submitted in the portal within one month from the date of results announcement of the semester.
	The Senate perused the norms and after deliberation, approved the norms concerning award of “I” Grade
2021-44-Senate-14	**Award of Provisional Degree to eligible students**
	In the 43rd Senate, list of 303 eligible graduands for award of degrees have been placed. However, three students who completed the requirements after the Senate were also awarded the degrees in the convocation after due approval by the Chairman, Senate. The details of such students are given below for kind perusal of the Senate.

Roll No	Name	Programme	Year of admission
EDS17M012	KASANABOINA RAMYA NANDINI	Master of Design in Electronic Systems	2017
MDS17M015	RAKESH BHARATI	Master of Design in Mechanical Systems	2017

The third candidate who registered for the Dual-Degree programme requested for the award of B Tech degree alone as the requisite credits for the DD could not be completed. And with the approval of the Chairman, Senate, he was awarded the B Tech degree.

Roll No	Name	Joined Programme in 2014	Degree Awarded in 2020
EVD14I018	JATIN	Bachelor of Technology in Electronics and Communication Engineering with Specialization in Design and Manufacturing and Master of Technology in VLSI and Electronic Systems Design (Under Dual Degree Programme)	Mr Jatin has earned required credits for the award of B Tech. Based on his request and approval of the Chairman, Senate he was awarded **"Bachelor of Technology in Electronics and Communication Engineering with Specialization in Design and Manufacturing" alone in the 8th convocation**

The following students of 2020 graduating batch have completed the academic requirements in January 2021. With the approval of the Chairman, Senate, these students have been awarded provisional Degree. Senate may kindly grant permission to award their degrees in the forthcoming Convocation.

1. Mr PALURU PRADEEP KUMAR REDDY (ESD15I021)
2. Mr ABHISHEK VERMA (MDM16B001)

The Senate, after deliberation, ratified the decision of Chairman Senate for awarding degrees to additional three students in 2020 convocation. The Senate also ratified the award of provisional degree to two students upon fulfillment of academic requirements in January 2021. These two candidates will be awarded degrees in the forthcoming convocation.

2021-44-Senate-15

Academic Calendar 2021

The Academic Calendar 2021 has been prepared and with the approval of the Chairman, Senate, circulated among the Institute community. The same is placed as Annexure I for the kind perusal of the Senate. The Special Academic Calendar for the 2020 batch is also submitted herewith for the kind perusal.

The Senate granted approval for the 2021 Academic Calendar given in ANNEXURE I.

2021-44-Senate-16

Cancellation of Ph D Registration of Mr. N. Siva Rama Lingham (COE19D007)

Mr. N. Siva Rama Lingham (COE19D007) joined Ph D programme in the department of Computer Science and Engineering on 22.07.2019 under Dr Munesh Singh as a full time Ph D scholar under HTRA scheme.

In line with provision of rules and regulations, Comprehensive Viva-Voce Examination was conducted for the student on 16.12.2020 and during the evaluation his performance was found not satisfactory by the committee and the committee recommended for repeat of Comprehensive Viva-Voce. The second Viva-Voce was conducted on 05.02.2021 and once again the candidate could not clear the Comprehensive Viva-Voce Examination.

Ph. D ordinances R.12a concerning Comprehensive Examination is as under:

a) *Every Ph.D scholar shall take and perform satisfactorily in a Comprehensive Examination.*
b) *If the performance of a research scholar in the Comprehensive Examination in the first attempt is not satisfactory, he / she will be given one more opportunity to appear for the*

	comprehensive examination within six months of the first attempt. The registration of a research scholar who fails to complete successfully the Comprehensive Examination in both attempts, will be given an option to convert his/her registration from Ph. D to M. S. programme if he/she so desired, ***otherwise his /her registration will be cancelled.*** c) *The objective of the Comprehensive Examination is to test the general capability of the research scholar and the breadth of his / her field of research. The Comprehensive Examination will usually consist of a written test and oral examination or oral examination. The Comprehensive Examination Committee shall intimate to the research scholar sufficiently in advance the scope of the Comprehensive Examination, so as to enable the scholar to prepare adequately for it.* d) *The Ph.D. research scholars are normally expected to complete successfully the Comprehensive Examination within a year after his/her registration in the Ph. D programme and in any case not later than three semesters after his registration in the Ph.D programme.* As Mr. N. Siva Rama Lingham (COE19D007) could not able to complete the comprehensive examination in 2 attempts, in line with rules and regulations, his registration for the Ph.D. program was cancelled by the Institute with due approval of the Chairman, senate.
	Senate, after deliberation, ratified the decision of the Chairman, Senate on cancellation of Ph.D. registration of Sh. N Siva Rama Lingam on account of non-completion of Comprehensive examination within the stipulated 2 attempts.
20210-44-Senate-17(1)	**Approval for offering M.Tech in AI and Robotics in place of Advanced Robotics**
	In the 41st meeting of the Senate held on 1st February 2020, a proposal to commence a new M.Tech program in *Advanced Robotics* was placed for consideration of the Senate. The proposal also includes offering joint degree in collaboration with University of Genova. The Senate, after consideration, approved the proposal and advised the Institute to consider the exchange program after mutual agreement to this effect by both the Institutes. Subsequent to this approval, the Govt. of India has unveiled New Education Policy 2020 wherein emphasis has been made for interdisciplinary education. Further, the policy envisaged to lead the country in preparing professionals in cutting edge areas including Artificial Intelligence. The Institute has also received an advisory to formulate action plan for implementation of provisions of NEP 2020. On account of change in scenario, a proposal was mooted to offer M.Tech in ***AI and Robotics*** in place of Advanced Robotics and the proposal was placed in Board of Studies. The BoS approved the proposal as it will facilitate to admit students from multiple streams which will add value to the program. The BoS further advised to offer this course by the Dept. of Mechanical Engg initially and to offer suitable bridge courses for students from other streams. A copy of Minutes of BoS held on 2nd April 2021 is placed as Annexure J1 for kind perusal of Senate. In addition, the course curriculum recommended by the BoS is placed as Annexure J2**.** The exchange program with University of Genova is not considered at this stage due to the Covid pandemic. *Senate may kindly consider the recommendation of the BoS to offer the M. Tech program in AI and Robotics in place of Advanced Robotics. Senate may further consider to approve the course curriculum for the program.*
	The Senate was apprised about the proposal. ***The Senate was further informed that the course will be offered by the Dept. of Mechanical Engineering and accordingly the degree would be offered as M. Tech in Mechanical Engineering with specialization in AI and Robotics.***

	The Senate, after deliberation, approved the proposal of offering M.Tech. in Mechanical Engineering with specialization in AI and Robotics. The Senate further approved the course curriculum for the program as given in ANNEXURE E-IV-E.
2021-44-Senate-17(2):	**B Tech and M Tech Curricula of Dept. of ECE as recommended by the BoS and M Tech level Elective Courses offered by the Departments**
	The BoS for the EC Dept. was held on 17th March. All the suggestions and comments provided by the respective BoS have been incorporated in the Department Curriculum. *Senate may kindly consider the Curricula and the course contents recommended by the ECE BoS for approval. Senate may also please peruse the Elective courses proposed.*
	The item was discussed along with the other B Tech and M Tech Curricula offered by the Institute and the same is presented in ANNEXURE E-III as detailed in Item Nos. 2021-44-Senate-07 and 08.
2021-44-Senate-17(3):	**Selection of PDF in the Department of Electronics and Communication Engineering**
	The Institute has invited applications for various PDF position and the applications received in the Department of Electronics and Communication Engineering was evaluated by the preliminary selection committee in its meeting held on 31st March 2021 through Google meet by inviting all the applicants. Taking into account the performance of the candidate, the committee selected Dr. Jyotismita Mishra and the candidate was advised to appear before the Institute Selection Committee constituted in line with provisions approved by the Senate. The selection committee, after due consideration and evaluation, recommended Dr. Jyotismita Mishra for the position of PDF in the Dept. of Electronics and Communication Engineering for a period of one year and further extension if any may be considered based on her performance. In line with the recommendation of the committee, the institute with due approval of Chairman Senate, offered the position of PDF to Dr. Jyotismita Mishra. CV of the candidate is placed as **ANNEXURE J** **Senate may kindly take note of selection of Dr. Jyotismita Mishra, as PDF in the Dept. of Electronics and Communication Engineering and also consider to ratify the approval accorded by the Chairman Senate.**
	The Senate ratified the approval accorded by the Chairman Senate on selection of Dr. Jyotismita Mishra, as PDF in the Dept. of Electronics and Communication Engineering.

There were no other items for discussion.

The meeting ended with vote of thanks to the Chair.

(Dr. Binsu J Kailath)
Dean Academic

(Mr. A. Chidambaram)
Registrar

(Prof. B. Majhi)
Chairman

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, DESIGN AND MANUFACTURING, KANCHEEPURAM

MINUTES OF 43rd MEETING OF THE SENATE

Date	:	**19th September, 2020**
Time	:	**3.00 P.M.**
Venue	:	**Virtual through Google Meet**

Members Present:

1. *Prof. Banshidhar Majhi, Director & Chairman Senate*
2. *Mr. A. Chidambaram, Registrar & Secretary Senate*
3. *Dr. Binsu J Kailath, Dean, Academic*
4. *Prof. S. Narayanan*
5. *Prof. S. P. Venkateshan*
6. *Prof. Jagadeesh Kumar*
7. *Prof. Chandramouli Padmanabhan*
8. *Prof. Krishna Sivalingam*
9. *Dr. Venkatesh G*
10. *Dr. Sudhir Varadarajan*
11. *Dr. M. Sreekumar*
12. *Dr. Naveen Kumar Vats*
13. *Dr. M.D. Selvaraj*
14. *Dr. N. Sadagopan*
15. *Dr. Priyanka Kokil*
16. *Dr. B. Raja*
17. *Dr. Tapas Sil*
18. *Dr. S. Vijayakumar*

Leave of Absence:

1. *Dr. Anand Lakshmanan*

<table>
<tr><td rowspan="2">2020-43-Senate-01</td><td colspan="3">Welcome to the members and invitees by the Chairman.</td></tr>
<tr><td colspan="3">The Chairman extended warm welcome to all the members and wished them good health during this pandemic period.</td></tr>
<tr><td rowspan="3">2020-43-Senate-02</td><td colspan="3">To confirm the Minutes of the 42nd meeting of the Senate held on 03rd June 2020.</td></tr>
<tr><td colspan="3">The Minutes of 42nd meeting of the Senate held on 03rd June 2020 was circulated to all members. No comments/suggestions were received from the members.
Senate may kindly confirm the Minutes of the 42nd meeting placed as Annexure I.</td></tr>
<tr><td colspan="3">The Senate confirmed the Minutes of its 42nd meeting held on 03rd June 2020.</td></tr>
<tr><td rowspan="4">2020-43-Senate-03</td><td colspan="3">Report on Action Taken on the decision of 42nd meeting of the Senate held on 03rd June 2020.</td></tr>
<tr><td>2020-42-Senate-04:</td><td>New Elective Course</td><td>Introduction to Photonics, a new elective Course is offered from July 2020 semester.</td></tr>
<tr><td>2020-42-Senate-05:</td><td>Admission only to B.Tech. Programmes with an option to pursue Dual Degree Programme</td><td>To be effective from 2020-21 admission batch.</td></tr>
<tr><td>2020-42-Senate-06:</td><td>Student Intake for the year 2020-21</td><td>The institute proposed UG intake of 270 seats taking into hostel capacity. However, MoE insisted for</td></tr>
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<tr><td rowspan="6"></td><td></td><td></td><td>enhancement of seats to accommodate the EWS reservation. Accordingly, a proposal was sent to revise the UG intake. A separate agenda on this matter is placed for kind consideration of senate.</td></tr>
<tr><td>2020-42-Senate-09:</td><td>Revised Academic Schedule and Activities for Even Semester (Jan-May) 2020.</td><td>Online Exams conducted for outgoing students and 1st / 2nd year students. Results were published and provisional certificate issued for the graduands.</td></tr>
<tr><td>2020-42-Senate-10:</td><td>Revised Academic Calendar for Jul-Nov 2020.</td><td>Revised Academic Calendar has been published in the website and also communicated to all the students.</td></tr>
<tr><td>2020-42-Senate-12:</td><td>Conduct of Supplementary Examinations of Final Year Students Online in case Students could not report to campus on 1st July</td><td>Exams were conducted in online and results published</td></tr>
<tr><td>2020-42-Senate-13:</td><td>Permission to issue Provisional Degree Certificates to the Students who complete the credit requirements by 31st July</td><td>Provisional degree certificates issued to all the students who have completed the academic requirements.</td></tr>
<tr><td colspan="3">The Senate noted the action taken by the Institute.
In the case of students intake for the year 2020-21, senate was informed that the proposed intake is under revision due to shortage of hostel accommodation and ministry has been requested in this regard. Accordingly, the senate was intimated that the revised intake as agreed by the ministry would be placed before the senate in its next meeting.</td></tr>
<tr><td>2020-43-Senate-04</td><td colspan="3">Design Spine Curriculum and Syllabus.

IIITDM Kancheepuram thrust in creating design centric engineers offers 6 design courses to all branches of engineering. The BoG of the institute has recently constituted a subcommittee under the leadership of Prof. G. Venkatesh, Member-Senate and Mr. Krishna V Giri, Member, BoG to review and recommend suitable changes in the course curriculum. At the outset, the committee identified three objectives which are:

1) To clearly articulate demand from industry, products to be produced by IIITDM and their positioning.
2) To review and strengthen the design centric engineering curriculum in terms of the overall structure, the content of the design spine and its integration with the rest of the courses.
3) To recommend an appropriate organization and budget to strengthen the design spine and the future programs to expand the foot print and impact of IIITDM on the industry/society.</td></tr>
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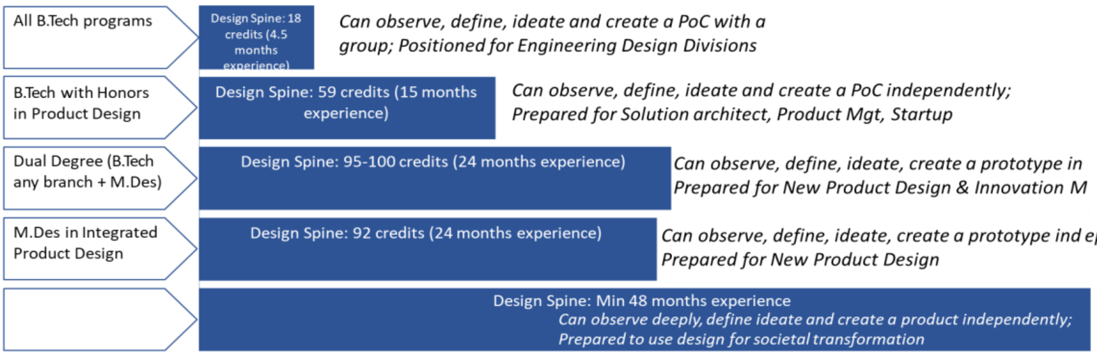
Keeping this objective in mind, the committee had due deliberation with various stakeholders and recommended to have 3 categories of offering by providing complete flexibility to the students to choose their electives/degrees.

a) *Design-centric engineers*: All engineers entering IIITDM will have a certain level of exposure to product design and digital that will differentiate them against engineering students coming from other institutions in terms of their problem-solving capability. They will receive the regular B.Tech degree. They may pursue their career aspirations in engineering – technology jobs, Masters programs in technology (India or abroad) or join PSUs. About 70-80% students may fall in this category.

b) *Design-centric engineers++*: Those who have an inclination for a career as solution architects, product designers, entrepreneurs or product managers will be taken into a separate stream and given an additional six electives (from the advanced M.Des courses) and supported through the internship. They will receive a B.Tech. in their program of study along with a Honors in Product Design. About 20-30% of students may fall in this category. A few from this group may opt for a 5-year Dual Degree program in B.Tech + M.Des. The products in this category will be the brand ambassadors of IIITDM.

c) *Product Designers*: These will be close to the type of products produced by the M.Des programs in NIDs and IDC/IITB. This product category does not exist in IIITDM portfolio today. About 20 students may be inducted in this program.

The product lines of above category is illustrated as under:



The curriculum has a Foundation program in the first semester to help the students to unlearn and rediscover their creative selves. Another 5 subjects in subsequent semesters ensures that students gain hands on experience in the process of product design right from need identification to PoC and business case development. Details of courses and its outcome are provided at Appendix 3 of the proposal placed as **Annexure 2**.

Students will be given an option to pursue honors in Product Design at the end of 5th Semester and a Dual Degree program in M. Des at the end of their 6th semester. However, they will have to go through an internal selection process that will be based on the potential and performance of the student in design spine. The emphasis on providing 25% weightage for problem-based learning in 30% of the science-engineering courses (between 1-6 semesters) will help the students gain practical skills in engineering design and manufacturing at the component level. Another key aspect of the proposed design curriculum is that it does not require major changes to the overall curriculum structure. By creating the

	two categories and making electives open it has created space to meet the requirements of different categories of students/products. In case of Master of Design program, it is proposed to adopt elements from TU Delft's Integrated Product Design and IDC (IITB) industrial design. The students will start working on an industry provided or self-identified problem in their first semester. Each of the courses will facilitate students work on the same problem but from the perspective of the course so that a holistic appreciation of the concept and embodiment is achieved. The electives and detailed syllabus are under preparation and will be placed in next senate. It is also proposed to commence inter disciplinary design doctoral program and this will be open to educators/ professional to reinvent their own practice or knowledge base. It is proposed to implement Design Spine curriculum & syllabus for the UG program (Design-Engineer &Design-Engineer with Honors in Product Design) starting with 2020 batch. M.Des Program in Integrated Product Design will be offered from Jul 2021 after finalization electives and its syllabus and PhD Program in Interdisciplinary design and innovation may be offered from Dec 2020. Senate may kindly consider and approve the Design spine curriculum proposed for UG courses and also the proposal of M. Des. and Inter disciplinary Ph.D. program.
	A presentation was made by Dr. Sudhir Varadarajan, Dean (Design, Innovation & Incubation) highlighting the salient features of the proposal. ***The Senate noted the Design Spine proposed by the institute and appreciated the members of the team for their efforts. The Senate has thoroughly deliberated upon the different points in the proposal and urged recruiting faculty members with specialization in Design so that the implementation of Design Spine curriculum would be really effective. A group of committed faculty members working closely with Industry would be required to align the students towards Design Spine and Institute should provide all support for the same. It's important to have a strong Design school to ensure proper nurturing of the 20% of students who opt for Minor/Honours in Design. However, it should be ensured that the SIDI doesn't work in isolation. Senate also advised that, the students from Dept. of CSE should also be exposed to the design aspects relevant to User interface Design, etc. in addition to the common design courses. Senate has advised to defer the PhD programme by a year or two and start the M Des programme after strengthening the Design School with some more faculty members. As some of the existing faculty members are already aligned towards interdisciplinary design, it is expected that by 2022 when the 2020 batch students reach their fifth semester, the Design school would be strengthened so that guiding and aligning the 20% students towards Minor or Honours in Design should be possible. The discussion is summarized as follows:*** • ***Senate has given approval to introduce the new design spine for B Tech and Minor/Honours in product design from 2020 batch.*** • ***The curriculum and syllabus for the M Des program would be presented in the subsequent Senate meeting and based on the approval by the Senate, M Des may be started from 2021 July.*** • ***School of Interdisciplinary Design and Innovation may be formed by attracting the right faculty/expertise. Also, as existing faculty members who work in Inter***

	Disciplinary Programme (IDP) find perfect balance between core research and interdisciplinary design, it would be possible to strengthen the Design school by 2022. • ***The nature of the PhD program would be presented and discussed in subsequent senate meeting and the program would be offered based on approval from the Senate.***
2020-43-Senate-05	**Creation of School of Interdisciplinary Design and Innovation** The challenge to promote a new culture of learning that nurtures curiosity, create industry partnerships to create the demand and position the talent appropriately, and encourage student led product innovation calls for sustained and focused efforts by a group of full-time dedicated faculty. Keeping this in mind, it is proposed to setup a School of Interdisciplinary Design and Innovation (SIDI) with four types of expertise – Interdisciplinary engineering design; Integration between Engineering and Product Design; Product Design and a Design and Innovation Lab. The School will have a Design Advisory Council, with 6-8 experts drawn from the academia and industry, to guide its activities. It is estimated that a min of 15 faculty (and a maximum of 25) will be required to support 1170 UG students and 220 brand ambassadors (Design++, M.Des, PhD).. SIDI is different from a department in the following ways: *(a) It is strongly aligned with the institutional goal*: • Advancing design and innovation in manufacturing sector • It is focused on encouraging student led product innovation and not restricted to pursuit of knowledge in a discipline. • It will shape the mind of all the UG students entering IIITDM over six semesters. • As a strategic unit, it will be mapped to the role - Dean (Design, Innovation, Incubation) *(b) It is a network with a few regular nodes and linkages with others*: • Faculty recruitment & promotion (regular or visiting) will not be restricted to one discipline; contribution to design-industry is key • There will be a greater proportion of visiting/adjunct/guest faculty compared to regular faculty (at least 1:1); remuneration for visiting/adjunct/guest faculty preferably as per IIT norms (Senate/BoG to guide) • Faculty from other departments interested in embracing design will be co-opted into specific initiatives-joint guidance of Interdisciplinary research / industry projects / incubation – quid pro quo; Similarly, Design Faculty can be included in Design Project Review committees in Departments; Common Faculty orientation sessions with design experts. • SIDI will explore opportunities to channel technology innovations of departments into products *(c) Its faculty will play the role of an enabler to ensure product-market fit*: • Creating a learning environment • Work with industry to position students (D++, M. Des.)

<table>
<tr><td></td><td>• Active role in product innovation & incubation

(d) SIDI is also different from a research Centre:
• Its activities include education, award of degrees (under institute name), research, consultancy, product innovation
• It has full-time faculty, recruitment & budget and its own outreach and have a goal of-the-self-sustenance in future.

The benefits to the faculty joining SIDI include:

• An opportunity to reinvent themselves (driven by a deeper appreciation of design),pursue industry oriented and inter-disciplinary work and enable student-led product innovation and startups
• All IIITDM rules applicable to faculty - # of PhDs, CPDA, etc. will remain same
• Faculty can apply for sponsored research in interdisciplinary/product development areas.
• The institute is having adequate sanctioned strength and faculty requirement will be met from existing as well as future requirement.

Senate may kindly consider and approve the creation of separate School of Inter-Disciplinary Design and Innovation.</td></tr>
<tr><td></td><td>***The Senate after deliberation approved the proposal of creation of School of Interdisciplinary Design and Innovation.***</td></tr>
<tr><td>**2020-43-Senate-06**</td><td>**Ph. D. Defense Completion**
Defense meeting of Mr. K. Balaji, Ph.D. scholar was conducted through online mode on 24th July 2020 with the due approval of the Senate. The details of Scholar and list of publications are as under:

<table>
<tr><td>**Name of the Scholar**</td><td>Mr. K. Balaji</td></tr>
<tr><td>Roll No.</td><td>MDM11D001</td></tr>
<tr><td>Department</td><td>Mechanical Engineering</td></tr>
<tr><td>Guide (s)</td><td>Dr. SHAHUL HAMID KHAN, Assistant Professor</td></tr>
<tr><td>**Thesis Title**</td><td>Kinematic Analysis of RS type Parallel Robotic Mechanisms – A Performance Index Based Approach</td></tr>
<tr><td>Date of Joining</td><td>03/01/2011</td></tr>
<tr><td>Date of clearing Comprehensive Examination</td><td>12/6/2012</td></tr>
<tr><td>Date of Synopsis meeting</td><td>5/12/2020</td></tr>
<tr><td>Date of Ph D viva-voce examination</td><td>24/07/2020 at 11AM by Google meet</td></tr>
<tr><td>Date of submission of final thesis</td><td>31/07/2020</td></tr>
<tr><td>Date of receipt of report from Indian Examiner</td><td>Dr.-Ing. M. Duraiselvam, B.E., M.E., M.B.A., Ph. D
Professor, Department of Production Engineering &
Dean (Planning and Development)
National Institute of Technology Tiruchirappalli
Reports Received on: 17.05.2020</td></tr>
</table>
</td></tr>
</table>

Date of receipt of report from foreign Examiner	Prof. J. Paulo Davim – Aveiro (Portugal) Reports Received on: 15.06.2020
Doctoral Committee	
Chairman	Dr.S.Jayavel, IIITDM Kancheepuram
Member	Dr.T.Asokan, IIT Madras
Member	Dr. Tapas sil, IIITDM Kancheepuram
Member 3	Dr.P.Pandithevan, IIITDM Kancheepuram
Internal Examiner for the Defence meeting	Dr. Jayabal K, , IIITDM Kancheepuram

LIST OF PAPERS BASED ON THESIS

CONFERENCE LIST:

- Balaji.K., SreeKumar.M.,(2017) “Performance Evaluations of 3DOF RS type Parallel Mechanisms using kinematic parameter”,International conference on Automotive system, Agricultural equipment and Manufacturing (ICAAM17),kalasalingamuniversity,Vol. 1 No.1 pp28.
- Balaji.K., SreeKumar.M.,ShahulhamidKhan.B.,(2017) "Kinematic analysis and Performance evaluation of novel 3- DoF RS type parallel mechanisms - Swarm Intelligence Approach ",International Conference on Mathematical Computer Engineering -(ICMCE2017),VIT, Chennai Campus.
- Balaji.K., ShahulhamidKhan.B.,(2017) "Kinematic Analysis and Performance Evaluation of Novel PRS Parallel Mechanism ",International Conference on Advances in Materials & Manufacture Applications(IConamma17), Amrita Vishwa Vidyapeetham, Bengaluru Campus.
- Balaji.K.,SreeKumar.M., ShahulhamidKhan.B.,(2018) "Multi Objective optimization based Performance evaluation of novel 3 DoF RS type parallel Mechanisms-NSGA-II approach",International Conference on Contemporary Design and Analysis of Manufacturing and Industrial Engineering Systems (CDAMIES18),NIT-TRICHY, Trichirapalli.(best paper for Oral Presentation)

JOURNAL LIST:

- Balaji.K., SreeKumar. M,Shahul Hamid Khan.B., "Kinematic Analysis and Performance Indices based Singularity Identifications of Novel 6 DoF RS type Parallel Mechanisms”, Sadhana,Springer Publications.(under review).
- Balaji.K., Shahul Hamid Khan.B.,(2017) "Kinematic Analysis and Performance Evaluation of Novel PRS Parallel Mechanism ",IOP Conf. Series: Materials Science and Engineering, vol.310 issue(1) (2018).
- Balaji.K., Shahul Hamid Khan.B.,(2018) "Kinematic Analysis of Novel 3-RRS Parallel Mechanism ",International Journal of Science and Research, vol.7 issue(1) .

The Senate may kindly approve for award of Doctoral Degree and for issuing of provisional certificate to Sh. K Balaji.

The Senate took note of the defense conducted by online. The Senate further approved for awarding Doctoral Degree and issuing of provisional certificate to Sh. K Balaji.

2020-43-Senate-07	**Convening of 8th Convocation of the institute** It is proposed to conduct the 8th Convocation of the Institute on 31st October 2020 at 10:30 am. Due to pandemic, it is planned to conduct in online mode. The institute has panelled few dignitaries and eminent personalities for Chief Guest on the occasion and is sending invitation in sequence. As soon as the Chief Guest is finalised, it will be circulated to all the members. The list of graduands who are eligible to receive the degrees along with those who are eligible for Honours and Distinction are given in **Annexure 3**. A total of 303 students will be awarded degrees in the convocation. The Senate may kindly approve the list of Graduands and permit convening of convocation of the Institute.
	The Chairman, Senate has informed that Dr Kasturirangan has kindly consented to be the Chief Guest for the convocation which will be held online. Mr. Arun Jain, CEO and MD, Intellect Design Arena, Chennai will join as the Guest of Honour. Senate has granted approval for the list of Graduands, as placed before the Senate, for awarding the graduands in the convocation ceremony scheduled on 31st October 2020 at 10.30 am.
2020-43-Senate-08	**To discuss and approve the list of Prize winners in the 8th Convocation** Senate in its 37th meeting held on 30th June 2018 has accorded approval for awarding various Prizes during Convocation for the graduating batch. In line with approval of senate, a committee, comprising Deans and HoDs, has recommended the list of prize winners taking into account their excellence in various academic and co-curricular activities and the same is given below: **List of Institute medal winners**

Roll No	Student Name	CGPA	Prize	Criteria
CED15I029	PRATHAMESH A DEGWEKAR	9.16	Institute Gold Medal for the All Rounder of the Graduating batch	All Rounder of the Graduating Batch (BTech /DD/ MTech / PhD)
MDM16B038	Y ADITYA VARMA	9.73	Institute Gold Medal for the Best Graduate across B Tech	Highest CGPA from COE, EDM, MDM, MSM
CED15I014	VIDHATHRI	9.47	Institute Gold Medal for the Best Post Graduate across Dual Degree	Highest CGPA from CED, ESD, EVD, MFD, MPD
CDS18M003	GOWRI MURALEEDHARAN B	10	Institute Gold Medal for the Best Post Graduate across M Tech	Highest CGPA from CDS, EDS, MDS. SMT
COE16B018	HARINI R	9.68	Institute Medal for the Best Graduate in B Tech COE, Dept. of CSE	Highest CGPA from COE
EDM16B016	K BHARATI	9.27	Institute Medal for the Best Graduate in B Tech EDM, Dept. of ECE	Highest CGPA from EDM
MDM16B038	Y ADITYA VARMA	9.73	Institute Medal for the Best Graduate in B Tech MDM, Dept. of MEC	Highest CGPA from MDM
MSM16B015	KARAMBOR CHAKRAVARTY SRIYA	9.22	Institute Medal for the Best Graduate in B Tech MSM,	Highest CGPA from MSM

			Dept. of ECE	
CED15I014	VIDHATHRI	9.47	Institute Medal for the Best Dual Degree Graduate from CED, Dept. of CSE	Highest CGPA from CED
ESD15I010	S PRANAV KUMAR	9.28	Institute Medal for the Best Dual Degree Graduate from ESD, Dept. of ECE	Highest CGPA from ESD
EVD15I007	F KIRAN ROBERT	9.44	Institute Medal for the Best Dual Degree Graduate from EVD, Dept. of ECE	Highest CGPA from EVD
MFD15I004	POTNURU HEMA PRANEETHA NAIDU	9.00	Institute Medal for the Best Dual Degree Graduate from MFD, Dept. of ME	Highest CGPA from MFD
MPD15I019	RATNANJALI TIWARI	9.31	Institute Medal for the Best Dual Degree Graduate from MPD, Dept. of ME	Highest CGPA from MPD
CDS18M003	GOWRI MURALEEDHARAN B	10	Institute Medal for the Best Post Graduate from CDS, Dept. of ECE	Highest CGPA from CDS
EDS18M013	ARTHI R	9.89	Institute Medal for the Best Post Graduate from EDS, Dept. of ECE	Highest CGPA from EDS
MDS18M002	BHAVSAR DIVYAKUMAR ASHIT	9.75	Institute Medal for the Best Post Graduate from MDS, Dept. of ME	Highest CGPA from MDS
SMT18M007	VISHAK P M	9.89	Institute Medal for the Best Post Graduate from SMT, Dept. of ME	Highest CGPA from SMT

BEST PROJECT AWARDS

Roll No	**Name**	**Award**
MDM16B025	RAHUL NARASIMHAN R	Institute Gold Medal for best IDP across all B Tech
MPD15I014	ARAVIND C B	Institute Gold Medal for best IDP across all Dual Degree
SMT18M007	VISHAK P M	Institute Gold Medal for best IDP across all M Tech
COE16B003	ARUN NARAYANAN H	Institute Silver Medal for Best Project, B Tech COE
EDM16B008	GATRAM MANOJ VENKATA SAI	Institute Silver Medal for Best Project, B Tech EDM
MDM16B038	Y ADITYA VARMA	Institute Silver Medal for Best Project, B Tech MDM
MSM16B034	SIDDHANT KARMARKAR	Institute Silver Medal for Best Project, B Tech MSM
CED15I043	EASHAN DASH	Institute Silver Medal for Best Project, DD CED
ESD15I020	S SANJANA	Institute Silver Medal for Best Project, DD ESD
EVD15I007	F KIRAN ROBERT	Institute Silver Medal for Best Project, DD EVD

MFD15I010	PARTH LAL	Institute Silver Medal for Best Project, DD MFD
MPD15I019	RATNANJALI TIWARI	Institute Silver Medal for Best Project, DD MPD
CDS18M003	GOWRI MURALEEDHARAN B	Institute Silver Medal for Best Project, M Tech CDS
EDS18M004	SOWMIYA S	Institute Silver Medal for Best Project, M Tech EDS
MDS18M005	KETAN VINAYAK WARGHAT	Institute Silver Medal for Best Project, M Tech MDS
SMT18M003	SHASHWAT PANDEY	Institute Silver Medal for Best Project, M Tech SMT

The Senate may kindly approve the list of Medal Winners.

The Senate has approved the list of prize winners, as placed before the Senate, for distributing the prizes in the convocation ceremony scheduled on 31st October 2020.

2020-43-Senate-09

New Elective Course

The course titled "*Introductory Quantum Science for Engineers*" has been proposed by Dr. Tapas Sil after approval from the DAC.

<table>
<tr><td>Course Title</td><td>Introductory Quantum Science for Engineers</td><td>Course No</td><td colspan="4">PHY5XXX</td></tr>
<tr><td>Specialization</td><td>Physics</td><td>Structure (LTPC)</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>To be offered for</td><td>UG/PG: students from branches</td><td>Status</td><td colspan="2">Core ☐</td><td colspan="2">Elective ■</td></tr>
<tr><td>Faculty Proposing the course</td><td>Dr Tapas Sil</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Modification ☐</td></tr>
<tr><td rowspan="2">Date of DAC</td><td rowspan="2">09/07/2020</td><td>Members Present in DAC</td><td colspan="4">Dr. Naveen Kumar Vats
Dr. Vivek Kumar
Dr. JayachandraBingi
Dr. A. P. Khandale</td></tr>
<tr><td>External Member:</td><td colspan="4">Prof. Sibasish Ghosh, IMSC, Chennai</td></tr>
<tr><td>Pre-requisite</td><td>CoT</td><td>Submitted for approval</td><td colspan="4">43rd Senate</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To develop in the student, an awareness of situations in engineering, which need ideas of quantum mechanics.
• The course emphasizes conceptual understanding rather than a heavily mathematical approach, but some amount of mathematics is essential for understanding and using quantum mechanics.
• To make the student understand the basic language and methods of quantum mechanics.</td></tr>
</table>

	• To enable the student with those aspects of quantum mechanics, which are necessary to begin to deal with microscopic systems.
Learning Outcomes	Students will be able to • understand the fundamental concepts and quantum mechanical processes in the nature. • apply principles of quantum mechanics to calculate observables on known wave functions or potentials. • pursue more advanced courses such as quantum optics, quantum computation, nanophotonic devices etc.
Contents of the course *(With approximate break-up of hours)*	**Introduction to quantum mechanics** How quantum mechanics is important in the everyday world, the bizarre aspects and continuing evolution of quantum mechanics, and how we need it for engineering much of modern technology. Blackbody radiation, The photo-electric effect, Atomic spectra, The Frank-Hertz experiment, Compton effect, Wave-Particle duality, Wave functions, Expectation values, Uncertainty principle. [12] **Schrodinger's wave equation** Getting to Schrodinger's wave equation. Solution of stationary-state Schrodinger equation for one dimensional problem – particle in a box, square-well potential, linear harmonic oscillator. Potential barrier and tunneling and applications such as, Esaki diode, scanning tunneling microscope, vibrational modes of ammonia molecule, etc. 3D isotropic quantum harmonic oscillator, Particle in 3D box and related examples (quantum dot, quantum wire etc.) [18] **Aspects of spin** Angular momentum operators. Stern-Gerlach experiment—spin. Solution of hydrogen atom problem. [8] **Introduction to few advanced concepts** Entanglement, EPR paradox, Bells inequality [4]
Text Books	1. David J. Griffiths and Darrell F.Schroeter," Introduction to quantum mechanics", (Cambridge University Press India, 3rd edition, 2019)
Reference Books	1. D. A. B. Miller, "Quantum Mechanics for Scientists and Engineers," (Cambridge University Press, 2008)" 2. R. Shankar, "Principles of Quantum Mechanics", (Springer, 2012)

Senate may kindly consider and offer suggestions.

The Senate, after deliberation, approved the course titled "Introductory Quantum Science for Engineers" as new Elective Course.

2020-43-Senate-10

Institute Challenge Project

The motto of the institute is "*Learning by Doing*" and the students are carrying out various project works throughout their academic duration.

However, in order to motivate the students, it is proposed to announce an award for inter disciplinary challenging projects every year. Institute will invite nominations for set of projects from group of students preferably inter disciplinary. A committee comprising Deans and HoDs would select 3 projects from set of nominations and the cost incurred for the project work be funded by the institute. Among the three projects, the best one will be selected by formulating suitable criteria and the winner will be awarded a suitable cash prize along with citation.

Senate may kindly consider the proposal and offer suitable suggestions.

The Senate appreciated and approved the proposal of Institute Challenge Project. The Senate further advised the institute to explore the possibility for getting sponsorship from industry.

2020-43-Senate-11

Academic Calendar for first year PG students for the semester Jul-Nov 2020

In the Academic Calendar approved by the 42nd Senate, the commencement of Odd Semester has been from 3rd August 2020 for the existing batch of students.

In the case of first year PG students, the CCMT special round results were announced on 7th September and an orientation programme was held on 8th. Therefore, the classes for them (Odd Semester) has been commenced from Wednesday, 9th September 2020 and accordingly a revised Academic Calendar is placed as **Annexure 4**.

Senate may kindly approve the revised Academic Calendar for first year PG students**.**

The Senate perused the Academic Calendar and offered following suggestions.

- ***It's important to maintain a constant learning pace for the students***
- ***Classes should be engaged by the faculty members rather than sending the recorded lectures***
- ***Online classes being a new phenomenon, both the students and faculty members should be comfortable in all aspects***
- ***Contents covered in the class may slightly be reduced as the classes will be held for 12 weeks.***
- ***Classes should be taken on Saturdays also, even though it is mentioned as Special classes in the Calendar.***

The Senate further approved the academic calendar as placed before the Senate.

2020-43-Senate-12

Student Intake for the year 2020-21

In the 42nd Senate, the senate approved the intake of 270 students which was based on available hostel capacity. Subsequently, the institute received a direction from ministry for enhancing the intake capacity to accommodate the EWS reservation. Due to this, the intake capacity has been enhanced to 375 including DASA students. The details are as under:

Degree	**Programme**	**No of Seats**		**Total Seats**	
		JEE/ GATE	**DASA**		
B. Tech.	Computer Science and Engineering	120	5	125	**360 + 15 = 375**
	Electronics and Communication Engineering	120	5	125	
	Mechanical Engineering	80	3	83	
	Smart Manufacturing	40	2	42	
M.Tech.	M Tech in ECE with Spl. in Communication Systems Design	20	1	21	**84**

		M Tech in ECE with Spl. in Electronics Systems Design	20	1	21
		M Tech in MEC with Spl. in Mechanical Systems Design	20	1	21
		M Tech in MEC with Spl. in Smart Manufacturing	20	1	21

The Senate may kindly approve the revised intake.

The Senate approved the intake strengths for B.Tech. and M.Tech as proposed.

2020-43-Senate-13

List of students Provisionally Awarded Degree

For the passing out students, Institute has conducted their January semester examinations in June followed by Supplementary Examinations in July through online mode. Based on approval of the Senate, the students who have completed the academic requirements as on 31.07.2020 have been issued provisional degree certificate and list of those students are placed as **Annexure 3**.

There are 298 graduands eligible for award of their respective degrees.

Degree	Batch	Programme	Completed	Incomplete	Total
B. Tech	2016	COE	40	0	40
	2016	EDM	39	0	39
	2016	MDM	35	2	37
	2016	MSM	31	0	31
B. Tech and M. Tech	2015	CED	40	0	40
	2015	ESD	18	1	19
	2015	EVD	19	1	20
	2015	MFD	18	0	18
	2015	MPD	17	0	17
M. Tech	2018	CDS	9	1	9
	2018	EDS	9	0	9
	2018	MDS	11	1	12
	2018	SMT	12	0	12
Total Students			**298**	**6**	**304**

Senate may kindly take note of issuance of Provisional Degree Certificates to the students who completed the credit requirements by 31^{st} July 2020.

The Senate noted the list of students awarded provisional degree.

2020-43-Senate-14

Award of Provisional Degree to Mr. BOORGULA KESHAVA, EDM16B005 who has completed the academic requirements in August 2020.

In the last meeting of the Senate, the senate approved for awarding degree to students who have completed all the academic requirement by July 2020.

Subsequent to this, a request was received from Mr. BOORGULA KESHAVA, EDM16B005 of the graduating batch 2020 for award of provisional degree as he has secured a seat in IIEST Shibpur through CCMT Counselling.

He was having one pending course of his fourth semester and the exam for the course was conducted on 20th August. The student informed that he could not complete the course earlier due to family issues.

Taking into account successful completion of one pending course and also considering his

	future avenues, he has been awarded the provisional certificate as special case with the due approval of Chairman Senate. Senate may kindly ratify the issue of provisional Degree Certificate to Mr. BOORGULA KESHAVA, EDM16B005 who completed the academic requirements by August 2020.
	The Senate ratified the decision of the Chairman, Senate for awarding Provisional Degree to Mr. BOORGULA KESHAVA, EDM16B005 who has completed the academic requirements in August 2020.
2020-43-Senate-15	**Consideration of NPTEL courses for Jan-Apr 2020**. In the 42nd meeting of the senate, the senate directed that students who have registered for the NPTEL courses should attend the exams scheduled by NPTEL. In case any student is not able to give the NPTEL exam due to genuine reasons, exams may be conducted and in such cases, 50% weightage each may be given to assignment and exams. However, subsequent to decision of the senate, the exams were not conducted by the NPTEL and NPTEL vide its letter dated 07.06.2020 that NPTEL will provide attested assignment score sheets and modified pass certificate based on average assignment score to the students from Jan-May 2020 semester. NPTEL has further requested all Institutes/Universities to accept the above documents for transferring credit to the student as a special case for the COVID-curtailed Jan 2020 semester. NPTEL also has mentioned that Institute are free to conduct the exams if they so desire. Taking into account the pandemic and request of the students to issue course completion certificate for their higher education/placement, with the due approval of the Chairman Senate, the results have been declared based on the modified pass certificates and assignment score card. Senate may kindly consider ratifying the decision of the Chairman of the Senate.
	The Senate ratified the decision of the Chairman, Senate for declaration of results based on modified pass certificates and assignment score card in case NPTEL courses.
2020-43-Senate-16	**General Guidelines: Admission, Performance and Time Schedule for Ph.D. Scholars.** ***A proposal of Regulations and Guidelines for timely assessment of performance of Ph.D. scholar was placed before the Senate for its consideration and approval.*** ***The Senate, after careful perusal of the proposal, advised the institute to constitute a committee to look into the proposed guidelines and add few more if any. The Senate further advised that the committee may interact with faculty; evaluate the procedures followed by other institutions. The proposal may be placed in the next meeting, along with the report of the committee, for further considerations.***
2020-43-Senate-17	**Seeking Senate advice in scheduling of 1st and 2nd Semester Classes of 2020 admission B.Tech. batch** • Classes to commence from 23rd November 2020 up to 22nd February 2021. • All Saturdays working days with 6 days for Quiz 1 & Quiz 2 (70 instructional +6 days). • 7 days given for End Semester Examination. • Same schedule for 2nd Semester from 29th March to 29th June. • 2 weeks' vacation after each semester

	• 3rd Semester to begin from 26th July 2021 along with other semesters
	The Senate has granted approval for the proposal and advised to modify if required as per any specific guidelines issued the MoE in future for the 1st year students. ***The Academic Calendar prepared as per the proposal is attached as Annexure 5.***

The next meeting of the Senate will be held in **December 2020.**

Shri. A. Chidambarm
Secretary

Dr. Binsu J Kailath
Dean (Academics)

Prof. B. Majhi
Director and Chairman Senate

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY DESIGN AND MANUFACTURING, KANCHEEPURAM CHENNAI – 600 127

MINUTES

42nd MEETING OF THE SENATE

held on

03rd June 2020 (Wednesday) at 10.30 AM.

Through Google Meet

MINUTES OF 42ND MEETING OF THE SENATE

Date	:	**03, June 2020**
Time	:	**10.30 A.M.**
Through Online	:	**https://meet.google.com/hkq-erwq-bpw**

Members Present:	**Leave of Absence:**
1. *Prof. Banshidhar Majhi, Director & Chairman Senate* 2. *Mr. A. Chidambaram, Registrar & Secretary Senate* 3. *Dr. Binsu J Kailath, Dean, Academic* 4. *Prof. S. Narayanan* 5. *Prof. S. P. Venkateshan* 6. *Prof. Chandramouli Padmanabhan* 7. *Prof. Krishna Sivalingam* 8. *Dr. Anand Lakshmanan* 9. *Dr. Venkatesh G* 10. *Dr. Sudhir Varadarajan* 11. *Dr. M. Sreekumar* 12. *Dr. Naveen Kumar Vats* 13. *Dr. M.D. Selvaraj* 14. *Dr. N. Sadagopan* 15. *Dr. Priyanka Kokil* 16. *Dr. B. Raja* 17. *Dr. Tapas Sil* 18. *Dr. S. Vijayakumar* 19. *Mr. R. Gunasekaran, Invitee* 20. *Mr. G. Ravikumar, Invitee*	1. *Prof. Jagadeesh Kumar*

<table>
<tr><td rowspan="2">2020-42-Senate-01:</td><td colspan="3">Welcoming the members and invitees by the Chairman.</td></tr>
<tr><td colspan="3">The Chairman greeted all the members and invitees with a warm welcome and wished them good health during this pandemic.</td></tr>
<tr><td rowspan="3">2020-42-Senate-02:</td><td colspan="3">To confirm the minutes of the 41st meeting of the Senate held on 01st February 2020.</td></tr>
<tr><td colspan="3">The Minutes of 41st Meeting of the Senate held on 01 February 2020 was circulated to all members through mails. No comments/suggestions have been received from the members.

Senate may kindly confirm the Minutes of the 41st meeting of the Senate duly approved by the Chairman of the Senate.
Annexure - 1</td></tr>
<tr><td colspan="3">The Senate confirmed the Minutes of the 41st meeting held on 01st February 2020.</td></tr>
<tr><td rowspan="2">2020-42-Senate-03:</td><td colspan="3">Report on Action Taken on the decision of 41st meeting of the Senate held on 01st February 2020.</td></tr>
<tr><td>2020-41-Senate-06:</td><td>Python Course for all students admitted in 2019 as elective / free elective.</td><td>In future, the course will be offered by Institute faculty.</td></tr>
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	2020-41-Senate-07:	Revised B. Tech. Curriculum	To be effective from 2021 batch
	2020-41-Senate-08:	Change of credits for students admitted into Direct Ph.D. Programme at IITM	To be effective for subsequent batches also
	2020-41-Senate-12:	Modification in Selection Procedure for External Ph. D.:	To be effective from subsequent semesters
	2020-41-Senate-13:	Cut off Marks for Honours Students in NPTEL Courses	NPTEL courses will not be considered for Honours
	2020-41-Senate-14:	To modify the Ph. D. ordinance of the Institute R. 9 – Doctoral Committee	To be effective from next batch
	2020-41-Senate-15:	Proposal to start new M Tech and M Des programme from July 2020	It is proposed to commence the program from next academic year as it will be difficult to maintain social distancing with higher student strength.
	While discussing the Action Taken Report, it was informed to the Senate regarding item No. 2020-41-Senate-06 that it may not be possible to offer the programming courses by the Department faculty members with the existing faculty strength. As soon as, more faculty members join the Institute, programming courses could be offered by the Department faculty members. However, students will be advised to take online Python course in 2nd Semester till such time. ***With respect to item No. 2020-41-Senate-07, the Senate was requested to grant permission to revise the B. Tech. curriculum from 2021 batch as some more discussions are required on Design Courses, 1st year lab contents and Department level courses which may not be feasible in the existing situation due to the pandemic. The Registrar has informed the Senate the BoG has advised to constitute a Committee headed by Prof. G Venkatesh, Member, Senate to advise the Institute on Design courses and Design Curriculum. The Committee should have Prof. Krishna V Giri, Member, BoG, Faculty Members from the Dept. of Engineering Design, IIT Madras and other Design Experts from Academia and Industry as members.*** ***Such a Committee will be formed within two months and the discussion on curriculum will be initiated.*** ***While referring to 2020-41- Senate-15, it was informed to the Senate that the M. Tech. and M. Tech. (Res) programmes are required to be deferred for a year so as to ensure social distancing in academic and hostel blocks as required by the preventive measures against the pandemic.***		

2020-42-Senate-04:	**New Elective Course** The course titled Introduction to Photonics is proposed by Prof. Srijith K after approval from the DAC. Senate may kindly consider and offer suggestions

Course Title	**Introduction to Photonics**	Course No	ELE5XXX			
Specialization	ECE	Structure (LTPC)	3	1	0	4
To be offered for	UG / PG	Status	Core ☐		Elective ☒	
Faculty Proposing the course	Prof. Srijith K	Type	New ☒		Modification ☐	
Date of DAC	23.04.2020	Members Present in DAC	All faculty members of the Dept.			
		External Members:	Prof. Balaji Srinivasan, Prof. Deepa Venkitesh, Dept. of EE, IITM			
Pre-requisite	CoT	Submitted for approval	42nd Senate			

Learning Objectives	This course is intended to be an introductory level course in Photonics which can lead to more advanced courses such as Fiber optic communication, Photonic Sensors and Nanophotonics.
Learning Outcomes	At the end of the course, the learners are expected to do the following: • To describe the fundamental principles of photonics and light matter interactions • To apply the principles of generation and detection of photons in various problems related to photonic structures/processes and analyze them. • To understand processes that help to manipulate the fundamental properties of light.
Contents of the course *(With approximate break-up of hours)*	Ray Optics, Wave Optics and Statistical Optics - Review of ray optics - paraxial approximation, introduction to matrix approach. Review of wave optics - interference of waves – Statistical properties of light – Spatial and Temporal coherence, Mutual coherence function - Properties of Gaussian beams (10) Photon properties - mean photon flux, number of photons, probability of finding a photon - Interaction of photons with atoms - absorption/emission processes - Spontaneous/stimulated emission - Optical amplification – Resonator - Laser fundamentals - output power/spectrum (10) Semiconductor photon sources and detectors – Interaction of photons with charge carriers - LEDs - output power, spectrum, modulation characteristics – Laser diodes - threshold condition, L-I characteristics, longitudinal modes, modulation bandwidth - Photodiodes - Responsivity, bandwidth – PIN and APD – gain and noise characteristics (12) Manipulation of photons – Faraday effect – Basic principles of Electro optics - Nonlinear optics - Stimulated Raman and Brillouin scattering (10)
Text Books	Saleh and Teich, Fundamentals of Photonics, 2nd Ed., Wiley Publishers, 2007
Reference Books	1. J.M. Liu, Principles of Photonics, Cambridge University Press, 2016. 2. Ben G Streetman and Sanjay Kumar Banerjee, Solid State Electronic Devices, 6th Ed., Prentice Hall India Learning Pvt. Ltd, 2006. 3. A. Yariv and P. Yeh, Photonics, 6th Ed., Oxford University Press, 2006. 4. Ajoy Ghatak, Optics, 6th Ed., Mc Graw Hill Publication, 2016. 5. Eugene Hecht and A R Ganesan, Optics, 4th Ed., Pearson Education, 2008.

While discussing the syllabus, the Senate enquired whether the suggestions given by the External Experts are incorporated. It was informed that the tutorial hour was added as per the suggestion from the Experts. Senate has also asked regarding the percentage of overlap with existing courses and it was informed that the overlap was verified to be less than 20%.

The Senate after discussion approved the Introduction of New Elective Course.

2020-42-Senate-05: Admission only to B.Tech. Programmes with an option to pursue Dual Degree Programme

The Dual Degree Programme was initiated from 2014 and over the years it has been observed that the B Tech students have always higher All India Ranks than the Dual Degree students. Also, from the placement perspective, it has been noticed that the companies prefer B Tech students.

Hence it is proposed to admit the students only for the B Tech programme from 2020 admissions and to provide option to them to upgrade to M Tech at the end of 5th Semester which will enable them to attain both the degrees at the end of fifth year.

Senate may kindly consider and approve the proposal.

The Senate has given approval for the proposal. However, the Senate urged to devise the modalities to be followed for the upgrading to Dual Degree programme as follows:

i. Minimum CGPA required for this upgrading should be 8.
ii. The maximum number of students to be upgraded is limited to 20% of the B Tech class strength

2020-42-Senate-06: Student Intake for the year 2020-21

In view of the prevailing situation due to Covid-19, as per guidelines of the Government, the institute is required to maintain social distancing in academic as well as residential blocks. It would not be feasible to adhere to the guidelines with the existing intake capacity of 350 both for B.Tech and Dual degree with additional 84 M.Tech. and Ph.D. students \. Therefore, it is proposed to reduce the student intake to 270 only for the B. Tech programme from the year 2020-21onwards.

It is also proposed to defer new M Tech and M Tech (Res) programmes approved in the 41st senate to next academic year due to the existing situation.

Accordingly, the proposed intake for the 2020-2021 academic year is submitted in the table below.

Senate may kindly consider and approve the proposed intake.

<table>
<tr><th rowspan="2">Degree</th><th rowspan="2">Programme</th><th colspan="2">No of Seats</th><th rowspan="2" colspan="2">Total Seats</th></tr>
<tr><th>JEE/ GATE</th><th>DASA</th></tr>
<tr><td rowspan="4">UG (B Tech)</td><td>Computer Science and Engineering</td><td>85</td><td>5</td><td>90</td><td rowspan="4">255 + 15 = 270</td></tr>
<tr><td>Electronics and Communication Engineering</td><td>85</td><td>5</td><td>90</td></tr>
<tr><td>Mechanical Engineering</td><td>57</td><td>3</td><td>60</td></tr>
<tr><td>Smart Manufacturing</td><td>28</td><td>2</td><td>30</td></tr>
</table>

	(table below)

PG (M Tech)	M Tech in ECE with Spl. in Communication Systems Design	20	1	**21**	**84**
	M Tech in ECE with Spl. in Electronics Systems Design	20	1	**21**	
	M Tech in MEC with Spl. in Mechanical Systems Design	20	1	**21**	
	M Tech in MEC with Spl. in Smart Manufacturing	20	1	**21**	
Ph D	In all Departments, together	16	-	**16**	**16**
Total		**351**	19	**370**	**370**

Senate has enquired whether this proposed intake is applicable this year only due to the pandemic and the Chairman, Senate has clarified that the same intake would continue in future as well.

The Senate after discussion approved the revised Student Intake from the AY 2020-2021.

2020-42-Senate-07: **Conduct of Ph.D. Defence Meeting online**

Ph.D. defence meeting of Mr Ashish Kumar was conducted online on 9th May,2020 with due approval of the Chairman, Senate considering the travel restrictions of experts due to pandemic. Similarly, the institute has conducted M.Tech. viva-voce for the outgoing batch online and DC meetings of existing Ph.D. students. The processes need to be continued till the situation is normal.

Senate may kindly approve the defense already conducted and may permit to conduct defence online till situation is normal.

Senate took note of the defense conducted and approved as proposed. Further, Senate advised that all the academic formalities be completed online irrespective of academic programmes.

2020-42-Senate-08: **Ph. D. Defence Completion**

Details of PhD Scholars who have successfully defended their theses and eligible for award of the Degree are furnished below for kind perusal of the Senate.

1. **Name of the Scholar**	**Mr. Xavier Arockiaraj S**
Roll No	EDM14D004
Department	Electronics and Communication Engineering
Thesis Title	CRITERIA FOR LIMIT CYCLE FREE STATE-SPACE DIGITAL FILTERS WITH EXTERNAL DISTURBANCE
Date of Joining	28.07.2014
Date of Passing of Comprehensive Examination	25.01.2016
Date of Submission of Thesis	28.06.2019

Indian Examiner	Prof I N Kar Professor, Department of Electrical Engineering, Indian Institute of Technology, Delhi
Date of receipt of report	29.10.2019
Foreign Examiner	Prof Choon Ki Ahn Professor, School of Electrical Engineering, Korea University, Seoul, Korea
Date of receipt of report	23.12.2019
Date of Ph D viva-voce examination	09.03.2020 at 10 AM
Date of submission of final thesis	18.03.2020
Doctoral Committee	
Chairperson	Dr Binsu J Kailath, ECE, IIITDM Kancheepuram
Research Supervisor	Dr Priyanka Kokil, ECE, IIITDM Kancheepuram
Internal Member	Dr M D Selvaraj, ECE, IIITDM Kancheepuram
Internal Member	Dr S S Karthikeyan, Dept. Of ECE, NIT Tiruchirapalli.
External Member	Prof C S Ramalingam Dept. Of EE, IIT Madras.

LIST OF PAPERS BASED ON THESIS

Papers in Refereed Journals

1. P. Kokil and S. X. Arockiaraj, “An improved criterion for induced l1 stability of fixed-point digital filters with saturation arithmetic,” Indonesian Journal of Electrical Engineering and Computer Science, vol. 4, no. 1, pp. 65–72, 2016.
2. P. Kokil and S. X. Arockiaraj, “Novel results for induced l1 stability for digital filters with external noise,” Fluctuation and Noise Letters, vol. 16, no. 4, pp. 1– 18, 2016.
3. P. Kokil, S. X. Arockiaraj, S. Jogi and H. Kar, “New realizability criterion for digital filters with external disturbance and saturation arithmetic,” AE□U –International Journal of Electronics and Communications, vol. 85, pp. 179–182, 2017.
4. S. X. Arockiaraj and P. Kokil, “New criteria for output strict and input strict passivity for interfered digital filters for biomedical applications,” Journal of Medical Imaging and Health Informatics, vol. 7, no. 2, pp. 492–496, 2017.
5. S. X. Arockiaraj, P. Kokil and H. Kar, “Passivity based stability condition for interfered digital filters,” Indonesian Journal of Electrical Engineering and Computer Science, vol. 6, no. 2, pp. 431–437, 2017.
6. P. Kokil, S. X. Arockiaraj and H. Kar, “Criterion for the limit cycle free statespace digital filters with external disturbances and generalized overflow nonlinearities,” Transactions of the Institute of Measurement and Control, vol. 40, no. 4, pp. 1158–1166, 2018.

Presentation in Conference

1. S. X. Arockiaraj and P. Kokil, “LMI based passivity Analysis of digital filters,” International Conference on Wireless Signal Processing and Networking (WiSPNET), pp. 1129–1132, 2017.

2. Name of the Scholar	**Mr. Ashish Kumar**
Roll No	PHY13D001
Department	Physics
Thesis Title	CHARACTERIZATION OF SINGLE-FIBER MACH-ZEHNDER INTERFEROMETER FOR SENSING APPLICATIONS
Date of Joining	29.07.2013
Date of Passing of Comprehensive Examination	07.04.2015
Date of Submission of Thesis	12.07.2019

	Indian Examiner	Prof. Vipul Rastogi Department of Physics Indian Institute of Technology Roorkee
	Date of receipt of report	10.01.2020 (Through E-Mail)
	Foreign Examiner	Prof. Prof. Sulaiman Wadi Harun Department of Electrical Engineering Faculty of Engineering, University of Malaya
	Date of receipt of report	15.01.2020 (Through E-Mail)
	Date of Ph D viva-voce examination	09.05.2020 at 12 Noon by Google Meet
	Date of submission of final thesis	19.05.2020
	Doctoral Committee	
	Chairman	Dr Tapas Sil, Physics, IIITDM Kancheepuram
	Research Supervisor	Dr Naveen Kumar, Physics, IIITDM Kancheepuram
	Internal Member	Dr K Selvajyothi, ECE, IIITDM Kancheepuram
	Internal Member	Dr S S Karthikeyan, Dept. of ECE, NIT Tiruchirapalli.
	External Member	Prof Balaji Srinivasan, Dept. of EE, IIT Madras

LIST OF PAPERS BASED ON THESIS

Publications in Refereed Journals

1. Naveen Kumar and Ashish Kumar (2018). Investigation on the Impact of Irregular Fringe Patterns of a Single-Fiber Mach-Zehnder Interferometer on Its Sensing Capabilities. Optical Fiber Technology, 43, 131-136.
2. Ashish Kumar and Naveen Kumar (2018). Simultaneous Measurement of Current and Temperature by Using an All-Fiber Interferometric Cost effective and Non-destructive Sensing Scheme. Optik, 171, 1-8.
3. Ryusei Momosaki, Ashish Kumar, Naveen Kumar and N N Subhashree Ojha (2019). Polarization Induced Non-reciprocal Phase Controlled All-Fiber Loop Mirror Based Inclinometer. Optics & Laser Technology, 112, 134-139.
4. N N Subhashree Ojha, Ashish Kumar, and Naveen Kumar (2020). Post-Fabrication Refractive Index Sensitivity Enhancement Technique for Single-Fiber Mach-Zehnder Interferometerr. Optical Fiber Technology, 54, 1-6.
5. Ashish Kumar and Naveen Kumar. Highly Sensitive Single-Fiber MZI Conguration for Weight Sensing. Optics & Laser Technology. (Accepted)
6. N N Subhashree Ojha, Ashish Kumar and Naveen Kumar. Sensitivity Enhancement of Single-Fiber Mach-Zehnder Interferometer by Sensitizing its Interference Length. Applied Optics. (In Press)

Conferences Proceedings and presentations

1. Ashish Kumar, Naveen Kumar and Rananavare Atul Subarao, Analysis of Single-Mode Single-Fiber MZI Based Acousto-Optic Sensor Using Two Different Techniques, In Proc. International Conference on Fiber Optics and Photonics 2016 (PHOTONICS-2016), IIT Kanpur, W3A.47, 1-3,04-08 Dec. 2016.
2. Naveen Kumar, Ashish Kumar and Vageshna Tarun Narendra Varma, Miniaturized Single-Mode Single-Fiber MZI Based Direct Current Sensor, In Proc. International Conference on Fiber Optics and Photonics 2016 (PHOTONICS-2016), IIT Kanpur, W2G.3, 1-3, 04-08 Dec. 2016.
3. Ashish Kumar and Naveen Kumar, Miniaturized Single-Mode Single Fiber MZI Based Refractive Index Sensor, In Proc. International Conference on Advances in Optics and Photonics (ICAOP-2017) (XLI Conference of Optical Society of India), Guru Jambheshwar University of Science & Technology, Hisar, PP16, 309-312, 23-26 Nov. 2017.

	4. Ashish Kumar and Naveen Kumar, Fabrication of Asymmetrically Corrugated Long-Period Fiber Grating by CO2 Laser Engraving/Cutting Machine, In Proc. International Conference on Advances in Optics and Photonics (ICAOP-2017) (XLI Conference of Optical Society of India), Guru Jambheshwar University of Science & Technology, Hisar, PP17, 313-315, 23-26 Nov. 2017. 5. N N Subhashree Ojha, Ashish Kumar and Naveen Kumar, Compact Single-Mode Single-Fiber MZI Based Strain Sensor, In Proc. Student Conference on Optics and Photonics 2018 (SCOP-2018), Physical Research Laboratory, Ahmedabad, India, P24, 116-117, 04-06 Oct. 2018. 6. Ashish Kumar, N N Subhashree Ojha and Naveen Kumar, Highly Sensitive and Cost-effective Optical Fiber Interferometer Based Pressure Sensor, In Proc. International Conference on Fiber Optics and Photonics 2018 (PHOTONICS-2018), IIT Delhi, SP031, 1-2, 12-15 Dec. 2018. 7. N N Subhashree Ojha, Ashish Kumar and Naveen Kumar, Enhancing the Sensitivity of Interferometer with Involvement of Fiber Loop Mirror, In Proc. International Conference on Fiber Optics and Photonics 2018 (PHOTONICS-2018), IIT Delhi, SP030, 1-2, 12-15 Dec. 2018. 8. Naveen Kumar, Ashish Kumar, Ryusei Momosaki and N N Subhashree Ojha, Operating Point Maneuvering Through Non-reciprocal Optical Biasing in Fiber Loop Mirror Con_guration, In Proc. International Conference on Fiber Optics and Photonics 2018 (PHOTONICS-2018), IIT Delhi, SP055, 1-2, 12-15 Dec. 2018. 9. N N Subhashree Ojha, Ashish Kumar and Naveen Kumar, Sensitivity Enhancement by Varying the Orientation of Phase Shifters Based on Non- reciprocal Phase Shift in Fiber Loop Mirror Configuration, International Conference on Optics & Electro-Optics (ICOL-2019), IRDE Dehradun, 19- 22 Oct. 2019. 10. N N Subhashree Ojha, Ashish Kumar and Naveen Kumar, Refractive Index Sensitivity Enchantment of a Fiber Filter by MZI Cascaded Sagnac Interferometer, Workshop on Recent Advances in Photonics 2019 (WRAP-2019), IIT Guwhati, 13-14 Dec. 2019. Senate may kindly approve for issuing of provisional certificates to the scholars.
	Senate noted the same. Prof. Narayanan has urged that the Examiners should be senior Professors from reputed Universities and Institutes and that the quality of the Examiners should not be compromised. Prof. S.P. Venakteshan has advised to formulate an exhaustive list of Indian and Foreign Examiners in each research area in a Dept. and to select the Examiners from that list. The Senate has also urged not to publish in certain Journals given in the list of Publications above. ***Chairman Senate has informed that faculty members are advised to publish only in Science Citation Indexed good quality journals and each Dept. has identified such SCI journals. The Senate has granted permission to issue the Provisional Certificate to the above two scholars.***
2020-42-Senate-09:	**Revised Academic Schedule and Activities for Even Semester (Jan-May) 2020** Keeping safety of students as first priority, academic activities of the Institute was suspended from 16th March and all the students were advised to leave their home. As the lockdown has been extended by the Government, the institute has commenced online classes for all the students. In case of graduating students, the institute has drawn a schedule to complete all academic activities by June so as to award provisional degree for their benefit. The details of the revised schedule is as under: **Graduating Students:** **Project reviews:** would be conducted from 15th to 30th May. **Core and In-House elective courses**: End Semester Exams would be completed from 1st to 6th June. Grading would be done based on performance in Quiz 1, Assignments completed online and offline and also based on the online End semester examinations. The exact weightage for each has been communicated to the final years by the respective faculty members. Students having any issues with internet bandwidth are advised to write the exam on paper, scan and send the answers back by email within the stipulated time.

	NPTEL courses as Electives (71): The exams in case of NPTEL courses are yet to be conducted. It is learnt that NPTEL has initiated action to conduct proctored exams which students could write from their homes in June. In case, NPTEL exams could not be conducted due to any technical issues, it is proposed to adopt the following plan so as to enable students to graduate in time as most of them have already got admission for higher studies abroad. Typically, NPTEL compute the final marks with 3:1 proportion for Assignment and End Examination. We may conduct End Exam for 50% and the Assignment for remaining 50%. Anyone scoring more than 60 may be declared as successful completion of the course. Alternatively, we may ask the students to submit a 5-page report on their learning from the course. The reports having less than 20% similarity, after verification for plagiarism, may be declared as successful. This procedure is followed in Stanford University for few courses. **Pre Final Years Undergoing Internship:** The 3rd year B Tech and 4th year DD students have been undergoing their 5 months' internship from 12th May to 11th October. The students have been advised to continue working from home till the lockdown period. More than 60% of the students are working with their Project Supervisors as many of the internship opportunities are closed due to the pandemic. Their 6th/8th semester course exams will be completed, within the first two weeks, on their reporting to Institute on 12th October. **1st / 2nd Year B Tech/DD and 1st Year M Tech** The courses for these students are planned to be completed by conducting online classes till 15th June so that students without sufficient internet connectivity also could cope up with the material/portions provided through mail. It is also planned to have a review of courses followed by conducting lab exams and the End semester exams from 1st July for 2nd years and 15th July for 1st years on their return to the campus. After completion of exams, it is planned to commence the Odd Semester classes (Jan- May 2021) without any vacation. However, in case of continuation of lock down, it is proposed to conduct online examinations for end semester with at least 1-2 days gap between exams. All the exams would be completed by 15th July. Students having any issues with internet bandwidth will be advised to write the exam in paper, scan and send the answers back by email within the stipulated time. Grading for theory courses would be done based on performance in Quiz 1 (conducted in February), Assignments / Project / surprise or other tests and online End Semester Examination. Weightage for each component would be decided by the respective faculty member and would be communicated to the students. Grading for practice courses would be done based on daily performance, mid semester exam, regular viva, project etc. Conductance of End Semester Examination for lab courses is not appear to be practicable, therefore, the faculty members will adopt suitable method and communicate the grading scheme to the students.

	The Senate discussed as follows:
	<u>Final Year Students;</u> ***Revised Academic Schedule and Activities for Even Semester (Jan-May) 2020 was discussed in detail in the Senate. Senate was apprised of completing the Project Reviews online. Senate was also informed regarding the ongoing End Semester Examinations which will be completed by 6th of June. Senate verified the way/mode the exams are conducted. Senate also urged to confirm the availability of students for online exams. It was informed to the Senate that students having any difficulty with internet connectivity were given the option to write the answers in paper, scan and send back within a stipulated time based on the duration of exam.*** ***<u>Project Reviews</u>*** ***Scheme of Evaluation for the Project reviews completed during 15th to 30th May 2020 to be as follows:*** ***Mid Semester Review conducted at Institute: 20%*** ***End Semester Review conducted Online: 30%*** ***Supervisor 30%*** ***External Examiner 20%*** ***<u>Core and In-House Elective Courses:</u>*** ***Grading for the courses would be done based on performance in Quiz 1 (conducted in Februa))y and other quizzes (if any), Assignments / Project / surprise or other evaluations and online End Semester Examination.*** ***The evaluation scheme proposed is as given below:*** ***Quizzes: 30-50%*** ***Assignments/Project/other tests/Research Presentation: 30-50%*** ***Online End Semester Examination: 30-50%*** ***Senate advised that the above distribution should be just a guideline, the faculty member can vary the weightage for each based on the course. The same is to be communicated to the students.*** ***The Senate advised to issue the course completion certificates without any delay to the students as and when they complete the credit requirements. Accordingly, it is planned to issue the course completion certificates by 15th June to students who would be completing project reviews and all exams by 6th June.*** ***<u>NPTEL Courses as Electives</u>*** ***Senate was apprised of the Schedule of End Examinations announced by the NPTEL on 2nd June 2020. The Senate directed that students who have registered for the NPTEL courses should attend the exam scheduled by NPTEL. In case any student is not able to give the NPTEL exam due to genuine reasons, considering the existing situation, exams may be conducted as proposed in the Senate. In such cases, assignment score from NPTEL will be given 50% weightage, and the exam will have the remaining 50% and whoever scores at least 60% will be earning the credits of the course.*** ***And the course completion certificates would be issued to such students after they complete the exam by NPTEL or exam by Institute.***

	<u>Pre-Final Year Students Undergoing Internship:</u> ***Senate has given approval to conduct the 6th / 8th End semester examinations of the above students when they rejoin the Institute in October after Internship. The mode of the examination could be decided based on whether the Academic activities being held online or on campus then.*** ***<u>1st / 2nd Year B Tech, 1st / 2nd / 3rd Year DD and 1st Year M Tech Theory Courses</u>*** ***Senate has granted approval to complete the courses by 15th June and to conduct online End Semester Examinations before 10th July. Students having any issues with internet connectivity will be advised to write the exam in paper, scan and send the answers back by email within the stipulated time.*** ***Grading for the courses would be done based on performance in Quiz 1 (conducted in February) and other quizzes (if any), Assignments / Project / surprise or other evaluations and online End Semester Examination.*** ***The evaluation scheme proposed is as given below:*** ***Quizzes: 30-50%*** ***Assignments/Project/other tests/Research Presentation: 30-50%*** ***Online End Semester Examination: 30-50%*** ***Senate advised that the above distribution should be just a guideline, the faculty member can vary the weightage for each based on the course. The same is to be communicated to the students.*** ***<u>1st / 2nd Year B Tech, 1st / 2nd / 3rd Year DD and 1st Year M Tech Theory Courses</u>*** ***Senate discussed in detail how effectively an online evaluation could be done for lab courses and asked to explore the possibility of conducting the exams when the students join back as the Institute reopens. However, the Chairman, Senate has informed the Senate that it's better to complete all evaluations before the commencement of next semester. Accordingly, the Senate granted approval.*** ***Grading for practice courses should be done based on the lab sessions the students have completed on campus until lockdown as around 70% of the lab sessions would have been completed by then. Weightage could be given to daily performance, mid semester exam, regular viva, project etc. as the case may be for the course.*** ***The evaluation scheme proposed is as given below:*** ***Daily performance 30-50 %*** ***mid Semester exam / Project 30-50%*** ***Regular viva 30-50%*** ***In case any online evaluation has been done for any lab courses by the faculty members, the same could also be considered along with the above.*** ***The faculty members can adopt the suitable grading scheme for the lab course and communicate the same to the students.***
2020-42-Senate-10:	**Revised Academic Calendar for Jul-Nov 2020** In the Academic Calendar approved by the 41st Senate, the Odd Semester was proposed to commence from 23rd July. However, taking into account MHRD/UGC

	guidelines, the Odd Semester is scheduled to commence from Monday, 3rd August and a revised Academic Calendar is attached as **Annexure 2.** Classes would be delivered online until the students could report to campus. Special sessions will be conducted for lab courses to compensate for the missed classes. The academic schedule of M Tech 1st year is expected to be same as the above as CCMT has already initiated the admission process. The academic schedule for the first years who will be admitted based on JEE 2020 will be different from the schedule of the seniors. As and when the dates of JoSAA/CSAB counseling rounds are announced, the academic calendar for the first years will be prepared and submitted to Senate for approval. **Annexure 2**
	Senate has approved the revised Academic Calendar for the existing students. Classes would start from 3rd August in online mode. In order to conduct lab sessions, utilizing resources such as Virtual Labs developed by IITs or any other Govt. portals has to be explored. And the hands-on practice sessions could be conducted when the students report back to campus as Institute open for academic activities. ***However, the Senate has urged not to combine M Tech 1st year students along with the existing students as some of the former would be completing their B Tech programme late due to the existing situation. Starting the classes on August 3rd for them would be inappropriate. And the Senate has asked to align the academic schedule of M Tech 1st year students along with that of B Tech 1st year students.*** ***Accordingly, as per the Senate advice, as soon as the counseling and admission rounds of CCMT and JoSAA/CSAB are declared, the new Calendar applicable for them would be prepared and circulated among the Senate Members for approval.***
2020-42-Senate-11:	**To approve selection of a PDF in the Institute** An application has been received from Ms. S Shoba who has submitted thesis in the Dept. of CSE in 2019 at SSN, Chennai for the position of PDF. The Chairman Senate has constituted departmental Selection Committee (DSC) and Institute Selection Committee (ISC). The candidate presented her research work and proposal for PDF to both the committees and based on the recommendation from DSC and ISC, Chairman Senate has granted approval for her selection as PDF of the institute. Senate may kindly ratify the decision.
	Senate has ratified the decision of the Chairman Senate.
2020-42-Senate-12:	**Conduct of Supplementary Examinations of Final Year Students Online in case Students could not report to campus on 1st July** It is planned by the Institute to declare the results of final year students by 15th June. 23 students from the graduating batch are found to have backlogs. Accordingly, the supplementary examinations are planned to be conducted in July. However, in case of continuation of lock down, it is proposed to conduct the supplementary Examinations also online only for the final years. The pattern/mode of examination would be decided by the course faculty member and would be communicated to the students. Supplementary Examination of students other than the final years is planned to be conducted only after the students report to campus after the restrictions are released.

Senate may kindly consider and advise suitably.

The Senate has granted permission to conduct supplementary examination online for the final year students in July 2020. The maximum number of papers a student can appear for the supplementary in July 2020 is limited to 3.

2020-42-Senate-13: **Permission to issue Provisional Degree Certificates to the Students who complete the credit requirements by 31st July**

Institute has planned to complete the regular examinations in June and Supplementary Examinations in July for the final year students. The students of the graduating batch are listed in the Annexure 3 attached herewith. There are 304 proposed Graduands from B Tech, DD and M Tech Programmes. As the convening of convocation is likely to be delayed in view of prevailing condition, it is proposed to issue provisional certificate for the benefit of these students.

Degree	Programme	No. of Students
B Tech	COE	40
	EDM	39
	MDM	37
	MSM	31
B Tech and M Tech	CED	40
	ESD	19
	EVD	20
	MFD	18
	MPD	17
M Tech	CDS	10
	EDS	9
	MDS	12
	SMT	12
Total Students		304

Senate my kindly grant approval to issue provisional Degree Certificates to the students who complete the credit requirements by 31st July 2020. **Annexure 3**

The Senate has granted approval to issue provisional certificates to all students who complete the credit requirements on or before 31st July.

2020-42-Senate-14: **Any other matter with permission of the Chair:**

The Chairman has asked if the HoD's have any item to be discussed and Prof. B. Raja, the Head of the Dept. of Mechanical Engineering pointed out the need for a Design Department in the Institute. The Chairman also discussed regarding forming a new Department as Applied(Basic) Sciences and Humanities Department comprising of faculty members from Physics, Mathematics and English.

The Senate members have univocally agreed on the proposal and emphasized the need of Design department as the IIITDM has a special mandate to impart engineering education with a thrust to design and manufacturing. Senate also advised to form a committee in line with BoG approval to finalize the design curriculum at the earliest.

The next meeting of the Senate will be held in August/September 2020.

(A. Chidambaram)
Secretary

(Dr. Binsu J Kailath)
Dean - Academics

(Prof. B. Majhi)
Chairman

Proposal for Advancing Design in IIITDM Kancheepuram through a School of Interdisciplinary Design and Innovation

Version 1.0

7 Sep 2020

Indian Institute of Information Technology, Design and Manufacturing
Kancheepuram, Chennai 600 127

Contents

1. Prologue:

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram (IIITDM) is an institute of national importance under MHRD setup in 2007 with a vision to produce a new breed of engineers to support the competitiveness and growth of the Indian manufacturing sector with IT/knowledge-intensive and creative products and processes. In other words, a model of engineering that synthesizes the best practices of IITs (Technology), IIITs (IT), and NIDs (design). IIITDM has also been strategically placed in the proximity of the manufacturing cluster in Chennai.

IIITDM, under the mentorship of IIT Madras, started implementing the above mandate by adopting an inter-disciplinary and design-oriented engineering curriculum in 2009 in three streams - mechanical, electronics and computer engineering. This was followed by a major enhancement in 2014 where 17% credits were devoted to the design spine (a series of design and management courses right from the first semester). This model is in line with the recommendations of the India Design Council Report (2014)[1], and institutions such as Singapore University of Technology and Design that started around the same time and with similar mandate.

In order to help students realize their potential (students come through JEE Mains / JOSSA selection process, and the median AIR is around 25,000) and move closer to output quality envisaged in the vision, IIITDM introduced some unique practices in the design spine. These include vertical integration of the design and management courses between semesters 3-6 to enable students to identify and translate ideas to PoCs, industry open house events once every semester to expose students and their concepts/PoCs to industry experts, a 5-month internship at the end of the 6th semester, and a framework to assess design competence[2]. These practices along with the incubation ecosystem have been instrumental in IIITDM being placed in the Band-A (Rank 11-25) among the Institutes of National Importance in the Atal innovation ranking (ARIIA 2020). The undergraduate and dual degree programs have also started gaining recognition with companies such as AMD, Daimler, MathWorks, PayPal, Saint Gobain, Samsung, TAFE, Trimble, TVS Motors, and tech startups. IIITDM students have also got admissions into graduate and PhD programs in institutions such as Dartmouth, Univ of Minnesota, Umass Amherst, Columbia Univ, Trinity College (Dublin), TU Delft, NTU, IITM, IITB, IISc & IIMs.

[1] India Design Council Report (2014): A Concept Note - Design Spine for Undergraduate Engineering Students @ NIT's, http://indiadesigncouncil.org/pdf/EngineeringDesignSpine.pdf

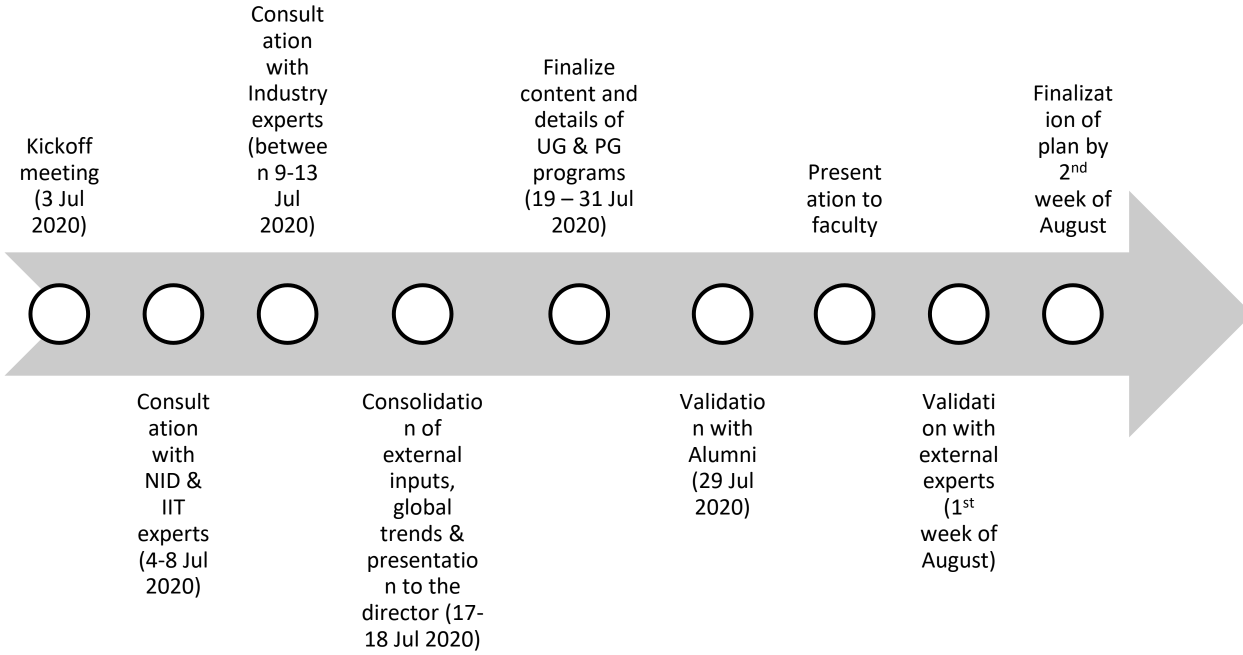
[2] Sudhir Varadarajan (2020), Measuring the value of systems thinking for design-centric engineering education, International Design Conference - DESIGN 2020, https://doi.org/10.1017/dsd.2020.72

In the current context, where the manufacturing industry in India is re-inventing itself to move up the value chain, and needs to plug supply chain gaps towards creating a self-reliant India, it is imperative that IIITDM must play a pivotal role by providing suitably trained and properly oriented talent that can directly fit future industry requirements. In this regard, IIITDM Board of Governors (BoG) recommended setting up a sub-committee under the leadership of Prof. G Venkatesh (member of the IIITDM Senate) and Mr Krishna Giri (member of IIITDM BoG) to review and recommend suitable changes in its curriculum. In response, Prof. Banshidhar Majhi (Director, IIITDM Kancheepuram) invited Prof. G. Venkatesh and Mr. Krishna Giri (member of the BoG) to guide the process, and Dr Sudhir Varadarajan (Dean – Design, Innovation, Incubation) to convene a set of consultations with internal and external stakeholders (email dated: 8 Jun 2020). This proposal presents the scope, objectives, and recommendations of the sub-committee.

Dr Sudhir Varadarajan convened an initial meeting of the BoG sub-committee (Prof. Venkatesh and Mr Krishna Giri) on 12 Jun 2020 to discuss the scope, objectives of the sub-committee and identify stakeholders for internal and external consultation. Prof. Venkatesh was nominated as the chairman of the sub-committee, and three specific objectives were defined:

1. To clearly articulate the demand from industry, products to be produced by IIITDM & their positioning
2. To review and strengthen the design-centric engineering curriculum in terms of the overall structure, the content of the design-spine, and its integration with the rest of the courses
3. To recommend an appropriate organization and budget to strengthen the design spine and the future programs to expand the footprint and impact of IIITDM on the industry/society

The constitution of the sub-committee, and the external experts for consultation are shown in Appendix-1. The experts covered academia (NID-Product/Industrial Design and IITs-Engineering Design) and industry (Automotive, Consumer Goods, Process Industry, Digital, Consulting). All the interactions with external experts, within the sub-committee, with alumni and faculty were conducted online (Google Meet/Teams) due to COVID-19. The consultation process along with the timeline is shown below:



2. Key findings from expert consultations & analysis of global trends

The key recommendations of experts with respect to the key objectives of this study are summarized in the Table below. The detailed observations of experts are given in Appendix-2.

Objectives of the study	**Recommendations of experts**
Demand for digital and design-centric engineers (B.Tech) and Product Designers (M.Des)	• There is demand for creative engineers and product designers. But it is latent and not reflected in the placement process or entry level salaries. • IIITDM must actively work with the potential recruiters and position its products and create demand. Faculty, alumni and students must be the brand ambassadors • M.Des program may focus on product design. The specialization can evolve from projects over time; PhD program can be in inter-disciplinary design
Design curriculum for B.Tech and M.Des programs	• Embracing design means creating a learning environment that nurtures curiosity, risk taking and innovation. Questioning is the most important ingredient to catapult innovation. Marks should be given to good questions rather than given to good answers • This process must start early (from the 1st semester) and continue through the program • The learning-by-doing approach must pervade all the design courses, and atleast the key engineering courses where fundamentals must be strong
Appropriate organization to support design programs	• An independent & flexible organization will be required to attract talent (faculty, students, industry). • The focus must be on creating a new culture of learning, increase choices for students, and encourage product innovation at B.Tech, M.Des and PhD levels

The sub-committee also analyzed various global trends in engineering and design education, starting with the recent NEET (New Engineering Education Transformation) initiative at MIT[3]. The NEET initiative articulates that future students must learn to work on machines and systems that are complex, highly networked and part of larger systems of systems, have higher levels of autonomy and are supportive of a sustainable environment. They will need to exhibit qualities such as Learning how to learn; Making; Discovering; Experimental; Creative; Systems thinking; Critical and Metacognitive thinking; Interpersonal skills; Personal skills and attitudes; Humanistic; Analytical thinking; Computational thinking. To develop these qualities engineering institutions must approach the overall training very differently, with emphasis on cross disciplinary, integrative, and problem-based learning. They must also work energetically to overcome academic inertia, conservative influences in accreditation and professional societies, and the hiring practices of major companies. The last point echoes the recommendation of experts that IIITDM will need to create and position its products in the Indian context. The sub-committee also took cognizance of the design-centric programs launched by institutions such as Olin College[4], Singapore University of Technology and Design (SUTD), University of Twente, TU Delft, and the developments in design education in India[5]. It may be noted that the model of design-centric program started in 2014 in IIITDM has strong resemblance with the above initiatives in terms of the intent and high-level structure. However, major differences exist in terms of control over selection of students, the choices for students, student-faculty ratio, and the overall implementation of the program.

3. Products, programs, and curriculum to advance the mandate of IIITDM

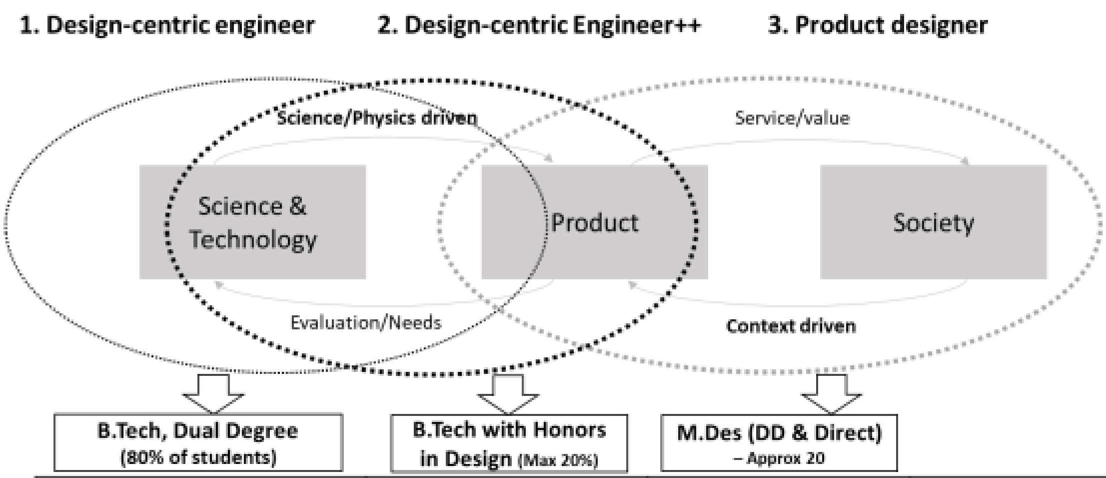
Given the lack of control over student selection, and the possibility that not all students joining IIITDM Kancheepuram may select the institution based on the “D” (some may join because it is an Indian Institute or a GATE to a PSU, while others may join thinking it is a IIIT), the sub-committee felt the need to categorize students and provide choices for different categories to pursue their interests. In addition, the steep challenges in creating and positioning high value design-centric engineers and product designers also meant that some of the categories will need to receive a greater amount of design content and hand holding. Based on these factors the sub-committee decided to have three categories of IIITDM products:

1. Design-centric engineers: All engineers entering IIITDM will have a certain level of exposure to product design and digital that will differentiate them against engineering

[3] https://neet.mit.edu/ and http://news.mit.edu/2018/reimagining-and-rethinking-engineering-education-0327
[4] Goldberg D. and Somerville M. (2014), A Whole New Engineer: The coming revolution in Engineering Education, Three Joy Associates, Michigan
[5] Balaram S (2011), Thinking Design, Sage India, 2nd revised edition; and Mandar Rane (2017), The design journey of Prof. Nadkarni (IDC, IITB)

students coming from other institutions in terms of their problem-solving capability. They will receive the regular B.Tech degree. They may pursue their career aspirations in engineering – technology jobs, masters programs in technology (India or abroad) or join PSUs. About 70-80% students may fall in this category.

2. Design-centric engineers++: Those who have an inclination for a career as solution architects, product designers, entrepreneurs or product managers will be taken into a separate stream and given an additional six electives (from the advanced M.Des courses) and supported through the internship. They will receive a B.Tech in their program of study along with a Honors in Product Design. About 20-30% of students may fall in this category. A few from this group may opt for a 5-year Dual Degree program in B.Tech + M.Des. The products in this category will be the brand ambassadors of IIITDM
3. Product Designers: These will be close to the type of products produced by the M.Des programs in NIDs and IDC/IITB. This product category does not exist in IIITDM portfolio today. About 20 students may be inducted in this program.



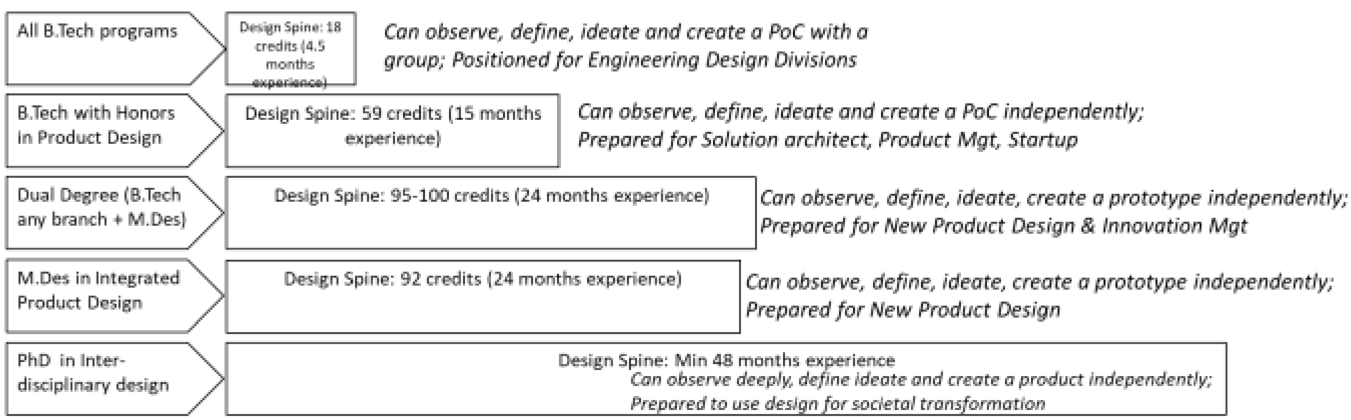
*	***	*****	Immersive & Iterative
*	***	*****	Integrative (connect the dots)
*	***	*****	Interactive (pathways of action)

The distinctions between the three product categories can be better understood using the model proposed by Prof. Toshiharu Taura (2014)[6]. The model distinguishes between engineering design and industrial/product design using the relationship between Technology-Product-Society. Engineering design is largely science-driven and operates in the T-P space, while product design is context driven and operates in the S-P space. The methods developed in engineering design to a large extent assume that the purpose of the product and its

[6] Toshiharu Taura (2016), Creative Design Engineering: Introduction to an interdisciplinary approach, Elsevier, London

requirements are known, and focus on translating the requirements into fine grained functions, and leveraging principles of physics to create appropriate mechanisms and structures that are fit for purpose. The methods developed in product design largely focus on surfacing the unstated needs from the context (economic, social, ecological) and defining the purpose of the product, its architecture, and interaction between the product and the users, and value creation. Product innovation requires a synthesis of both perspectives. The effectiveness and efficiency of product innovation will be far higher if engineers understand the context better, and when product designers understand the constraints, and when you have a special breed of engineers (Design-centric engineer++) who are able to connect the dots between technology and user insights, resolve contradictions and improve collaboration through dialogue. IIITDM hopes to produce these three types of products who can contribute to the competitiveness of the Indian manufacturing industry.

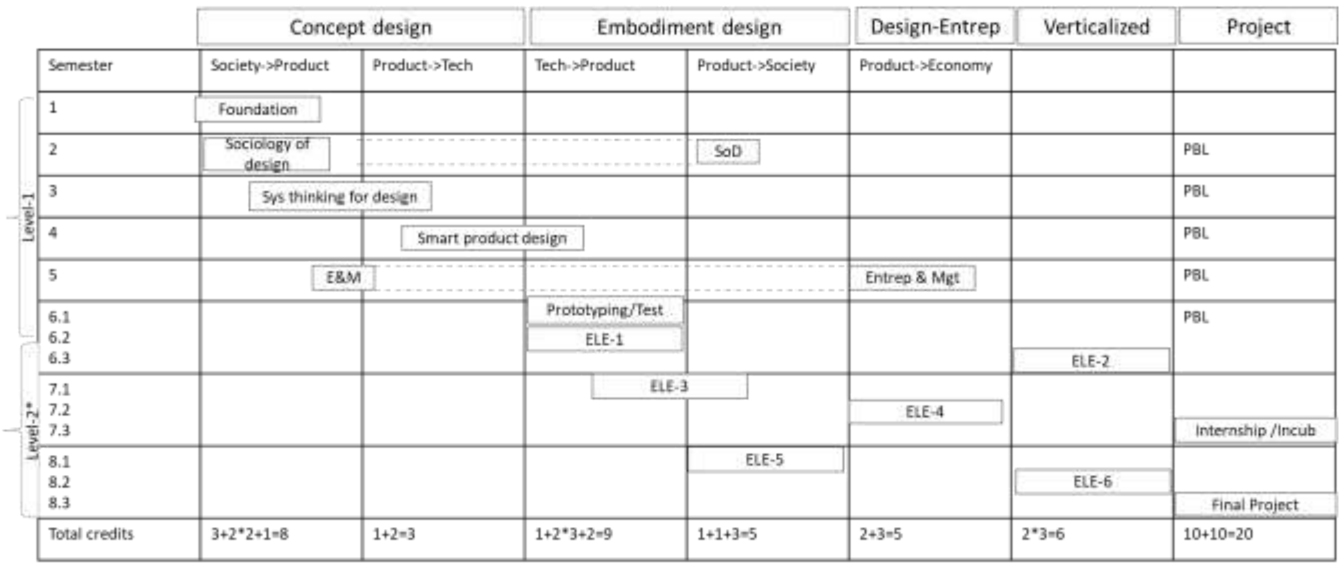
The relative maturity of design spine in the five product lines is shown in the figure below:



It may be noted from the above figure that the Honors in Product design and the Dual Degree in M.Des will be the marquee products or brand ambassadors of IIITDM.

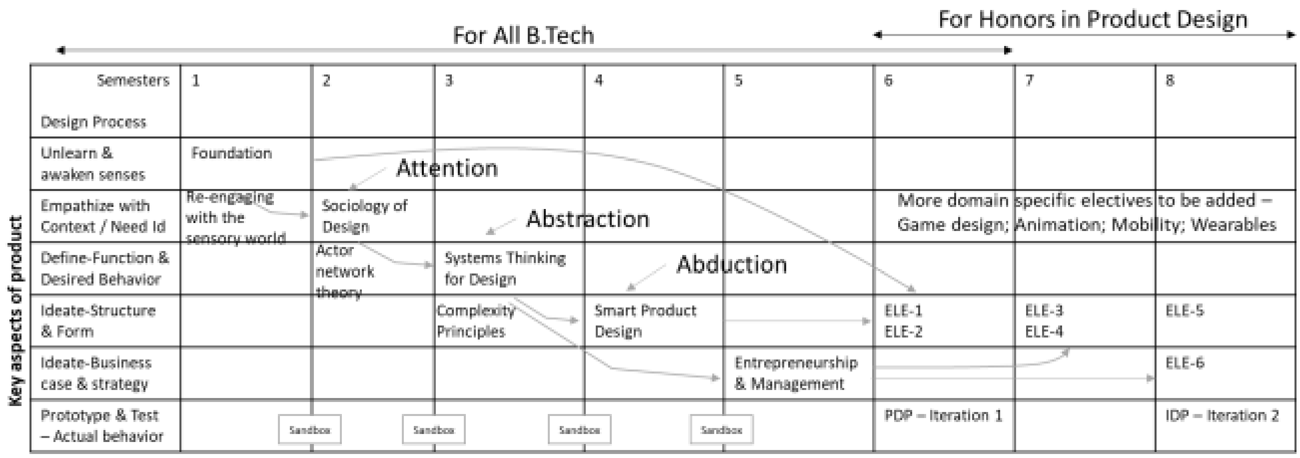
3.1 Bachelors Programs (Design-Centric Engineer & Design-Centric Engineer with Honors in Product Design)

The curriculum of the design spine for design-centric engineers (B.Tech) and design-centric engineers++ (B.Tech with Honors in Product Design) is shown in Figure below:



*Level-2 courses will essentially be taken from the portfolio of courses offered in the M.Des program in ODD/Even semester
* This will be applicable for both Design++ and M.Des Dual Degree students

The curriculum has a foundation program in the first semester to help students to unlearn and rediscover their creative selves. The sequencing of subjects across semesters, problem-based learning and exposure to external jury at the end of every semester ensures that students gain hands-on experience in the process of product design right from need identification to PoC and business case development. The choice of subjects and their syllabus is designed to facilitate inter-disciplinary synthesis as shown in the Figure below:



Interdisciplinary concepts and techniques; Blended Learning Model

Each subject must strengthen the following qualities: Curiosity, Industry context, Product Level, Customer focus, Team building, Interdisciplinarity

Six strategies to cultivate creativity; The credit split – Lecture (1) + Facilitation (2); 3 hours will be continuous to facilitate immersion

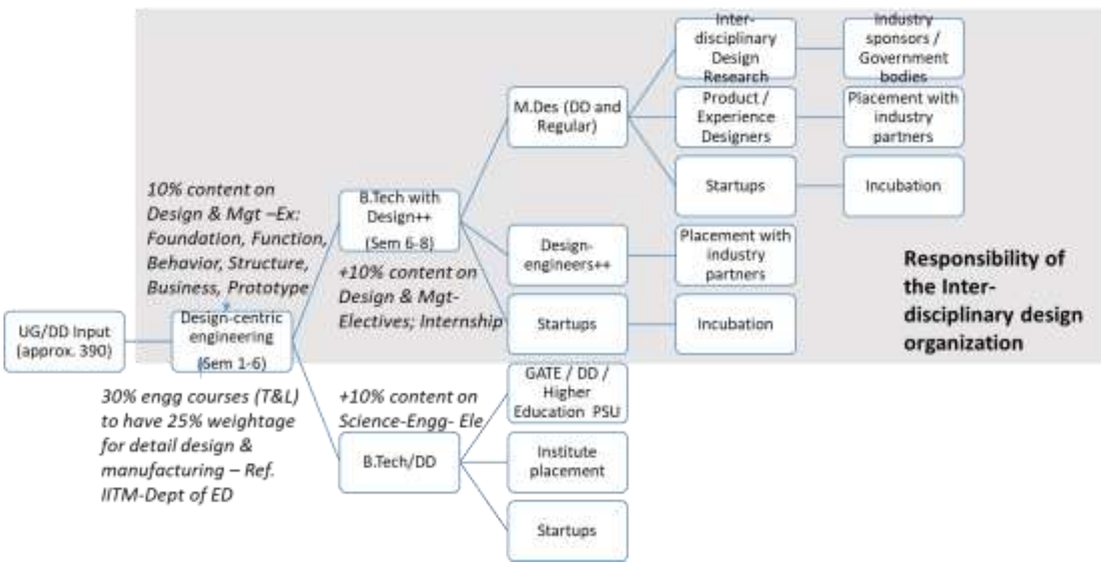
The snapshot of the syllabus for the six design courses for all B.Tech is shown in Table below. Each subject is designed to enhance creativity in a certain way. The detailed syllabus for the courses is provided in Appendix-3.

Subject Name	**Foundation**	**Sociology of Design**	**Systems Thinking for Design**	**Smart Product Design**	**Entrepreneurship & Management**	**Prototyping & Fit**
Objective	Unlearn Learn to observe	Empathize Surface needs	Define Purpose-Fn-Behavior	Ideate Fn Arch-Struc-Form	Business Case	Prototype (scaled down)
Contents	Unlearning Immersion Sketching objects Photography	Ethnography Rich pictures Narrative writing ANT/SI/Semiotics	Stakeholder analysis Frame objectives Functional hierarchy Complex systems	Level of smartness Functional arch Fn-Struc mapping Approp AI meths	Mkt / Micro economics Comp, Strategy & Org Asset & Resource Mgt Compliance	MVP/BoM 2 Hackathons DFM; Agile Project Mgt
Pedagogy & Evaluation	Learning by doing / Studio Model 80% Internal/Indiv 20% External Jury	Learning by doing /SM 50% Team Project 30% Indiv/Concept 20% External Jury	Learning by doing / SM 50% Team Project 30% Indiv/Concept 20% External Jury	Learning by doing /SM 50% Team Project 30% Indiv/Concept 20% External Jury	Learning by doing / SM 50% Team Project 30% Indiv/Concept 20% External Jury	Learning by doing / Studio model 70% Internal 30% External Jury
Credits	3	3	3	3	3	3
Equivalent courses in B.Des (IITB)	• Art & Design fundamentals-2D • Captured image design	• Des Studio-1 (problem ident); • Design, Society, Culture; • Design history • Visual studies-1; Semiotics; Storytelling	• Des Studio-2 (Prob Analysis) • Knowledge orgn & communication • Systems design project	• Design Studio-3 (Creative explore) • Creative thinking methods	• Design management -	• Design Studio-4 (Prototyping)
	Creativity through immersion/observe	Creativity through meanings/listen	Creativity through connecting dots	Creativity through metaphors	Creativity through benchmarking	Creativity through paradoxes/conflict

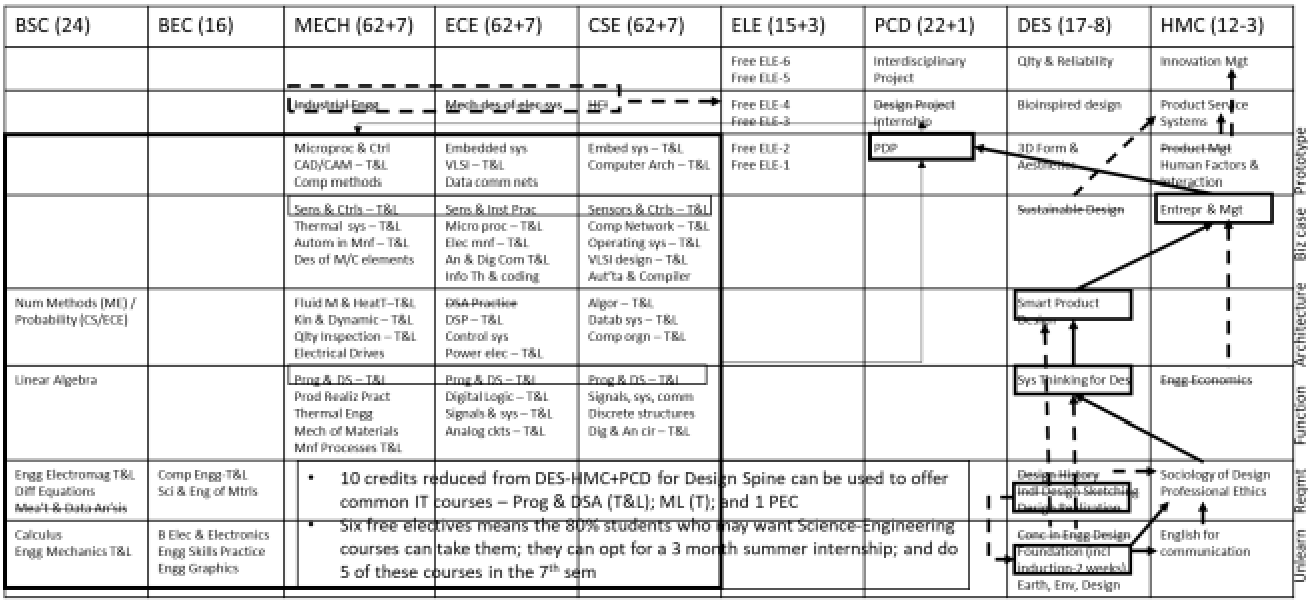
A close look at the above Figure will show that the focus is on new product conceptualization and w.r.t smart products (cyber-physical). The process of surfacing the new is not only based on attention and abstraction of the present and emerging context, but also relating to the historical socio-cultural context. In this respect Design in IIITDM is different from design in other institutions. This approach will be further enhanced in the M.Des program.

Students will be given an option to pursue honors in Product Design at the end of Semester 5 and a Dual Degree program in MDes at the end of their 6th semester. However, they will have to go through an internal selection process that will be based on the potential and performance of the student in design spine. The emphasis on providing 25% weightage for problem-based learning in 30% of the science-engineering courses (between 1-6 semesters) will help the students gain practical skills in engineering design and manufacturing at the component level.

In the sixth semester one of the electives will be a domain specific elective (Animation, Medical devices, Automotive) to ensure that students taking up internship have some background when they enter the industry. The courses offered to the design students during their internship (7th semester) will be designed to ensure that it creates opportunity for join supervision by the design faculty and discover the client context. The two courses suggested in this regard are Bio-inspired design and Sustainable PSS.



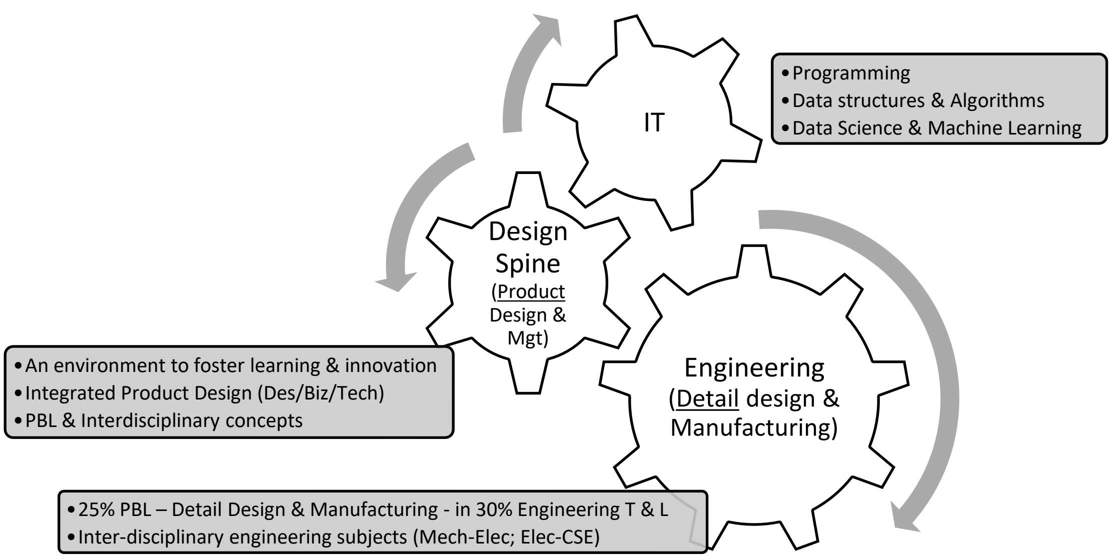
Another key aspect of the proposed design curriculum is that it does not require major changes to the overall curriculum structure. By creating the two categories and making electives open it has created space to meet the requirements of different categories of students/products.



BSC (24)	BEC (16)	MECH (62+7)	ECE (62+7)	CSE (62+7)	ELE (15+3)	PCD (22+1)	DES (17-8)	HMC (12-3)	
					Free ELE-6 Free ELE-5	Interdisciplinary Project	Qlty & Reliability	Innovation Mgt	
		~~Industrial Engg~~	~~Mech des of elec sys~~	~~HCI~~	Free ELE-4 ~~Free ELE-3~~	~~Design Project~~ Internship	Bioinspired design	Product Service Systems	
		Microproc & Ctrl CAD/CAM – T&L Comp methods	Embedded sys VLSI – T&L Data comm nets	Embed sys – T&L Computer Arch – T&L	Free ELE-2 Free ELE-1	PDP	3D Form & Aesthetics	~~Product Mgt~~ Human Factors & Interaction	Prototype
		Sens & Ctrls – T&L Thermal sys – T&L Autom in Mnf – T&L Des of M/C elements	Sens & Inst Prac Micro proc – T&L Elec mnf – T&L An & Dig Com T&L Info Th & coding	Sensors & Ctrls – T&L Comp Network – T&L Operating sys – T&L VLSI design – T&L Aut'ta & Compiler			~~Sustainable Design~~	Entrepr & Mgt	Biz case
Num Methods (ME) / Probability (CS/ECE)		Fluid M & HeatT–T&L Kin & Dynamic – T&L Qlty inspection – T&L Electrical Drives	~~DSA Practice~~ DSP – T&L Control sys Power elec – T&L	Algor – T&L Datab sys – T&L Comp orgn – T&L			Smart Product Design		Architecture
Linear Algebra		Prog & DS – T&L Prod Realiz Pract Thermal Engg Mech of Materials Mnf Processes T&L	Prog & DS – T&L Digital Logic – T&L Signals & sys – T&L Analog ckts – T&L	Prog & DS – T&L Signals, sys, comm Discrete structures Dig & An cir – T&L			Sys Thinking for Des	~~Engg Economics~~	Function
Engg Electromag T&L Diff Equations ~~Mea't & Data An'sis~~	Comp Engg-T&L Sci & Eng of Mtrls	• 10 credits reduced from DES-HMC+PCD for Design Spine can be used to offer common IT courses – Prog & DSA (T&L); ML (T); and 1 PEC					~~Design History~~ ~~Indl Design Sketching~~ Design Realization	Sociology of Design Professional Ethics	Reqmt
Calculus Engg Mechanics T&L	B Elec & Electronics Engg Skills Practice Engg Graphics	• Six free electives means the 80% students who may want Science-Engineering courses can take them; they can opt for a 3 month summer internship; and do 5 of these courses in the 7th sem					~~Conc in Engg Design~~ Foundation (incl induction-2 weeks) Earth, Env, Design	English for communication	Unlearn

In order to ensure that there is an element of immersive learning environment, three aspects may be emphasized: (a) organize the design courses between semesters 1-6 as a single 3-hour slot; (b) include a 1 day hackathon during the semester; and (c) align the assignments in different courses to the common problem selected by the student, preferably through an effective use of the Academic Class Committee.

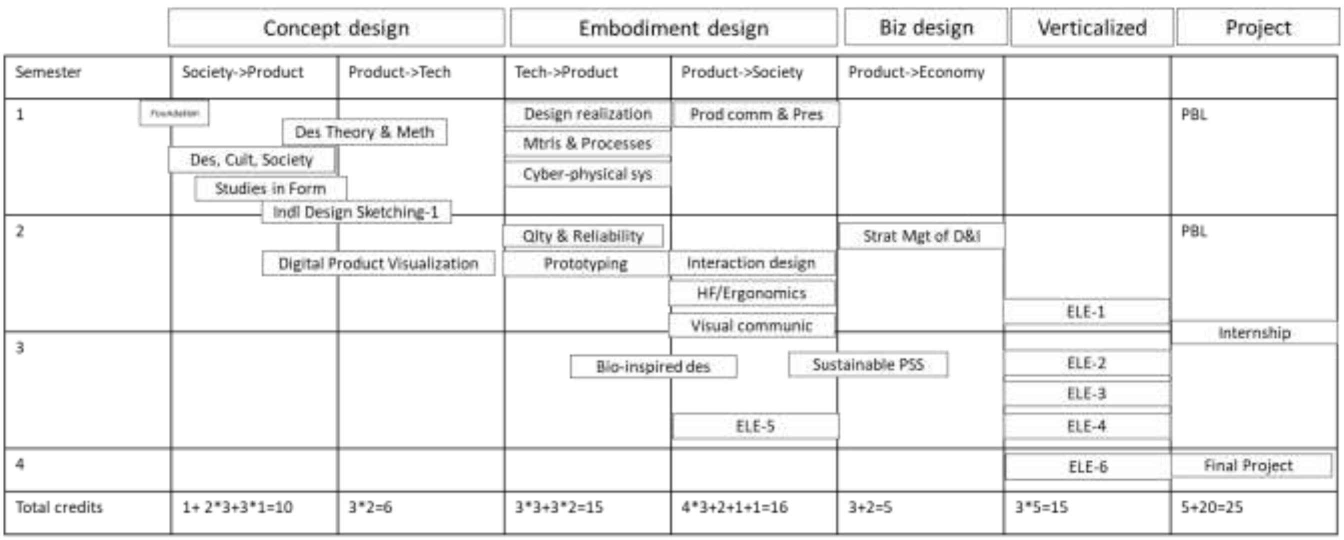
Implementation of the above proposal will create a differentiated model at B.Tech level with the right mix of IT, design and Engineering as shown below.



Needless to say, a serious commitment to learning by doing will be required to deliver a differentiated product at the B.Tech level .

3.2 Master of Design Program (M.Des)

In order to structure the M.Des curriculum, the sub-committee reviewed various models of M.Des in India and abroad and narrowed down to two models that seemed to be closer to the design spine finalized for the undergraduate program, namely TU Delft's Integrated Product Design and IDC (IITB)'s Industrial design. A synthesis of these two models was done to arrive at the following model for M.Des in Integrated Product Design in IIITDM.



* Dual degree Mdes students will take 6 electives from MDes semesters 1&2 in their 7th and 8th sem; and follow 9th and 10th as per regular M.Des

The students will start working on an industry provided or self-identified problem in their first semester. Each of the courses will facilitate students work on the same problem, but from the perspective of the course so that a holistic appreciation of the concept and embodiment is achieved. This will also facilitate strong immersive experience.

The M.Des program will be open for students with B.Des, B.Tech, B.Arch. CEED score will be required for selection of candidates who may receive a scholarship from the institute. For self-sponsored candidates, a minimum of two-years work experience will be required.

3.1 Doctoral program in Interdisciplinary Design (PhD)

It is proposed to start a PhD program in interdisciplinary design. In line with the NID philosophy, the purpose of the PhD programme will be "to support the creation of products or services that improve the quality of life of people, meet demands to sustain the environment, improve policymaking; and better the understanding and use of design in industry, education and society at large".

"The programme shall be open to educators and professionals in design and allied fields who wish to reinvent their own practice or knowledge base while pushing the boundaries of the discipline through innovation in practice and create new design theories".

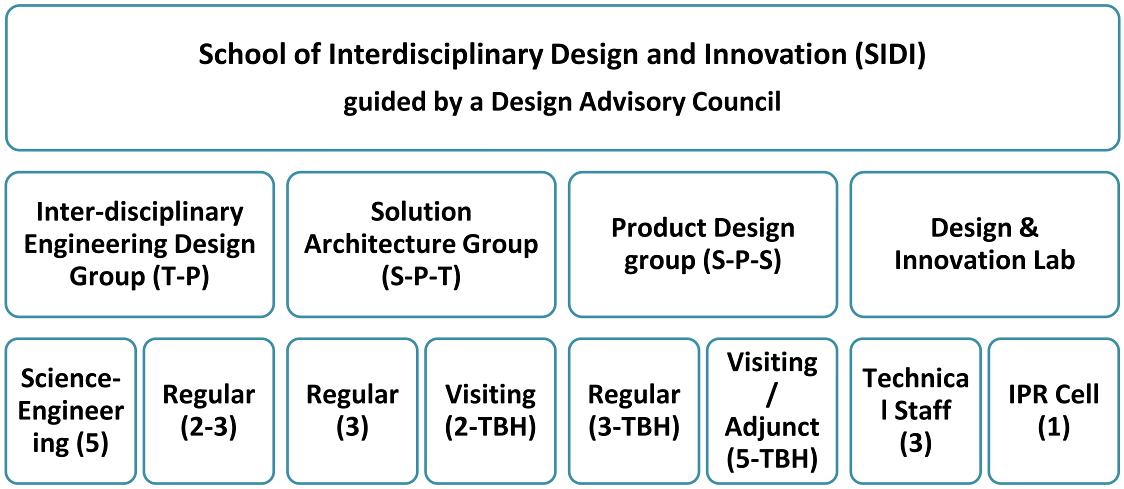
The selection will be based on an interview. The number of PhDs onboarded, the tenure of the program and the scholarship for the program will be based on IIITDM rules for PhD program.

4. Case for the School of Interdisciplinary Design and Innovation

The challenge to promote a new culture of learning that nurtures curiosity, create industry partnerships to create the demand and position the talent appropriately, and encourage student led product innovation calls for sustained and focused efforts by a group of full-time dedicated faculty. This may not be feasible within the discipline focused department structure or a loose coalition like a centre.

The organization will also need some flexibility in the initial stages to attract the right type of talent. It is estimated that a min of 15 faculty (and a maximum of 25) will be required to support 1170 UG students and 220 brand ambassadors (Design++, M.Des, PhD). The diversity of talent required and the challenge in attracting the right talent with experience in design and affinity for teaching calls for higher proportion of visiting faculty compared to the rest of the institute (1:1 or 1:2 in the beginning). New roles such as Professor of Practice will need to be created to attract talent.

Based on the above, it is proposed to setup a School of Interdisciplinary Design and Innovation (SIDI) with four types of expertise – Interdisciplinary engineering design; Integration between Engineering and Product Design; Product Design and a Design and Innovation Lab. The School will have a Design Advisory Council, with 6-8 experts drawn from the academia and industry, to guide its activities. A high-level organization structure of SIDI is shown in Figure below.



SIDI is different from a department in the following ways:

- It is strongly aligned with the institutional goal:
    - Advancing design and innovation in manufacturing sector
    - It is focused on encouraging student led product innovation and not restricted to pursuit of knowledge in a discipline
    - It will shape the mind of all the UG students entering IIITDM over six semesters
    - As a strategic unit, it will be mapped to the role - Dean (Design, Innovation, Incubation)
- It is a network with a few regular nodes and linkages with others:
    - Faculty recruitment & promotion (regular or visiting) will not be restricted to one discipline; contribution to design-industry is key
    - There will be a greater proportion of visiting/adjunct/guest faculty compared to regular faculty (atleast 1:1); remuneration for visiting/adjunct/guest faculty preferably as per IIT norms (Senate/BoG to guide)
    - Faculty from other departments interested in embracing design will be co-opted into specific initiatives-joint guidance of Interdisciplinary research / industry projects / incubation – quid pro quo; Similarly Design Faculty can be included in Design Project Review committees in Departments; Common Faculty orientation sessions with design experts
    - SIDI will explore opportunities to channel technology innovations of departments into products
- Its faculty will play the role of an enabler to ensure product-market fit:
    - Creating a learning environment
    - Work with industry to position students (D++, MDes)
    - Active role in product innovation & incubation

SIDI is also different from a research centre:

- Its activities include education, award of degrees (under institute name), research, consultancy, product innovation
- It has full-time faculty, recruitment & budget and its own outreach and have a goal of self-sustenance in future

The benefits to the faculty joining SIDI include:

- An opportunity to reinvent themselves (driven by a deeper appreciation of design), pursue industry oriented and inter-disciplinary work and enable student-led product innovation and startups
- All IIITDM rules applicable to faculty - # of PhDs, CPDA, etc. will remain same
- Faculty can apply for sponsored research in interdisciplinary/prod devp areas

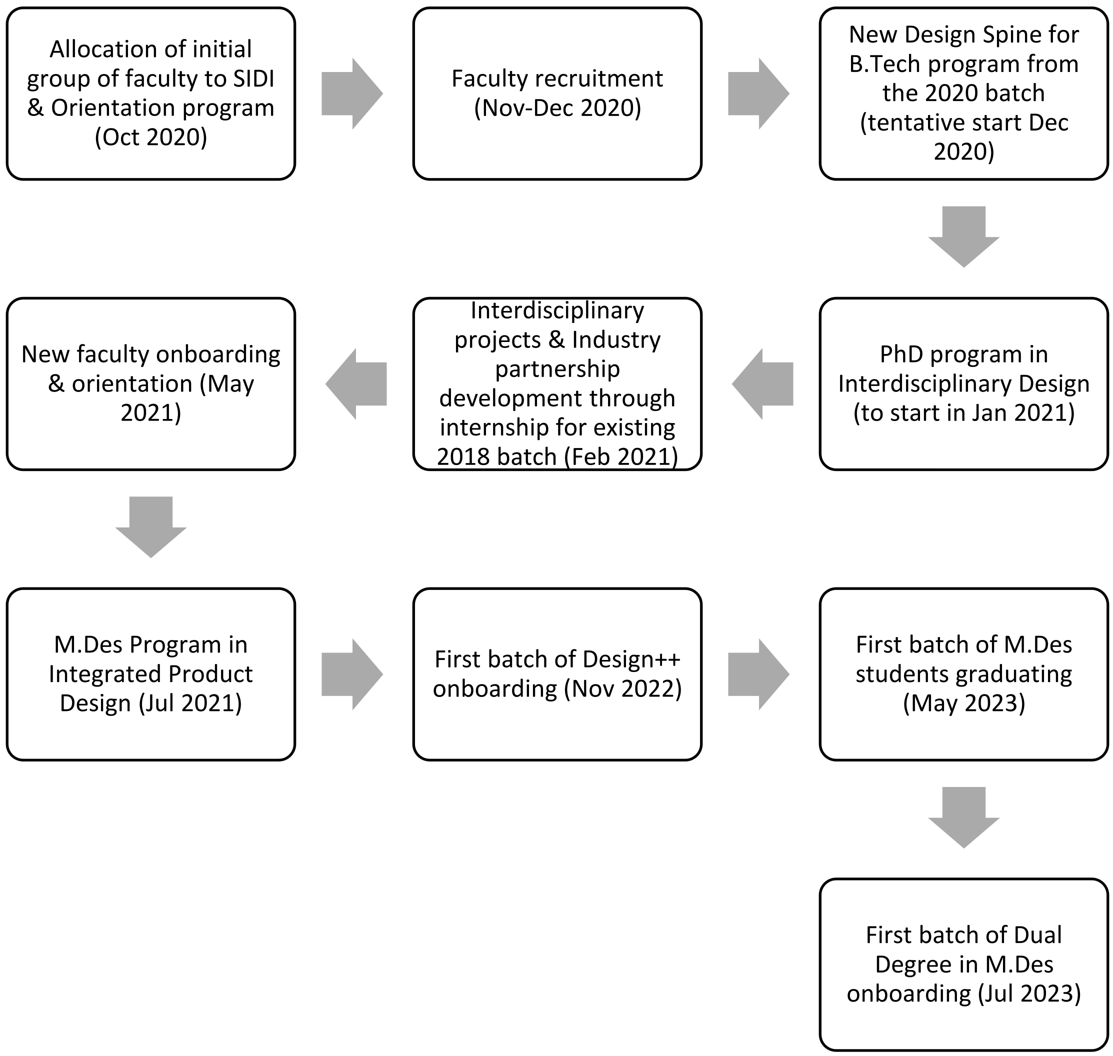
In order to seed a new culture, emphasis has to be placed on careful selection of faculty (regular and visiting), having a regular faculty orientation program with chosen experts, including a process of peer review of courses and their delivery, and effective class committee to align with engineering courses, ensuring that all faculty focus on student learning.

Indicative list of academic and industry partnerships that we will need to develop:

Academia	NID; IITB; IITM; SUTD; TU Delft
Industry	Aditya Birla Group; Amazon; Ashok Leyland; Daimler India Commercial Vehicles; Godrej; HCL-Product Engg; JK Fenner; Mahindra & Mahindra; Mercedes Benz R&D; PayPal; Royal Enfield; Saint Gobain; Samsung; Siemens (Medical); TAFE; Tata Elxsi; TCS-Engg Services; Titan; Tube Investments; TVS Motors

4.1. Implementation Plan

Suggested timeline for implementation subject to approval by the IIITDM Senate and the BoG:



4.2 Faculty Estimation:

Requirement based on the number and variety of courses:

	Society-Product	Product-Technology	Technology-Product	Product-Society	Industry specific
Total courses	7	7	9	8	6
# of courses that can be handled by current faculty	**3**	**5**	**9**	**4**	**1**
# of courses where we need support	4	2	0	4	5
Logical grouping of subjects	1. Design Theory & Meth 2. Foundation; 3. Studies in form; 4. Design, culture, Society;	1. Design Research 2. Model based design;		1. Visual communication; 2. Product comm & presentation; 3. Interaction design; 4. Human factors & Ergonomics	1. Animation 2. Game design 3. Biomedical devices 4. Non-invasive systems 5. Automotive design
Min number of faculty to be hired to start M.Des (10)	**3**	**1**	**0**	**2**	**4 (Adjunct/Guest)**

Faculty estimate based on the number of students:

	2020-21	2021-22	2022-23	2023-24	2024-25
Total UG students admitted	390	429	472	519	571
Total in campus (2nd year)	305	390	429	472	519
Total UG (3rd year)	376	305	390	429	472
Total UG students (2 courses p.a. for each batch	1071	1124	1291	1420	1562
Faculty for the B.Tech program – Sem 1-6: Assuming 100 students per class, 2 classes per faculty in a semester	**10**	**11**	**12**	**14**	**16**
Design++ students (4th year)	42	56	61	78	86
Dual Degree Students (5th year)	0				10
Total M.Des Students (scholarship + self-fund)	0	20	40	40	40
Total PhD Students	15	32	40	48	60
Faculty for the advanced design courses (approx. 8 subjects per semester; and a faculty takes 3 courses in a yr)	**0**	**5**	**8**	**10**	**14**
Total faculty required for SIDI	**10**	**16**	**20**	**24**	**30**

4.3 Budget Estimate:

Operational parameters:

	2020-21	2021-22	2022-23	2023-24	2024-25
Total UG students admitted	390	429	472	519	571
Total in campus (2nd year)	305	390	429	472	519
Total UG (3rd year)	376	305	390	429	472
Total UG students (2 courses p.a. for each batch	1071	1124	1291	1420	1562
Design++ students (4th year)	42	56	61	78	86
Dual Degree Students (5th year)	0				10
Total M.Des Students (scholarship + self-fund)	0	20	40	40	40
Total PhD Students	15	32	40	48	60
PhD Students (Institute scholarship)	10	16	20	24	30
PhD students per regular faculty	2	2	2	2	2
Self-funded PhD students per regular faculty	1	2	2	2	2
Regular Faculty	5	8	10	12	15
Visiting Faculty (Full-time)	2	4	5	6	8
Guest/Adjunct Faculty (Part-time)	2	4	5	6	7
Technical staff & IPR Cell	2	3	4	5	5
Student-Faculty Ratio (for B.Tech sem 1-6)	133.9	80.3	73.8	67.6	58.9
Student-Faculty Ratio (PhD+MDes+DD+D++)	7.1	7.7	8.1	7.9	7.4

Operating Expenditure:

All Amount in Rs Lakhs	2020-21	2021-22	2022-23	2023-24	2024-25	Total
Faculty & Staff Salary	**180.0**	**330.0**	**459.8**	**612.3**	**819.9**	**2402.0**
Total Guest Faculty cost	12.0	26.4	36.3	47.9	61.5	184.1
Foundation program costs per year (one expert for 2 weeks at 20K per day)	2.5	2.8	3.0	3.3	3.7	15.3
Total cost for Invited Talks	1.0	1.8	2.4	3.2	4.4	12.8
Total design studio consumables	86.6	87.4	123.7	152.0	186.7	636.4
Total library cost	4.2	8.1	11.7	15.1	19.4	58.5
Total scholarship (assuming only 50% of MDes) - TA	0.0	19.8	43.6	47.9	52.7	164.0
Total scholarship for PhD Students (TA)	42.0	67.2	84.0	100.8	126.0	420.0
2 (1-week) Faculty orientation programs per year @ 50k per day (including expert cost / accommodation/ food)	5.0	5.5	6.1	6.7	7.3	30.5
Patents per faculty	1.0	2.0	2.0	2.0	2.0	
Cost of patents	5.0	17.6	24.2	31.9	43.9	122.7
Consultancy project & Workshop expenses	16.0	32.0	48.0	76.8	120.0	292.8
Utilities - HVAC and Electricity (2 * 3000 sq ft lab)	8.0	8.8	9.7	10.6	11.7	48.8
Total operating expenditure	**346.3**	**575.4**	**804.4**	**1031.8**	**1337.3**	**4095.1**

Operating Revenue:

All Amount in Rs Lakhs	2020-21	2021-22	2022-23	2023-24	2024-25	Total
M.Des Fees	1.5	1.7	1.8	2.0	2.2	
Total Mdes Fee	0.0	33.0	72.6	79.9	87.8	273.3
B.Tech Fees (Design++)	0.6	0.7	0.7	0.8	0.9	
Total D++ Fee	25.2	37.2	44.3	62.3	75.4	244.4
Dual Degree Fees	1.5	1.7	1.8	2.0	2.2	
Total DD Fee	0.0	0.0	0.0	0.0	22.0	22.0
PhD Fee	1.5	1.7	1.8	2.0	2.2	
Total PhD Fee	22.5	52.8	72.6	95.8	131.8	375.5

Industrial consultancy & Workshop revenue per faculty	4.0	5.0	6.0	8.0	10.0	
Total Consultancy Revenue	20.0	40.0	60.0	96.0	150.0	366.0
Licensing from patents	1.0	3.5	4.8	6.4	8.8	24.5
Total Revenue	**68.7**	**166.5**	**254.3**	**340.4**	**475.7**	**1305.7**
Deficit (to be supported by the MHRD grant for faculty salary)	**-277.6**	**-408.8**	**-550.1**	**-691.4**	**-861.5**	**-2789.4**

Capital Expenditure:

All Amount in Rs Lakhs	**2020-21**	**2021-22**	**2022-23**	**2023-24**	**2024-25**	**Total**
Furniture for design lab, WiFi, vending machine, etc	10.0	10.0	15.0	15.0	20.0	70.0
Design Studio Equipment (Prototyping - SRP, 3D, Electronic, Ergonomics, 25 Workstations)	40.0	40.0	50.0	50.0	60.0	240.0
Design Studio Software (Sketching, VR, Interaction Design, Ergonomic Analysis, Visual Communications, Game, Animation, AR)	30.0	30.0	40.0	40.0	50.0	190.0
Total capital expenditure	**80.0**	**80.0**	**105.0**	**105.0**	**130.0**	**500.0**
Sponsored research per faculty (assuming it contributes to design infra)	5.0	6.0	7.2	8.6	10.4	
Total SR grant	**25.0**	**48.0**	**72.0**	**103.7**	**155.5**	**404.2**
Difference	**55.0**	**32.0**	**33.0**	**2.0**		

5. Epilogue

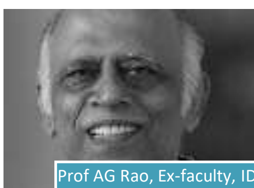
The disruption unleashed by COVID-19 has exposed the fault-lines in education at all levels. The New Education Policy (NEP) launched by the Govt of India can help institutions move towards a new model of education. The NEP calls for increasing choices for students, creating more wholesome and interdisciplinary learning experiences, and encourage student led innovation. These macro trends give strong tailwind to this proposal for advancing design through the School of Interdisciplinary Design and Innovation. The proposal strongly aligns with the vision of NEP. Design education is fundamentally about creating a new learning environment that nurtures curiosity and calls for a more unified approach to development of mind-body-morality, aspects that are fundamental to the NEP. The six free electives introduced in the curriculum creates options for engineering students in different branches to get Honors in Product Design or Minor in a different branch of engineering or science. A school structure can provide the right learning environment and tight integration of interdisciplinary content at the program level to enhance learning experience of students. It will avoid the risk of proliferation of departmental silos as single stream institutions such as IIITDM seek to create multi-disciplinary environments.

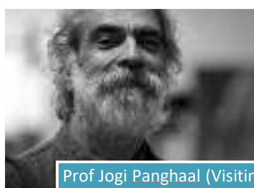
Appendix-1

Constitution of the BoG sub-committee:

1. Prof. G. Venkatesh, Chairman (Senate member)
2. Mr. Krishna Giri, Member (BoG member)
3. Dr Anand Lakshmanan, Member (Senate member)
4. Dr. Raja B, Member (HoD, Dept of Mechanical Engg)
5. Dr. Binsu K, Member (Dean, Academic & Dept of ECE)
6. Dr. Raguraman, Member (Asst Prof., Dept of Mechanical Engg)
7. Dr. Jayachandra Bingi, Member (Asst Prof., Dept of Physics & Founder, BiRD Lab)
8. Special Invitees associated with Interdisciplinary Projects:
    1. Dr Noor, Dept of CSE
    2. Dr Tapas Sil-HoD, Dept of Physics
    3. Dr Nachiket Khare, Dept of Maths
    4. Dr Pandiyarasan, Dept of ECE, DST-INSPIRE
    5. Dr Karthicnarayanan, Consultant to MaDeIT, Visiting Faculty & Formerly with SUTD
9. Dr Sudhir V, Convener (Dean, Design, Innovation, Incubation)

Expert Panel from Academia and Industry


Prof AG Rao, Ex-faculty, IDC IITB (NID)


Prof Jogi Panghaal (Visiting Faculty, NID)


Prof. Balaram, Director SCID (Formerly with NID)


Mr Jinan, EKF (NID)


Prof. B Ravi, IITB


Prof. Srikant V, IITM-ED


Dr Shankar V, MRV


Mr Sathiya Seelan, Ashok Leyland (IDC, IITD)


Ms Revathi Kant, CDO, Titan


Mr Naren Ghate, CDO,Tata Elxi (IDC, IITB)


Mr Kumaradevan, CIO, Saint Gobain


Mr Abhik Chatterjee, Head of Digital, BCG

Appendix-2: Minutes of external consultations

IIITDM Design Spine: Consultation with NID/IDC design experts

Date: 04 Jul 2020, Time: 5-6 pm, Google Meet

Participants:

1. Prof. AG Rao, Ex-faculty, IDC, IITB
2. Prof. Jogi Panghaal, Visiting Professor, NID
3. Prof. Balaram S, Director, Sasi Creative Institute of Design, and formerly with NID
4. Mr Jinan Kodapully, Adjunct Faculty, IDC-IITB, NID alumnus & Founder, EKF
5. Prof. G Venkatesh, Chairman, IIITDM BoG sub-committee
6. Dr Anand Lakshmanan, Member, BoG sub-committee & Senate Member, IIITDM
7. Dr Jayachandra Bingi, Member, BoG sub-committee, Asst Prof, Physics
8. Dr Sudhir Varadarajan, Convenor, BoG sub-committee and Dean (Design, Innov, Incub)

Prof. Venkatesh welcomed the design experts and thanked them for sparing time for this important consultation on the future of design in IIITDM. Dr Sudhir then made a brief presentation on the current state, challenges, future aspiration, and possible programs (IIITDM-DesignSpine-Consultation-4Jul2020.pdf) and invited suggestions from experts. The key suggestions of experts are summarized below.

1. Design-centricity: creating a culture of learning & responsiveness to the context

Expert	Observations
Prof. AG Rao	1. Introducing design means creating a strong culture of learning. It is not about addition or removal of some courses 2. The guiding principles that created the NID culture (1-1 faculty-student interaction, small class size, studio environment) may not be feasible in many engineering institutions (Prof. Rao highlighted experiences in IITG, IISc, IITD and IITB). There are fundamental differences in the way engineering disciplines approach learning when compared to design 3. A lot of time must be spent by the faculty in engaging with students, motivating them to become self-directed learners; instead of using attendance or excessive testing. Assessment methods, attendance rules etc. need to be looked at for design
Prof. Balaram S	4. Design is a culture to be nurtured. It is important to nurture creativity, originality, courage to be stupid, questioning status quo right from the beginning (undergraduate and even school levels). Design should be treated as complementary to the knowledge of engineering and not as competing knowledge 5. The focus must be on “Thinking Design”, which is different from Design Thinking (the process). Thinking design is an attitude of "Why" while Design thinking is a process of "How" that follows from the former. Thinking design is about becoming responsive to the local and global contexts 6. While there is a growing interest in learning, the aspect that is often forgotten is the need for unlearning the rigidities developed in the 10+2 schooling process. A good foundation program is required to facilitate this

Prof. Jogi Panghaal	7. It is important to create an immersive thinking and learning culture. First create a Space to work in. 8. It is important to nurture the values of exploration and experimentation right from the beginning (UG level); Courage to think differently, be stupid, without being taunted by teachers and peers 9. Logic emerges from exploration. Allow the ideas to flow by making the thoughts run wild. Here there should not be any thought that is termed as a stupid idea - every thought is welcomed; this phase is the "Creative thinking phase". Once the bucket of ideas is filled up, and the paper is all filled up with the "wild-thoughts" then start working on rationalizing and logically connecting the ideas and refining the ideas. This is a sort of "Logical/rational thinking phase" 10. It is important to ensure that the engineering mindset and environment (one right answer, shooting down ideas as impractical, etc.) does not stifle this process of exploration
Mr Jinan Kodapully	11. Engineering institutions essentially have a teaching environment, whereas design is about creating a learning environment. 12. There is need for a strong foundation program to shift students from a tutored setup to an independent learning environment

2. Integrating design and engineering

Expert	Observations
Prof. AG Rao	1. Design faculty may not have specific knowledge of different domains. There is an opportunity for design faculty to work with engineering faculty to develop domain specific frameworks 2. Consider a workshop model where faculty from outside co-teach with IIITDM faculty. Two faculty from within IIITDM across disciplines could also get together and run the workshop
Prof. Balaram S	3. Design and Engineering are complimentary. Every course must have faculty from both the Design and Engineering domains come together and in that way, the domain requirements for each course could be built into the course 4. Getting more projects from the industry will help align the faculty and the students to emerging requirements and help dissolve the differences between industry and education
Prof. Jogi Panghaal	5. It may be useful to look at engineering education in a different way. Engineering as an input to design

3. M.Des / PhD programs and research areas

Expert	Observations
Prof. AG Rao	1. IIITDM must consider starting a MDes program. It will help in developing a core group of faculty 2. A good way to start a M.Des program is to understand the problems in the present models, especially w.r.t enabling self-directed learning 3. Design faculty need to work with industry professionals to develop new frameworks. There is not much happening in this space even in PhD research in India. Current PhD work in design may not be valuable for practitioners. IIITDM

	may consider addressing this
Prof. Jogi Panghaal	4. Mission to produce new knowledge should be the driving force for M.Des or PhD programs. 5. Undertaking challenging client projects can drive this activity. 6. Understanding the state of the art globally will be important while launching new programs
Mr Jinan Kodapully	7. M.Des programs are supposed to produce students who can respond to emerging contexts. It is the student and faculty projects that create the state of the art. 8. If the M.Des program is designed to enable learning, then it can always remain fresh in relation to the emerging context, unlike other programs that depend on a refresh of the knowledge base

4. Creation of a core group of faculty and the case for an independent centre

Expert	Observations
Prof. AG Rao	1. Important to create a core group of faculty, and a separate centre with autonomy to pursue the goal of creating a learning culture 2. Introducing a MDes program can help attract faculty. 3. Given our recruitment norms (PhD etc) this becomes difficult to do, so it must be given specific attention. Some workarounds will be required to attract good faculty who may not have a PhD degree. 4. Industry experts may be brought in as visiting faculty. However, the centre cannot run on visiting faculty alone. The internal core group of faculty must be the link between visiting faculty and the centre/students. Otherwise, it will be ineffective

The meeting concluded with Prof. Venkatesh and the IIITDM team thanking the expert panel for their valuable suggestions. Prof. Venkatesh also highlighted that the suggestion made by Prof. AG Rao to start the consultations with the design experts before speaking to the industry and engineering design experts, has indeed proven useful in grasping the essence of design-centricity. It was also indicated that post assimilation of the expert suggestions and consultations with other experts, a second round of consultation will be organized in 2 weeks to validate possible directions for IIITDM.

IIITDM Design Spine: Consultation with Prof. Ravi B, IITB

Date: 08 Jul 2020, Time: 11-12:15 hrs, Google Meet

Participants:

1. Prof. Ravi B, Dept of Mechanical Engineering, IITB, Founder BETIC and Head of Desai Sethi School of Entrepreneurship
2. Prof. G Venkatesh, Chairman, IIITDM BoG sub-committee
3. Dr Jayachandra Bingi, Member, BoG sub-committee, Asst Prof, Physics, IIITDM
4. Dr Karthicnarayanan, Spl Invitee, BoG sub-committee, Consultant, MaDeIT
5. Dr Sudhir Varadarajan, Convenor, BoG sub-committee and Dean (Design, Innov, Incub)

Dr Sudhir and Prof. Venkatesh welcomed Prof. Ravi and thanked him for sparing time for this important consultation on the future of design in IIITDM. Dr Sudhir then made a brief presentation on the current state, challenges, future aspiration, and possible programs (IIITDM-DesignSpine-Consultation-4Jul2020.pdf). The key suggestions made by Prof Ravi are summarized below.

1. **Strong case for persisting with the focus on design-centric engineering**
    a. There is a broad acceptance in Government that we are in the age of design (after IT/Biotech). Industry and academic institutions are also realizing this. However, it may not have yet manifested into the demand on the ground. There are a few cases such as IIT Hyderabad, where design talent is commanding better premium than CSE
    b. The changes triggered by the pandemic and the backlash against Chinese products does create an opportunity for Indian manufacturing companies and MSMEs (indigenization). Design is critical to realize such opportunities. Example of pocket transistor (Chinese brands)
    c. IIITDM already has “D” embedded in its name and must try to leverage this. It is important to convince all key stakeholders – faculty, students, parents, industry. And the location advantage (Chennai 600127 / STD code: 044) must be exploited in brand building. Increased outcomes in terms of patents, startups, and industry case studies will help develop the brand
2. **Improve engagement with industry and align with market requirements**
    d. IIITDM can target different types of companies – manufacturing companies like M&M, offshore centres of MNCs like GE, Engineering services divisions of Indian IT companies
    e. One way of targeting these companies is to offer certificate programs (2 day or 1 week) and then translate them into consulting opportunities. And involving in these projects will help faculty and students get exposure to real-world problems. The case studies created based on these projects are also helpful.
    f. Indian MSMEs differently abled when compared to MSMEs in countries like Germany. However, there are opportunities for Indian MSMEs to contribute to indigenization. Example, in ventilators there is an opportunity to indigenize the propulsion valves that may require strong inter-disciplinary design expertise – mechanical, electronic, manufacturability, aesthetics, etc. Today, there may be companies that either address mechanical aspects or electronic aspects. If IIITDM must explore opportunities to develop such integrated solutions. These can be powerful case studies that create strong visibility in the market

g. Government initiatives: The pandemic is driving attention towards 'essential sectors' including Healthcare, Agriculture, EduTech and services (logistics, sanitation, etc.). IIITDM can explore these opportunities

3. Digital is going to create new opportunities

h. Important for the institute to exploit the opportunities emerging from digital, pandemic, and geopolitical (US visa restrictions, anti-China sentiment)
i. Majority of IT talent pool sitting in India – creates new opportunities for development of local applications (replacing say Chinese apps). And this calls for better design (UI, UX) in addition to domain skills (coding and English).
j. New opportunities for automation in manufacturing / work and learning (pedagogy)

4. Curriculum design and trade-offs

k. Curriculum must be driven by the market requirements. It will good to speak to many professionals / companies – not only those who are currently engaged with the institute, but a much wider group.
l. It may also be useful to undertake a survey on specific points – what topics need to be covered, how it needs to be taught, etc. (IITB has done something like for the new entrepreneurship program)
m. Curriculum structure could be looked from two perspectives: (1) Basic Sciences, Engineering, Technology, Application/domain; or (2) a competency model - Knowledge, skills, mindset, network & resources.
n. Mini-projects and final project must be team-oriented and promote inter-disciplinary skills
o. It may be useful to look at trade-offs in the curriculum by starting with 50:50 and then move in different directions depending on the feedback from survey/ stakeholders and need.
p. Problem based learning could go top down - start with immersion in the problem context (outside the classroom) to understand the Function (requirements/ specifications). Then explore Form (by design), Fit (by manufacturing), and Behavior (by testing, check if it matches the original intended function) – thereby completing the circle/iteration. The sequencing of these components can be aligned with the industry. Apart from the design courses, the entrepreneurship and management courses are also important. Since IIITDM already has this, they can build on it.

5. IPR

a. IPR and commercialization (licensing) policy for corporates, startups may be articulated as part of this review.
b. Far more focus must be there on patents & startups. This will help improve visibility of the institute

6. Input

a. Leverage "Chennai" location in communications to attract better quality students
b. Separate entrance for admissions for experienced professionals (2 years after graduation) for masters programs. Mixing such candidates with regular students can enhance quality

7. Creating a faculty pool & organization structure

a. It is critical to have critical mass of faculty to drive the vision. Structure may be required, but whatever structure is adopted it must be loose and encourage collaboration.
b. Important to ensure that faculty engage in interdisciplinary work. Faculty may not sit dept wise, but random. Mutual discussions of different stream people must happen. Some of the

new IITs like IIT Gandhinagar, IIT Hyderabad, IIT Jodhpur are creating new physical infrastructure for collaboration among faculty – common lounge

c. It may be useful to consider appointing Professor of Practice for experienced industry professionals without PhD (20 years-experience at CXO level equivalent to Professor of Practice, and 10-15 years for Associate Professor of Practice)
d. Important to get many external experts (from various fields) to visit the institute on a regular basis to create a vibrant ecosystem

The meeting concluded with Prof. Venkatesh and the IIITDM team thanking Prof. Ravi for his valuable suggestions. It was also indicated that post assimilation of the suggestions and consultations with other experts, a second round of consultation will be organized in 2 weeks to validate possible directions for IIITDM.

IIITDM Design Spine: Consultation with Prof. Srikant Vedantham, IITM

Date: 09 Jul 2020, Time: 11-12:00 hrs, Google Meet

Participants:

1. Prof. Srikant Vedantham, Dept of Engineering Design, IITM
2. Prof. G Venkatesh, Chairman, IIITDM BoG sub-committee
3. Dr Jayachandra Bingi, Member, BoG sub-committee, Asst Prof, Physics, IIITDM
4. Dr Sudhir Varadarajan, Convenor, BoG sub-committee and Dean (Design, Innov, Incub)

Dr Sudhir and Prof. Venkatesh welcomed Prof. Srikant and thanked him for sparing time for this important consultation on the future of design in IIITDM. Dr Sudhir then made a brief presentation on the current state, challenges, future aspiration, and possible programs (IIITDM-DesignSpine-Consultation-4Jul2020.pdf). Prof. Venkatesh requested Prof. Srikant’s views on three key questions: (a) the product and engineering design content for engineers; (b) demand and positioning of design-centric engineers (design minors); and (c) directions for M.Des/PhD programs. The key suggestions made by Prof Srikant are summarized below.

1. **Product and engineering design content for engineers**
    a. There is a challenge in converting science-driven engineers (one problem, one right answer) to design-centric engineers (open-ended, multiple answers). There is a danger that people may end up as tinkerers instead of internalizing the discipline of dealing with open-ended problems
    b. It will be useful if students in small teams are given a few mega challenges (full system design like EV, etc.) at the beginning of first year, and then all the courses are aligned to help them tackle these issues. This has been done in some institutions. It demands a high level of alignment among faculty / courses.
    c. Reducing the content of product design as suggested in the consultation document might help. However, this must be compensated by increased the design component in engineering courses.
    d. It is possible to add design component in the existing courses, syllabus, and work with existing textbooks. For instance while teaching fluid dynamics or control systems, one can start by introducing some real-world case studies in the beginning of the course; add 20%

weightage in the theory courses for design projects. If a lab is coupled with the theory course, it could be used to help students (in groups) to prototype/manufacture the design - 30% weightage in lab course can be for this type of activity; content from existing textbooks may have to be used in a non-linear way depending on the design issue being dealt with. It has been noticed even weaker students tend to do well in this approach. They understand the difficulty in prototyping. There may be a case to write a textbook for this type of approach.

e. It may be useful to mandate the design component in the course syllabus so that anyone delivering the course can follow it. The process can be adopted in a few courses to begin with and slowly extended to others.

2. **Demand and positioning of design-centric engineers**
    a. It is worthwhile to give a choice for students with strong design-orientation to get a minor in design
    b. Useful to promote a separate cohort that is more design-centric engineers (who can bridge the gap with product designers or can potentially take up product design roles), even though there appears to be no explicit value placed by the industry on such talent at this point. Industry might visit NID for industrial designer or IIT for engineer. It depends on the maturity in the industry and senior leadership mindset and may take time.
    c. It will be useful to involve industry closely in the development of such cohort. And this could be combined with the PG/PhD programs that are industry oriented.
3. **Directions for PG/PhD programs**
    a. It will depend on the faculty group and their interests. Need special mindset for interdisciplinary design work
    b. Interdisciplinary design research must be encouraged. Institute could incentivize two faculty from different disciplines to jointly guide a student in an inter-disciplinary area

The meeting concluded with Prof. Venkatesh and the IIITDM team thanking Prof. Srikant for his valuable suggestions. It was also indicated that post assimilation of the suggestions and consultations with other experts, a second round of consultation will be organized in 2 weeks to validate possible directions for IIITDM.

<u>IIITDM Design Spine: Consultation with Mr Narendra Ghate, Tata Elxsi</u>

Date: 09 Jul 2020, Time: 15-16:00 hrs, Google Meet

Participants:

1. Mr Narendra Ghate, Chief Designer, Tata Elxsi
2. Prof. G Venkatesh, Chairman, IIITDM BoG sub-committee
3. Dr Jayachandra Bingi, Member, BoG sub-committee, Asst Prof, Physics, IIITDM
4. Dr Sudhir Varadarajan, Convenor, BoG sub-committee and Dean (Design, Innov, Incub)

Dr Sudhir and Prof. Venkatesh welcomed Mr Narendra Ghate and thanked him for sparing time for this important consultation on the future of design in IIITDM. Prof. Venkatesh requested Mr Ghate’s views on three key questions: (a) the product and engineering design content for engineers; (b) demand and positioning of design-centric engineers (design minors); and (c) directions for M.Des/PhD programs. The key suggestions made by Mr Ghate are summarized below.

1. **Design could help develop creative confidence of engineers**
    a. Strong communication skills: One of the key things that designers are exposed to during their education is "to defend their designs in front of the jury", handle tough questions on the why, what, how aspects relating to their concept. Creating opportunities for students to do this multiple times during their education helps designers develop strong communication skills (oral and presentation).
    b. Creative confidence: Designers are confident in taking key decisions when compared to engineers. Engineers need to develop this confidence instead of waiting for instructions or having all the details. This quality is critical to reduce delays.
    c. More emphasis on soft skills in design thinking: In the curriculum it may be useful to tilt that balance towards developing soft skills as opposed to getting the prototype/PoC right. The latter may be challenging and might discourage students from developing the well-rounded design thinking capability.
    d. Also, students must be encouraged to avoid the trap of being influenced by tools, and navigating towards what is easily achievable, but instead focus on what is desirable.
    e. In the industry, this problem is handled by separating the mockup/look and feel from the actual PoC. The mockup will be a simulation of the ideal solution, whereas the PoC may demonstrate one or two key features.
    f. It is important to de-emphasize the connection between aesthetics and design. For example, the two aspects of sketching – sketching/doodling to think vs sketching to communicate. The former aspect is an important soft skill for a designer
    g. Studio environment, learning through interaction with seniors, working in teams are critical to develop well rounded designers – who understand that they cannot do everything by themselves and need to collaborate, listen better, etc.
2. **Demand and positioning of design-centric engineers**
    a. There is demand for engineers with creative confidence. However, this may not be explicit at the entry level or in the recruitment process or show up in terms of entry level salaries. There is no doubt that engineers with design orientation can do well in their careers and add value to projects lot more. Case of Apple: Apple does not have more designers compared to Samsung. However, Apple has more engineers who understand design. That is their key differentiator.
    b. A young designer can demonstrate value to clients when he can combine his design expertise with an understanding of user/customer/market context. This is where some exposure to management courses might also help a designer. A design-engineer with this orientation will be valuable.
3. **Directions for PG/PhD programs**
    a. M.Des must be focused on developing design competence, not engineering. Exposure to photography and film making and similar diverse activities is important. Mixing it with engineering may not be desirable as it may end up producing rigid designers. A designer + engineer combo does not work at PG level. Engineers will need a lot of unlearning before they become good designers.
    b. Digital is an important area for designers – UI/UX. But, there are two levels here: (i) where the core framework is creatively designed, which could be 5% of the screens – this is where a designer is required; and (ii) where a template driven approach is applied

to standardize the remaining 95% of the application – this is where engineers with design exposure can play a role.

c. In an environment like Tata Elxi (design services), there is demand for project/program managers who can understand and manage design projects. There is a larger requirement of management competence for managing design teams. However, in organizations that develop their own products, there will be need for product managers. Typically, engineering managers or senior designers tend to get into these roles. Entry level engineers or PGs cannot add much value here.
d. Research in design can look at three avenues: (i) understanding of AI, interpretation of data, prediction or forecasting brands etc.; (ii) AI in design – automated creation of new adverts/presentation based on user preferences; (iii) ergonomics, anthropometric data, user engagement in autonomous cars etc.

The meeting concluded with Prof. Venkatesh and the IIITDM team thanking Mr Ghate for his valuable suggestions. It was also indicated that post assimilation of the suggestions and consultations with other experts, a second round of consultation will be organized in 2 weeks to validate possible directions for IIITDM.

<u>IIITDM Design Spine: Consultation with Ms Revathi Kant, Titan</u>

Date: 10 Jul 2020, Time: 15-16:00 hrs, Google Meet

Participants:

1. Ms Revathi Kant, Chief Design Officer, Titan Company Ltd
2. Prof. Venkatesh G, Chairman, IIITDM BoG sub-committee
3. Dr Raguraman, Member, BoG sub-committee
4. Dr Jayachandra Bingi, BoG sub-committee
5. Dr Sudhir Varadarajan, Convenor, BoG sub-committee and Dean (Design, Innov, Incub)

Dr Sudhir and Prof. Venkatesh welcomed Ms Revathi and thanked her for sparing time for this important consultation on the future of design in IIITDM. Dr Sudhir explained the background and requested Ms Revathi's views on three aspects: (a) design-centric engineering; (b) digital and design; and (c) focus areas for M.Des/PhD programs. The key observations made by Ms Revathi are summarized below.

1. **Case for design-centric engineering**
    a. This is really the need of the hour. There is need for more engineers who understand design and can bridge the gap between design and engineering to speed up new product development. This gap is today handled through different coordination mechanisms and is not smooth. In countries like China we seem to notice a more seamless process.
    b. IIITDM's design-centric engineers could be positioned to address this gap. It can be a differentiator. The institute must position itself effectively and reach out to the industry
    c. While the basic knowledge of design thinking process can be given to all (exposure to form, function, behavior, structure), those chosen for a minor must be able to think like designers, which means a strong appreciation of the user/customer context

2. **Digital and Design**
    a. Interaction design is an area that has much demand. It requires visualization (design) and coding (engineering) skills.
3. **Directions for PG/PhD programs**
    a. The number of institutions that offer M.Des program is still relatively small. There is may be scope for IIITDM to enter this space
    b. The program can be open for all (students & experienced professionals; different disciplinary backgrounds – engineering, architecture)
    c. The program must emphasize the complete cycle of design and aim to produce a full-fledged designer who can conceptualize and realize. The institute could consider specialization in different domains depending on the market / gaps
    d. PhD program must be more focused on design and innovation. Design-management could be a good area for PhD research.

The meeting concluded with Prof. Venkatesh and the IIITDM team thanking Ms Revathi for her valuable suggestions. It was also indicated that post assimilation of the suggestions and consultations with other experts, a second round of consultation will be organized in 2 weeks to validate possible directions for IIITDM.

IIITDM Design Spine: Consultation with Mr Kumaradevan, Saint Gobain

Date: 10 Jul 2020, Time: 14-15:00 hrs, Google Meet

Participants:

1. Mr Kumaradevan G, Chief Information Office, Saint Gobain Inda Pvt Ltd
2. Prof. Venkatesh G, Chairman, IIITDM BoG sub-committee
3. Dr Raja B, Member, BoG sub-committee and HoD, Mech
4. Dr Karthinarayanan, Spl Invitee, BoG sub-committee
5. Dr Sudhir Varadarajan, Convenor, BoG sub-committee and Dean (Design, Innov, Incub)

Dr Sudhir and Prof. Venkatesh welcomed Mr Kumaradevan and thanked him for sparing time for this important consultation on the future of design in IIITDM. Dr Sudhir explained the background and requested Mr Kumaradevan's views on three aspects: (a) Saint Gobain's experience with IIITDM alumni; (b) digital orientation for engineers; and (c) scope for M.Des program. The key observations made by Mr Kumaradevan are summarized below.

1. **Experience with IIITDM alumni**
    a. The experience with IIITDM alumni has been good. About 7 have been recruited so far. In terms of both caliber and outlook, they are in the top bracket among all the engineers that Saint Gobain recruits.
    b. Saint Gobain is a process industry, and there are have not been many avenues to observe and comment on the design capability of IIITDM students. However, in the few cases where they were asked to build solutions for their plants (wireless hardware solutions), they have done a good job in terms of selecting appropriate components, working with vendors, engaging customers and delivering on time. IIITDM students have demonstrated the ability to assimilate process knowledge and collaborate with multi-cultural teams. Self-starting and entrepreneurial.

c. While they are good at managing the requirements and developing the prototype/solution, there is scope for improvement in final communication and presentation skills – presenting the case, and connecting with the audience
d. Aspects such as aptitude and peripheral vision of students are important for recruiters. The flexibility that appears to be there in the present curriculum (courses, internship, etc.) is useful. Happy with the type of projects that students presented during the industry open-house (EHIPASSIKO). These are similar to the ones they are pursuing as part of digitalization in manufacturing.
e. More depth in core engineering courses like VLSI or Fluid mechanics may be required for product / component manufacturing firms when compared to a process firm like Saint Gobain. A curriculum like smart manufacturing may be more suited for Saint Gobain's requirement.

2. **Digital orientation for engineers**
   a. There is need for stronger data management capability among engineers (exposure to relational databases, tools like SQL, handling industry scale data, etc.)
   b. Another area is data analytics and data visualization. Knowing basic things like which representation would be appropriate for which type of data is important. Also, UI/UX mainly for presenting data in HMI to user groups who are usually operators / shop floor workers – understanding the best way to communicate to such groups through different types of signs
3. **Directions for PG/PhD programs**
   a. Industry may be more interested in experienced M.Des professionals than freshers. It may be a good idea to position it as an upskilling opportunity for experienced professionals

The meeting concluded with Prof. Venkatesh and the IIITDM team thanking Mr Kumaradevan for his valuable suggestions. It was also indicated that post assimilation of the suggestions and consultations with other experts, a second round of consultation will be organized in 2 weeks to validate possible directions for IIITDM.

IIITDM Design Spine: Consultation with Mr Sathiya Seelan, Ashok Leyland

Date: 11 Jul 2020, Time: 11-12:00 hrs, Zoho Meet

Participants:

1. Mr Sathiya Seelan, Head of Styling, Ashok Leyland Ltd
2. Prof. Venkatesh G, Chairman, IIITDM BoG sub-committee
3. Dr Raguraman, Member, BoG sub-committee
4. Dr Sudhir Varadarajan, Convenor, BoG sub-committee and Dean (Design, Innov, Incub)

Dr Sudhir welcomed Mr Sathiya Seelan and thanked him for sparing time for this important consultation on the future of design in IIITDM. Dr Sudhir explained the background and requested Mr Sathiya Seelan's views on three aspects: (a) industry demand for designers; (b) Case for MDes program; and (c) focus areas for design research. The key observations made by Mr Sathiya Seelan are summarized below.

1. **Strong demand for designers and design-centric engineers**
    a. There is good demand for designers, and firms are willing to pay premium for design talent. There is strong demand for UI/UX talent in Chennai / India. Ashok Leyland itself has a standing demand for 3-4 designers every year. However, right now it is a chicken and egg problem. While firms such as Ashok Leyland, Royal Enfield, Bharat Benz have in-house design teams in Chennai, other OEMs such as Ford, Isuzu, BMW, Hyundai, etc. have their design centers outside India. One of the reasons is the shortage of design talent in Chennai / India. This situation is likely to change given that Government is encouraging firms to setup their R&D activities in India, and firms such as Hyundai are considering setting up design studio in Chennai. Many more will follow suit. Important to create a network that helps design talent to connect with industry demand.
    b. Government is also encouraging starting design courses in premier institution, example B.Des in IITD. Right now there are very few institutions that produce good design talent (NIDs or IDC in IITB). Private institutions such as VIT, SRM may have such programs, but they are not comparable.
    c. A more fundamental reason why India needs design talent is that there are many problems in India that need localized and contextual solutions. For instance, there is a huge market for commercial transport. One of the key behaviors of truck drivers is to cook food inside the cabin, next to the engine. Solutions designed in Germany by Germans cannot factor such local requirements and will end up as force fits to a context and are never comfortable. While some work is happening UI/UX area, there is need for focus on interface between man and machine. Today product design, interior design, etc. is mostly done by engineers and graphic designers (from places like Loyola). This is not appropriate. Design will also be critical for revival of MSMEs. It is important to create awareness for market centric design.
    d. It is good to introduce a dose of design for engineers or even other disciplines at undergraduate level (or even offer a minor like in Stanford). Need to prepare engineers for design – beyond say mechanical engineering – this can help bridge the gap between designers and engineers, which is a key challenge in industry.
2. **M.Des Program**
    a. We must not mix up design and engineering in M.Des. We must bring-forth the creative and artistic ability of the designer. Salary is tied to this creative ability
    b. Important to have a strong selection process at entry level to identify people with creative background (with or without experience). The person must essentially be a dreamer, explorer, can make fearless entry into the future
    c. M.Des program must be generic and flexible (around Product Design) – students can be allowed to develop their specialization / interests in areas like UI/UX, mobility, leather, footwear, furniture, etc. – related to local industries. Can help bring industry people in these areas and cultivate a network
    d. Design in an online world will be a new challenge. Soft skills in design can be imparted through online interaction. However, there are aspects of design that need physical interaction/context.

3. **Focus areas for design research**
    a. Design research is different from design in engineering. Design is to simplify human life through a deep understanding of the context and localized solutions
    b. Design research must focus on delivering a new product (innovation) and has direct relevance to industry.
    c. Design research may focus on gaps where design can make a difference (related to 1.c). For instance, delivering experience design in areas like urban planning and transportation (direct policy impact)

The meeting concluded with Prof. Venkatesh and the IIITDM team thanking Mr Sathiya Seelan for his valuable suggestions. It was also indicated that post assimilation of the suggestions and consultations with other experts, a second round of consultation will be organized in 2 weeks to validate possible directions for IIITDM.

<u>IIITDM Design Spine: Consultation with Dr Shankar Venugopal, M&M</u>

Date: 11 Jul 2020, Time: 16-17:00 hrs, Microsoft Teams

Participants:

1. Dr Shankar Venugopal, VP & Dean, Mahindra Technical Academy, MRV, M&M
2. Prof. Venkatesh G, Chairman, IIITDM BoG sub-committee
3. Dr Binsu, Member, BoG sub-committee
4. Dr Raja B, Member, BoG sub-committee
5. Dr Sudhir Varadarajan, Convenor, BoG sub-committee

Dr Sudhir welcomed Dr Shankar and thanked him for sparing time for this important consultation on the future of design in IIITDM. Dr Sudhir then provided a quick background and requested Dr Shankar's views on (i) design-centric engineering, (ii) M.Des in design, and (iii) PhD in design. The key observations made by Dr Shankar are summarized below.

1. **Design exposure for engineering students with the objective of enhancing their creativity**
    a. Industry needs Innovative Engineers who can understand customers, define the right problems, and think out-of-the-box – hence there is a definite demand. Engineers who are Innovators and Design Thinkers are highly valued by the industry as they can create differentiated products and enable business growth. Industry needs engineers who have both technical depth and breadth – a mechanical engineer needs to know basics of electrical, electronic domains
    b. M&M has about 3000 engineers in their R&D centre in MRV (the vehicle design team sits in Mumbai). Recognizing the importance of design for engineers, M&M trains all their engineers in product design. This is done through a blended learning model that includes online courses with assessment, interactive sessions with practitioners, and a mini project guided by a mentor. This model (implemented for last 2 years) is helping a lot.
    c. There are two kinds of problems that engineers in M&M work on: (i) engineering problems where there may be one right answer, for example, optimizing strength of material. About 50% of problems fall in this bucket – a mainstream/regular engineer is

expected to handle this; (ii) design problems – where there is no one right answer. It may need an open mind, exploration, and iteration to arrive at a solution. These are the problems that have potential to deliver competitive advantage to the company. They require design-centric engineers. About 50% of problems fall in this category. An important capability of design-centric engineers is to understand customer needs (Rational, Emotional, Meaningful) and translate them into engineering problems. Design thinking skills are a must for this.

d. It may be difficult to cover the breadth and depth of both engineering and design in a four-year undergraduate program. This is only going to get more difficult in the future world of mobility, where a mechanical engineer is expected to have skills in electrical, electronics and computer programming and data analytics to participate in new product initiatives like Electric, Connected and Autonomous vehicles etc. M&M is piloting a couple of approaches with IITM and some younger IITs like Gandhinagar, Jodhpur to develop and attract the right type of talent for this emerging requirement. In IITM, Dr Shankar has piloted a model that engages a group of students across the four years – starting with problem identification in the first year, ideation in the second year, prototyping in the third year and business case preparation in the fourth year. These are facilitated through a series of workshops and involve interdisciplinary teams. Some of the ideas that have emerged from this process have translated into startups. This type of engagement over four years is important. IIT Jodhpur has piloted a product focused course. Example developing competency in EV by exposing engineers to inter-disciplinary design covering aspects of electrical, mechanical, chemical engineering and data analytics, etc. M&M has also found that students recruited from IISc CPDM seem to fit their requirement well. These students do a regular four year-engineering program and then work for two years before doing a two-year Masters program from IISc (in essence a 6+2 = 8 year maturing process).

6. Post-Graduate Program – M.Des – Dual Degree Program with Design Specialization

a. 4 + 1 year (Dual Degree) allows IITDM to cover a full-fledged engineering core courses and offer Design courses right from the first year (this is not possible in a 4-year course)
b. Introduce Industry specific electives in the 4th and 5th year
c. Provide industry exposure to faculty and students – summer internships for students, mini sabbaticals in the industry for faculty, invite industry expert talks for all courses etc.
d. Encouraging students to participate in hackathons will also hone the design skills of students. This kind of experience will be valued by the industry.
e. Preparing students to tackle design challenges of MSMEs means getting them to deliver on day-one, when compared to a corporate environment where they may get some more time. This may also be similar in the case of startups.

7. Ph.D Program in Design

a. Research in design is important, but it is better done in collaboration with industry. Identifying the right problems at the time of candidate selection will be useful - Industry problems in Interdisciplinary areas – cross-departmental Ph.D
b. Co-Guide from the Industry
c. Industry sponsored Ph.D (like Prime Minister Fellowships)

8. Digital and Design

   a. Digital (data-insights-strategy-growth framework of M&M) is being used to address key challenges in (i) product development – system or architecture level decisions; and (ii) create space for engineers to iterate and do divergent thinking instead of converging to a solution quickly

9. **Guidance on curriculum design & implementation**
   a. There must be enough flexibility in a four-year curriculum to allow students to explore rather than converging quickly to a discipline – choice based credits (Example of KidZania (Mumbai) that allows children to explore different career paths through role play).
   b. Look at blended learning to help students to mix and match – students can take other discipline courses through online electives
   c. It is important for faculty to practice what they preach. Can we practice Design Thinking in the way we design and offer the course – by giving enough space for exploration & experimentation – by allowing students to custom-design their learning in a step-by-step manner. Proximity to industry must be leveraged to identify and focus on specific segments, interact with experts, etc.
   d. Dr Shankar offered to help from M&M perspective as well as provide connects to CII CTO forum so that IIITDM could also reach out to leaders from different industries/startups.

The meeting concluded with Prof. Venkatesh and the IIITDM team thanking Dr Shankar for his valuable suggestions. It was also indicated that post assimilation of the suggestions and consultations with other experts, a second round of consultation will be organized in 2 weeks to validate possible directions for IIITDM.

<u>IIITDM Design Spine: Consultation with Mr Abhik Chatterjee, BCG</u>

Date: 13 Jul 2020, Time: 11-12:00 hrs, Google Meet

Participants:

1. Mr Abhik Chatterjee, Managing Director, Centre for Digital in Oil & Gas, BCG
2. Prof. Venkatesh G, Chairman, IIITDM BoG sub-committee
3. Dr Binsu K, Member, BoG submittee
4. Dr Anand Lakshmanan, Member, BoG sub-committee
5. Dr Sudhir Varadarajan, Convenor, BoG sub-committee

Dr Sudhir welcomed Mr Abhik Chatterjee and thanked him for sparing time for this important consultation on the future of design in IIITDM. The key suggestions made by Mr Chatterjee are summarized below.

1. **Demand for designers and design-centric engineers**
   a. In terms of career paths for engineers, we see four directions today: (i) IT & ITES – 40-50% seem to go in this direction, with CS background & others as well; (ii) Manufacturing sector – about 50% - here the expectation is that engineers have some digital exposure like mobile app development, integration, data; (iii) higher education and deep tech like Robotics, Additive Manufacturing – about 5-7%; and (iv) consulting

b. What industry/recruiters look for in engineers, in the order of priority: (i) problem solving ability / adaptability (that comes through design thinking); (ii) technical depth (that comes through engineering fundamentals); (iii) perseverance, discipline, etc. (that is in some ways reflected in the scores/grades)

c. Three broad types of requirements for design engineers and designers in the industry:

   i. Product design (full cycle) – in two types of industries (manufacturing / operations technology domain – example, ABB, Schneider, Ericsson) and deep tech (example, Apple, Samsung, Google). In the case of manufacturing, digital is more leveraged to drive efficiency – good demand for engineers with system design, integration and data capabilities. The demand in deep tech is hot, and largely untapped;

   ii. Strategic design or human centred or experience design – largely in B2C segment – requirement for understanding customers, customer analytics, ethnography and designing solutions (say Apps with relevant functionality and technology to enhance stickiness). Design houses/agencies like Accenture Interactive, Deloitte, etc. play a key role and hire talent in this space;

   iii. UI/UX – this has now become a commodity with several Tier-2/3/4 players

2. Elements to be considered in curriculum design

a. There is a strong case for a curriculum that is focused on (i) Product Design and (ii) Experience Design at UG and Masters levels. A set of mandatory or electives courses could be considered to cultivate these two capabilities right from 2nd year (for UG). UI/UX type of skills can be acquired by students themselves.

b. There needs to be a two-way relationship between the curriculum structure (skeleton of courses) and the experience that a student gains through that. Typical competency maturity model – beginner (2-3 yrs experience), proficient (3-6 years, with specialization in a domain), advanced (6-9 years), and expert (10+ years with 75% work done in that specific area)

c. There is good demand for designers with M.Des qualification. If IIITDM is considering launching a M.Des then it should look at the type of specialization that will be needed 3-5 years down the line. Example, Auto, Retail, etc.

d. Process focused design-centric engineers and creative designers will face challenges in adapting to the outcome-based models in business. Some orientation in terms of the industrial context / management aspects might help.

3. Developing brand ambassadors, placement & internships

a. Influencing behavioral change among students will be challenging. Will be useful to understand what drives students' behavior – type of work (good & novel), brand, hygiene factors (salary, etc.)

b. Developing students as brand ambassadors needs focused effort. It can be a 18-24 month journey starting from 1st or 2nd year, and cultivating a channel that attracts the right students and aligns them with specific / priority collaborators

c. Placement depends a lot on institute's value proposition – what type of students is the institute producing and how well it fits the requirement of a company (fit for purpose). Industry partnerships may be required. Priority collaborations with industries, incorporating elements that are specific to their requirement

d. Students must have opportunity to have variety in their internship – say 2 internships (2-3 months each) so that they can explore and understand different paths. Scheduling them may not be a big issue.

The meeting concluded with Prof. Venkatesh and the IIITDM team thanking Mr Chatterjee for his valuable suggestions. It was also indicated that post assimilation of the suggestions and consultations with other experts, a second round of consultation will be organized in 2 weeks to validate possible directions for IIITDM.

IIITDM Design Spine: Consultation with IIITDM Alumni (2014-15 batches)

Date: 29 Jul 2020, Time: 19:00-20:30 hrs, Google Meet

Participants:

1. Prof. Venkatesh G, Chairman, IIITDM BoG sub-committee
2. Dr Raja B, Member, BoG sub-committee
3. Dr Karthicnarayan, Spl Invitee, BoG sub-committee
4. Dr Sudhir Varadarajan, Convenor, BoG sub-committee
5. Alumni members:

Mechanical	CSE	ECE
• Pramod Nareshkumar, 2013, Product Manager, Addverb • Sreyas Sriram, 2014, Associate Product Mgr, Atlan • Balasundar, 2014, Engineer, Brakes India • Sai Teja K, 2014, ONGC • Teja Balu, 2014, Team member, Digital Transformation, Saint Gobain • Rohan Sehgal, 2015, Team member, IS/Manufacturing, Saint Gobain • Kruphakar G, 2015, Team Member, IS/Manufacturing, Saint Gobain • Ashwinraj P, 2015, Design Engineer, MaDeIT • Venkatesh V, 2015, Engineer, Mercedes Benz R&D India • Rajkumar Reddy, 2015, Analytics Modeler, Ford India	• Vijay Raghavan, 2014, Software engineer, Trimble • Sowbarnika, 2015, Software Engineer, Amazon • Prathamesh N, 2015, Engineer, Mathworks	• Sushmitha Indurthi, 2014, Saint Gobain • Varshitha Bhavani, 2015, Titan

• Tejaswini Chatty, 2014, PhD Innovation Fellow at Dartmouth College • Sai Prasath, 2015, Grad admit • Rahul Narasimhan, 2016, Grad admit	• Aishwarya R, 2015, Grad student, Umass, Amherst • Shiv Vidhyut, 2015, Grad student, Univ of Columbia, NY • Nimhilkha, 2015 • Nitesh Narayana, 2016, Intern with AMD	• Abinaya S, 2015, PhD admit in Arizon State Univ • Vaishnavi V, 2015, Grad student, KTH Royal Inst of Tech, Sweden • Prabha Sahithi, 2016, admit in John Hopkins

Comments:

1. I see a lot of potential in this plan, and don't want to be unnecessarily skeptical. But anticipating some of the problems and preparing for them would help. The different terms used for the three categories of products may confuse students/recruiters. How do you plan to handhold the Design++ students? How do you ensure that engineering faculty do not take retaliatory actions against Design++ students – we have seen this happen in the past; and placement for the rest 80%?- Tejasvini Chatty
2. Shouldn't we have different degree names to differentiate the products? We need to emphasize the industry readiness of IIITDM students in terms of their ability to collaborate in teams; There is lot of potential in the design-centric model, for instance, I am seen as an out of the box thinker – Pramod
3. The proposal appears to be over ambitious? B.Tech could be differentiated, but how would you compete in M.Des with leading institutions – Balasundar
4. Handholding the Design++ students and having partnerships will be key for the success of this model. This can be a huge risk as well. – Rohan Sehgal / Pramod
5. It is important to provide visibility to students very early – what they will get by joining the Design++ stream – Abinaya
6. I think it looks good as a model and I'm optimistic about the learning experience, not so much about the placement/job front which will be quite difficult to crack and needs a lot of strategic partnerships and alumni relationships to be made/re-discovered. I feel ultimately, the quality of practice courses, assignments and Thesis/research prompts will make the difference – good Tas/Lab staff, access to tools, maker spaces, practice in basic electronics. – Sreyas Sriram
7. This is a good initiative. But, implementation challenges need to be addressed. For instance, labs need to be open for longer periods (in the night) for students, newer electives for computer engg students – Aishwarya R
8. It is an interesting proposal. I think switching of Sociology before Systems Thinking makes a lot of sense to me. I noticed a lot of shift in how I consumed the coursework before and after sociology. The foundation is also a great addition, as we've discussed, there is a real need for an

unlearning aspect as soon as you come to the institute just to undergo that shift in mindset. Either way, I see two major challenges with the current proposal: Immersion (design studio, access to tools, TAs) and Handholding (partnerships, industry centric workshops, placement) – Prabha S

9. We see companies now teaching design thinking to fresh and experienced engineers. The design courses in the current curriculum have put us in a better shape when compared to others – Rajkumar Reddy
10. The current program has been beneficial to me. I started in the Verification division and quickly moved into the patents division within the company. The exposure to design goes beyond entry level in the company – it helps in career progression – Venkatesh V
11. I'm already satisfied with the existing curriculum and practice. What I primarily learned is the approach to patience, observation, flexibility, and exploration. These qualities facilitated looking for tools/techniques needed for the problem on my own, even though not taught at IIITDM. I feel the condition is like how a snake has to wait till it digests its food. Reflection from this learning will take time, but the success will be different from others. By considering the points above, kindly suggest to me the need for new steps/ bifurcations for BTech?. – Ashwinraj P
12. I am currently doing Masters in Columbia Univ, NY which is known for entrepreneurship. The exposure to design-centric engg has been extremely beneficial for me; Also, while working as a placement coordinator we noticed that recruiters such as Paypal, Mathworks were very excited to hear about the product & design focus our curriculum gives – Shiv Vidhyut
13. The feedback I got from IISc CPDM (for internship) was that students from IIITDM are far better at adapting to the problem solving requirement – Sai Prasath
14. Yes, we are able to adapt better. For instance, I am a mechanical engineer, but able to manage in-house software development team for shopfloor applications – Rohan Sehgal/Kruphakar
15. Even though I have a ECE background, I could quickly adapt to the requirements of a manufacturing company because I always saw myself as an engineer who can solve problems rather than in a disciplinary perspective; It will be useful to bring industry people to handle courses, that can bridge the gap – Sushmitha I
16. It is not just for industry, but the training in systems thinking, dealing with open-ended problems in the 3rd semester, has subconsciously helped in adapting to a research environment. How do you plan to select the people for Design++ stream – Abinaya S
17. I noticed that students with some entrepreneurial orientation grasped the design courses pretty well compared to others – Teja Balu
18. Companies like Mathworks which are now into Model based design etc. are highly interested in IIITDM type of curriculum – Prathamesh D
19. Students will have to start looking at how they can tie/explore their own problem statements in the context of these courses for the PDP sessions to start making sense and to form the deeper understanding of the subsystem level architecture designing competency we sorely lack. The point where top-down and bottom-up learning meets is the context. If they can take the context they are exploring into any other environment and play around with looking at their problem in that scenario, the problems will start taking better shape. – Prabha

20. Compatibility in timetabling will be important for offering the electives – Nitesh N
21. Will the program allow for field testing of concepts?– Sushmitha
22. Important to have some intersection between courses – repeat the concepts in higher courses to ensure learning – Sai Prasath
23. A lot of engineering design work today is moving into digital platforms. Would the new curriculum provide exposure to digital tools like MBD (Simulink)? – Venkatesh V
24. A mandatory internship at the end of every semester will help students get good experience, especially those entering the Design++ stream – Varshitha B

IIITDM Design Spine: Consultation with IIITDM Faculty

Date: 30 Jul 2020, Time: 10:30-12:15 hrs, Google Meet

Participants:

1. Prof. Banshidhar Majhi, Director, IIITDM
2. Prof. Venkatesh G, Chairman, IIITDM BoG sub-committee
3. Dr Binsu K, Member, BoG submittee
4. All BoG sub-committee members (except Dr Anand Lakshmanan and Dr Karthicnarayanan)
5. About 40+ faculty members
6. Dr Sudhir Varadarajan, Convenor, BoG sub-committee

Comments:

- This is a good initiative that will advance the unique mandate of IIITDM and it is the moral responsibility of all faculty to support this initiative – Prof. Majhi
- We started with one model in 2009 (thin coat), and then added more design content in 2014 (thick coat). Now is the time to take it further. Important to ensure that students don't lose interest in design after the 2nd semester and compare themselves with NITs and other mainstream institutions. All faculty and departments need to embrace design – Dr Raja
- We can include engineering design content in 30% of engineering courses. However, it may not be forced on all faculty.
- The separation into three categories is good. Also, it gives choice to students. This is a good outcome– Dr Sivaselvan, Dr Sadagopan; The term "Interdisciplinary design" in orgn name is appropriate -- Dr Senthil
- The proposal has come out nicely. Faculty can involve themselves in design work and this will open up opportunities for consultancy work. Implementation is important – Dr Noor
- This is a good proposal and I fully support it. The earlier proposal was also based on external consultation, however, it could not be translated into effective actions – Dr Tapas
- It is in the right direction. We should implement and see the results. And since the specialized focus is on less than 20% of students, it should be manageable. It is important to create a design studio to support student work – Dr Naveen
- There is no continuity in the presentation – no discussion on the past, present and future. People like Prof Krishnakumar should have been consulted. NIDs are not the right institutions to consult. Concerned that it will create another silo/shield. Design is everywhere, why should there be a separate organization – Dr Timmaraju

- Instead of School of Interdisciplinary Design, we should call it as Dept of Product Design and Innovation; and it should be responsible for producing patents; the design courses for UG program should be introduced after third year; PG program is fine; PhD program should be narrow and specialized – Dr Sreekumar
- Doing puja at home is not the same as visiting a temple. A separate entity will help create a new culture, and it will be an open organization – those interested can contribute – Prof Majhi

Appendix-3: IIITDM Design Spine Courses & Syllabus

Undergraduate (B.Tech – Six Core Courses)

Semester 1:

Course Title	**Foundation for engineering and product design**	**Course No**				
Specialization	Design Spine (Semester 1)	Structure (LTPC)	1	2	0	3
Offered for	B.Tech & DD All streams	Status	Core X		Elective	
Prepared by (Faculty Name)						
Prerequisite	None	To take effect from	2020 Batch			
Course Objectives	The objective of this foundation program is to help students coming from +2 background to: 1. Unlearn limiting assumptions, risk avoidance, fear of failure 2. Awaken their senses & rediscover their creative selves **3.** Experience the impact of design and technology in everyday objects					
Course Outcomes	At the end the course, the student should ● demonstrate qualities of immersion in a task; ● unlearn some limiting assumptions; ● comfortable with sketch thinking; and ● be excited by the potential of technology and design in improving lives;					
Contents of the course (With approximate break up of hours)	**Module-1: Induction: (1 week)** ● Know your context - physical and social; ● History of the place; the industrial ecosystem; institution ● Exercises to improve interaction; local visits; ● Unlearning activities; Start journaling **Module-2: Learn to observe nature (9 hrs)** ● Observe wholes-parts (trees-leaves); variety of leaves; colors ● Document in a variety of ways - collage; sketch, paint, photograph, video ● Introduction to color theory - mixing of colors to get different shades ● Storytelling / Imagination **Module-3: Learn to observe and explore objects (18 hrs)** ● Unbundle everyday objects, observe, reorganize ● Whole-part relations; System physics;					

<table>
<tr><td></td><td>● Observe interplay of art, design, culture, technology in everyday objects
● Introduction to design sketching-1 (paper/pencil)
● Concepts of perspective drawing and product sketching.
● Explore variations on the form of chosen objects
Module-4: Visualize and Realize 3D objects (15)
● Crafts/Origami
● Realize designs with tools and materials (Clay modeling; Foam cutting; Laser cutting; Joining: Glues/Tapes)
● Introduction to digital sketching & 3D printing</td></tr>
<tr><td rowspan="2">Text and References</td><td></td></tr>
<tr><td>1. Kevin Henry, Drawing for Product Designers, Laurence King Publishing, 2012.
2. Thomas C Wang, Pencil Sketching, John Wiley, 2002.
3. Koos Eissen and Roselien Steur, Sketching – The Basics, BIS Publishers,2011.
4. Wucius Wong, Principles of Color Design: Designing with Electronic Color, John Wiley and Sons Inc, 2nd Edition, 1996</td></tr>
</table>

Semester 2:

<table>
<tr><td>Course Title</td><td>Sociology of Design</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Design Spine (Semester 2)</td><td>Structure (LTPC)</td><td>1</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>B.Tech & DD All streams</td><td rowspan="2">Status</td><td rowspan="2" colspan="2">Core
X</td><td rowspan="2" colspan="2">Elective</td></tr>
<tr><td>Prepared by (Faculty Name)</td><td></td></tr>
<tr><td>Prerequisite</td><td>Foundation Program</td><td>To take effect from</td><td colspan="4">2020 Batch</td></tr>
<tr><td>Course Objectives</td><td colspan="6">The objective of the course is to introduce engineering students to the importance of understanding the social context of technology and product design:
1. Observing the problem context and surfacing unstated user/customer needs / new product concepts,
2. Understanding people, team dynamics and working in multicultural / cross-functional / distributed teams.</td></tr>
</table>

Course Outcomes	At the end of the course, the students should be in a position to: ● Understand the need and the process of doing an ethnographic study ● Surface unstated needs and articulate the high level product requirements ● Connect with people, form teams and collaborate towards a common goal
Contents of the course (With approximate break up of hours)	**Module 1: Technology, Design and Society - [9 hrs]** ● Observe the way people interact with objects ● Understanding the relationship between people and a variety of objects ● Actor Network Theory; History of Technology and Design; 2-3 Case studies ● Discover your passion and domain of interest & network to identify partners **Module 2: Understanding user/customer contexts [21 hrs]** ● Ethnography - immersion in a problem context ● Learning to observe - see and listen; ● Developing rich pictures; Gigamapping ● Introduction to signs and semiotic analysis **Module 3: Understanding groups (multicultural/cross-functional teams) [12 hrs]** ● Learning team formation and dynamics through a movie; ● Introduction to sociological imagination - Functionalism, Conflict Theory, Symbolic Interactionism; Interaction Ritual Chains ● Values, culture, methods of engineers and designers and how they shape the quality of our lives; ● Group dynamics within organizations and across organizations and implications for innovation and change Evaluation: Continuous assessment (40%); Final ethnography report (20%); End Semester (40%)
Text and References	
	1. Trevor Pinch (Editors) (2012), The Social Construction of Technological Systems: New directions in the sociology and history of technology, MIT Press, Anniversary Edition 2. Wendy Gunn, Ton Otto and Rachel Smith (2013), Design Anthropology: Theory and practice, Bloomsbury 3. Adrian Forty (2014), Objects of desire: Design and society since 1750s, Thames & Hudson 4. Bernhard E Burdek(2015), History, theory and practice of product design, second revised edition 5. Keri Smith (2008), How to be an Explorer of the World: Portable Life Museum, Penguin Group

Semester 3:

Course Title	**Systems Thinking for Design**	**Course No**				
Specialization	Design Spine (Semester 3)	Structure (LTPC)	1	2	0	3
Offered for	B.Tech & DD All streams	Status	Core X		Elective	
Prepared by (Faculty Name)						
Prerequisite	Sociology of Design	To take effect from	2020 Batch			
Course Objectives	The objective of this course is to: 1. Introduce engineering students to a systemic (holistic and integrative) approach to product design in particular and problem solving in general **2.** Explore the ambiguity, uncertainty prevalent in the fuzzy front-end of new concept development					
Course Outcomes	At the end of the course, the students will: ● Know how to focus on the right problems in a domain (opportunity / need identification) ● Apply frameworks & methods to model function, behavior and a high level product architecture					

<table>
<tr><td>Contents of the course (With approximate break up of hours)</td><td>Module 1: Introduction to product design (9 hrs):
The sequence of activities in introducing a new product into the market: Relation between engineering (detail design and manufacturing), product design & development and business (in Indian and global manufacturing sector).
Framework to understand product and design process: Function-Behavior-Structure model; the need for inter-disciplinary view and use of systems/complexity concepts; similarities and distinctions in thinking about design (engineers vs designers vs entrepreneurs)
Analysis of an existing product in chosen domain to appreciate the function, behavior, structure at part/component/sub-system/system level and over time (history)
Module-2: Discovery & Diagnosis - modeling the problem (18 hrs)
Introduce methods for need identification; methods to translate needs to functional requirements; methods to extract the functional hierarchy (architecture) and overall purpose;
Application of need identification techniques for new concept or redesign in chosen domain (1 week – structured methods), ethnography methods (2 weeks), function modeling (2 weeks); design reviews
Module-3: High level Product Spec (15 hrs)
Methods to translate functional requirements into high-level requirement spec (SysML); and potential ways to create mock-ups / design realizations to communicate product ideas
Concept presentation (form-Pretotype) using design sketching and realization tools (3D printing, clay modeling, CAD simulations etc.)
Evaluation: Continuous assessment (40%); Final ethnography report (20%); End Semester (40%)</td></tr>
<tr><td rowspan="2">Text and References</td><td></td></tr>
<tr><td>References:
Ulrich Karl, Eppinger Steven and Goyal Anita (2009), Product design and development, 4th edition, Tata McGraw Hill
Dan Norman (2010); Living with complexity, MIT Press
Nigel Cross (2008), Engineering Design Methods: Strategies for product design, 4th Edition, John Wiley & Sons
Andrew P. Sage and James E. Armstrong Jr. (2000), Introduction to Systems Engineering, Wiley
Stanford Friedenthal et al. (2014), A practical guide to SysML: The systems modeling language, Third Edition,</td></tr>
</table>

Semester 4:

Course Title	**Smart Product Design**	**Course No**				
Specialization	Design Spine (Semester 4)	Structure (LTPC)	1	2	0	3
Offered for	B.Tech & DD All streams	Status	Core X		Elective	
Prepared by (Faculty Name)						
Prerequisite	Systems Thinking for Design	To take effect from	2020 Batch			
Course Objectives	The objective of this course to help the students understand and apply the concepts of designing smart/intelligent products, i.e., information intensive and context sensitive					
Course Outcomes	At the end of the course, the students will: 1. Identify and define the right type of intelligent behaviour for a chosen product concept 2. Design high-level functional and component (structural) architecture for intelligent behaviour using appropriate metaphor and analogy 3. Evaluate and select the right AI technique for the proposed functional and component architecture and vice versa					

Contents of the course (With approximate break up of hours)	**Module 1:** Introduction to intelligence behavior **(9 hours)** ● Definition of intelligence ● Dimensions of intelligence ● Levels of intelligence **Module 2: Architecture for intelligent behavior (15 hours)** ● Functional arch for Intelligent Behavior (Intelligence and information intensity relation (equilibrium, amplification)) ● Biological metaphors for cyber-physical systems (Bio-inspired adaptive systems (Positive and negative feedback) ● Theory of living systems (Self evolve, self improve, self-aware (e.g., self-configuration, -organization, -optimization) properties) **Module 3: Selection of appropriate AI Techniques (18 hours)** ● Rule-based systems - Fuzzy inferencing - Artificial neural networks - Evolutionary computation - ● determine which type of intelligent system methodology would be suitable for a given type of application problem ● Demonstrate a working prototype, in the form of a major project work, the ability to design and develop an intelligent system for a selected application. ● Poster Session Evaluation: Continuous assessment (40%); Final concept presentation (20%); End Sem (40%)
Text and References	
	References: 1. Donald A Norman (2007), The design of future things, Basic Books, New York 2. Dario Floreano and Claudio Mattiussi (2008), Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, MIT Press 3. Michael Negnevitsky (2005), Artificial Intelligence: A Guide to Intelligent Systems, Second Edition, Addison Wesley

Semester 5:

Course Title	**Entrepreneurship and Management Functions**	**Course No**				
Specialization	Design Spine (Semester 5)	Structure (LTPC)		0	0	3
Offered for	UG & DD (All Streams)	Status	Core X		Elective	
Prepared by (Faculty Name)						
Prerequisite	None	To take effect from	2020 Batch			
Course Objectives	The objectives of this course are: 1. To provide an exposure to the basic concepts of economics, organization and entrepreneurship / management 2. To help application of management techniques to analyze industry, competition and create a business plan					
Course Outcomes	At the end of the course, the students will learn how to 1. Understand the market & competition 2. Prepare a business case for the product concept					

Contents of the course (With approximate break up of hours)	**Module 1: Introduction [6 hrs]** ● Introduction to Macro & Micro-economics; GDP, Supply-demand, Production possibilities curve, Division of labor and creation of value ● Evolution of organizations, industries and sectors, for profit and non-profit (economic, social and knowledge perspectives) ● Role of Entrepreneurs and Managers in value creation **Module-2: Defining Strategy and Organization [15 hrs]** ● Understanding industry dynamics & competition (Porter's Framework) ● Understanding the industry value chain and firm positioning; and strategy ● Types of organization structures (product, functional, matrix, global) ● Typical organizational functions (R&D, Marketing & Sales, HR, Operations) **Module-3: Mobilizing Resources [15 hrs]** ● Financial management (Sources of funding, how to read a P&L, balance sheet, Product Costing & Investment Decisions) ● Human resource management ● Global sourcing and supply chain management ● Intellectual Property & Knowledge Management ● Management Information & Decision Making **Module-4: Ensuring Legal and Regulatory compliance [6 hrs]** Evaluation: Continuous assessment (40%); Business Plan (20%); End Semester (40%)
Text and References	
	● Michael Porter (2008), On competition, Updated and Expanded Edition, HBS ● Peter F Drucker (2006), The Practice of Management, Harper Collins, NY ● Eric Ries (2011), The Lean Startup, Portfolio Penguin

Semester 6:

Course Title	**Prototyping & Testing**	**Course No**				
Specialization	Design Spine (Semester 6)	Structure (LTPC)	1	2	0	3
Offered for	UG & DD (All Streams)	Status	Core X		Elective	
Prepared by (Faculty Name)						
Prerequisite	None	To take effect from	2020 Batch			
Course Objectives	The objective of the course is to help students develop rapid prototyping skills and realize a minimum viable product					
Course Outcomes	Students will develop skills in rapid prototyping; project management and focusing on delivering outcomes					
Contents of the course (With approximate break up of hours)	1. **Minimum viable product plan (3 hours)** ● Markets and Needs ● Business Goals ● Key features 2. **Core Product Architecture (6 hours)** ● Storyboarding of the product core. ● Framework for mechanical , electronics and computing paradigm 3. **Design for Manufacture & Assembly (3 hours)** ● Manufacturing Process: Form ● Assembly constraints : Fit 4. **Developing the Proof of Concept (30 hours)** ● Build ● Assemble ● Iterate ● Validate ● Pitch Evaluation: Continuous assessment (80%); Final PoC demo (20%) 2 one-day hackathons may be organized during this period (one weekends) to accelerate PoC development					

Text and References	
	1. How to Solve Big Problems and Test New Ideas in Just Five Days by **Jake Knapp, John Zeratsky, Braden Kowitz** 2. The Total Inventors Manual :Transform Your Idea into a Top-Selling Product by **Sean Michael Ragan** 3. Prototyping and Modelmaking for Product Design by **Bjarki Hallgrimsson** 4. Bringing a Hardware Product to Market: Navigating the Wild Ride from Concept to Mass Production by **Elaine Chen**

Appendix-4: M.Des Curriculum (Courses & Objectives)
(Including the Electives for Design++ and Dual Degree); Detailed syllabus-WIP

Semester 1

Course	Objectives
Induction and Foundation (two weeks), (1 credit) – Core	This is going to be a mandatory two weeks course for anyone joining the MDes program at IIITDM. The objective of this course is to help students coming from different background to: ● Unlearn limiting assumptions, risk avoidance, fear of failure ● Awaken their senses & rediscover their creative selves ● Experience the impact of design and technology in everyday objects.
Design Culture and Society (3 credits) – Core	This course focuses on providing insights into understanding of the history and theory of modern design, within its changing cultural and social contexts, and their continuing relevance to design practice today. ● Students are able to consider cultural behaviour such as material culture, design history, cultural anthropology and philosophy of technology during the design process and deliver the complete concept design of a product.
Design Theory and Methods (3 credits) – Core	This course will offer Design Theory and Methodology as a framework that integrates theoretical concepts from different fields, which all contribute to the process and thus to the product. This course will examine how designers conduct research in order to produce relevant and meaningful products and services that are appropriate for specific audiences, cultures, and contexts. ● Students will learn how to apply a range of research methods via fieldwork to their everyday design practice including developing and using ethnographic strategies, personas, interviewing, and iterative design processes, among others. ● Students work in teams, putting theory into action, which informs collaborative design practice.
Materials and Processes (3 credits) - Core	This course is to train students on design-oriented materials selection. The course introduces analytical tools and methods for qualified materials selection and principles for material design for typical applications with respect to temperature stability, thermal and electrical conductivity, strength, toughness and chemical resistance, etc. ● Students should be able to understand the basics of design-oriented materials selection for engineering applications; ● Students are able to work with and apply systematic and objective materials selection based on the physical principles, role of

	geometrical aspects and mechanical properties.
Industrial Design Sketching-1 (3 credits) – Core	This course is aimed to introduce advanced sketching and 3D modeling concepts using digital tools and techniques with aesthetic sense to provide hands on training to the students. Students will acquire drawing and modeling skills that are required to communicate the design ideas/concept products using computer-based tools.
Product Communication and Presentation (2 credits) – Core	Objective of this course is to teach presentation techniques and portfolio work for designers/students to showcase their product knowledge, stand out and stay competitive.
Design Studio-1 (2 credits) – Core	Introduction to basic design and prototyping tools
Design of Cyber-Physical systems /Smart Products (3 credits) – Core	This course introduces students to the conceptual design of smart products / cyber-physical systems. The theme of the course is on the interplay of practical design with formal models of systems, including both software components and physical dynamics ● Students will apply concepts learned in lectures to programming the required control systems for their chosen project as a part of the concept design project course.

Semester 2

Digital Product Sketching and Visualization (3 credits) – Core	Introduce the advanced sketching and modeling concepts needed for product design. Hands-on training in computer-based sketching and 3D modeling tools.
Design Studio – 2 (2 credits) – Core	Introduction to advanced design and prototyping tools
Human Factors and Ergonomics (3 credits) – Core	Introduction to human factors; physical, cognitive, occupation and biomechanical aspects in design. Anthropometry; Ergonomic methods to analyze products, product-service systems and built environments; usability constraints, contextual constraints;
Interaction Design (3 credits) – Core	Smart devices (mobile phones, PDAs, tablet computers), smart products (car, navigation) and smart environments (ambient intelligence) are enabling new services that require innovative interfaces. This course focuses on the study, design, development and evaluation of novel user interfaces, interactive systems and services. Upon completion of this course, students will ● Have knowledge of human factors, usability and its critical importance, as well as cognitive issues related to user behaviour ● Be able to recognize, analyze, compare and apply various usability standards (heuristics) and methods for mental workload assessment and understanding human error ● Be able to discuss requirements for the design of user interfaces in digital media with regards to human factors and end-users needs. ● Be able to analyze and assess the appropriateness of various methods for mental workload assessment. ● Be able to perform independent practical work in understanding human error and usability. ● Be able to link the mental workload to interaction design.
Visual Communications (3 credits) – Core	Visual thinking and communications skills are developed and exercised in the context of solving design problems. Exercises for the mind's eye. Rapid visualization and prototyping with emphasis on fluent and flexible idea production. The relationship between visual thinking and the creative process.
Design for Quality and Reliability (3 credits) - Core	The design phase is crucial for product quality improvement since design quality is a key determinant on the final product quality. Design quality means that design requirements reflect the voice of the customer (VoC) or the demands of the market. Manufacturing quality means that the end-product conforms to the product design requirement and specification, where it is the conformance to quality. The first part of the

	course will provide insights into the quality relationship model showing interpretation of the leveraged relationships between design, manufacturing and product quality, and explain the uses and limitations of the model. Design for reliability ensures that products and systems perform a specified function within a given environment for an expected lifecycle. Hence, the second part of the course will talk about design for reliability concepts, bathtub curve, safety critical design, probability analysis of reliability issues, repairable and non-repairable systems. At the end of the course, students will be able to: ● Apply the various tools and techniques used to improve the product quality at the design phase. ● Construct QFD, FMEA and fault tree analysis and also to perform reliability analysis for the chosen product.
Strategic Management of Design and Innovation (3 credits) – Core	The objective of this course is to help designers understand the innovation challenge from the entrepreneur and manager's perspective, i.e., both at a strategic level and organizational level. In other words, how do entrepreneurs and managers build organizations and ecosystems that can continuously generate and commercialize innovations, and how can they protect and enhance competitive advantage. At the end of the course, students will have a familiarity with: ● Topics in strategic innovation management, such as innovation networks, idea brokering, open innovation; ● Innovation processes and structures such as R&D team, the pros and cons of various R&D organizational structures, and challenges of innovation in large and small firms; ● Skills to identify, evaluate, and resolve a variety of issues relating to poor innovative performance in large firms as well as entrepreneurial firms.
Model Based Design - 3 credits - Elective	This course brings together the concepts from across digital manufacturing and design, forming a vision in which the geometry of a product is just one way of describing it. MBD is where the model resulting from the evolution of system requirements, design, analysis, verification and validation activities is the focus of design and manufacturing. ● Students will gain an understanding of systems engineering, the model-based approach to design and manufacturing, the Digital Twin, and a roadmap toward a model-based enterprise. ● Students will be able to explain the value and expectations of systems engineering and model-based systems engineering, and the underlying motivations and opportunities represented by a model-based enterprise. They will develop the knowledge necessary to perform a baseline assessment of an organization's potential to

	leverage MBD.
Design Research Methodologies - 3 credits – Elective	DRM teaches a methodology for carrying out research into design. Its steps are to clarify research success; to understand relevant phenomena of design and how these influence success; to use this to envision design improvement and develop proposals for supporting improvement; to evaluate support for its influence on success; and, if unacceptable, to modify, support, or improve the understanding of success and its links to the phenomena of design. After successful completion of this course students are able to: ● recognize the difference between a conceptual and a technical research design and explain the importance of formulating a research objective and a research issue; ● compare the experimental, cross-sectional and case study research designs and apply the strategies for random and non-random sampling; ● infer data collection by means of questionnaires/interviews, observation and content analysis; ● identify the basics of data analysis in quantitative and qualitative research and formulate an adequate research objective and an adequate set of research questions with a proper technical research design for an experimental study, a cross-sectional study and a case study; ● develop an operationalization for one-dimensional and multi-dimensional concepts.
Mathematics for Designers (3 credits) – Elective	Many people who pursue artistic fields believe that the skills required for product design simply have no relationship to the skills required for mathematical pursuits. Individuals fail to realize that mathematics is an integral part of design. In fact, concepts such as patterns, symmetry, positive and negative space, arrangement, and sequence that are so important to design. For example, fractals are repeating geometric patterns that combine to form a design. Designers use fractals from clothing design to web design. Similarly, fibonacci series found several applications in design. Hence, this course is going to build confidence and fluency in applying mathematical skills in the context of design work. Students will practice measuring and calculating the areas and volumes of manufactured objects and proposed designs. They will use trigonometry to develop 2D and 3D scale drawings and will use statistics to inform designs, for example when using ergonomic data. They will explore the geometry of curves and will be introduced to the use of mathematical symmetries, sequences and patterns as design tools. Basic matrix operations and linear algebra are a foundation for design work involving software algorithms.
Summer Internship (5 credits) - Core	This summer internship is to develop and improve business skills in communication, technology, quantitative reasoning, and teamwork in an

	industrial environment and also to explore the potential design projects as their final project. It helps to meet professional role models and potential mentors who can provide guidance, feedback, and support on their final year design projects.

Semester 3:

Bio-inspired Design (3 credits) – Core	This course intended to give the student the exposure of principles and perspectives of bio-inspired design and train them to apply the bio-inspired methodologies for innovation. ● Students will be able to describe various methods for creative design and identify working principles of biological phenomena - explain their construction, motion, and/or processing mechanisms - formalize the essence of these mechanisms in models -derive non-conventional design principles from these models. ● Students will be capable of implementing these design principles in innovative technical devices - summarize the transition process from the biological to the mechanical domain - present their design in drawings and working models.
Sustainable Product and Service Systems (3 credits) – Core	This course helps students to explore sustainability as a business opportunity for developing innovative products and services. It will focus on consumer needs related to sustainability, willingness to pay for these needs, and the innovative processes necessary to create sustainable solutions. On successful completion of this course, students will be able to: ● Understand and critically analyze current realities, opportunities, and structural issues in sustainability across a range of organizations. ● Manage and evaluate insight-driven research as a precursor to sustainability- driven innovation. ● Map sustainability-driven offerings in the market to evaluate the competitive landscape and find strategic opportunity. ● Design sustainability-centric product and service offerings around identified and tangible market needs. ● Create, iterate, and evaluate initial beta offerings to understand viability.
Simulation-Driven Design and Innovation (3 credits) - Elective	Simulation technologies were primarily considered as validation tools, used to verify the performance of components and systems and rarely influenced the product design. It highlighted problems and passed reports back for modifications that approach served its purpose, but as the technologies have become more sophisticated and able to deliver results more quickly, the scope to use simulation earlier in the design cycle and deliver design direction in line with the pace of product

	development programs is now enabling manufacturers to realize significant time and cost savings. No longer is simulation a tool to ‘okay’ a design. It is now a driver of innovation, allowing design engineers to propose optimised design solutions that exhibit the best compromise of multiple engineering functions and constraints. Thus, this course is aimed at teaching simulation-driven design philosophy and vision of where simulation should play a key role in the product development process. At the end of the course, ● Students will be able to understand the value of simulation driven design during the conceptualisation phase. ● Students will be able to build generative design and topology optimisation for better concept designs. ● Students will be able to modify the geometry to iterate and explore new design paths in a virtual domain.
Design of Electric Vehicle Systems (3 credits) - Elective	This course will provide students with a broad technical knowledge and practical expertise of hybrid and electric vehicle (HEV) technologies, analysis, design, component selection and sizing at both system and vehicle level. On successful completion of this course, students will be able to: ● Analyse the different powertrain architecture options and select the appropriate solutions within realistic performance and commercial constraints. ● Evaluate various technology options for (electrical and mechanical) energy generation, storage, transmission, and management for a HEV, and be able to select between different technologies relative to a given vehicle application and overall system design. ● Size various HEV sub-systems, within the context of various vehicle constraints, such as performance, fuel economy and packaging. ● Employ and experiment rapid control prototyping techniques to design and validate HEV high-level and low-level control systems. ● Carry out performance evaluations of a HEV and its subsystems using simulations.
Design of Biomedical Devices and Systems (3 credits) - Elective	The course teaches fundamental approaches, methods and tools related to the design of biomedical devices, experiences, systems and services with a focus on users and context of use. Also, this course brings together candidates from a range of fields including design, health care, engineering and business, and prepares graduates to play a leading role in the development of emerging medical devices. It will cover topics ranging from basic medical science and bioinstrumentation to product design and human factors. At the end of the course, ● Students learn to conduct human centered contextual research, extract meaningful insights, create and visualise concepts, and develop and evaluate prototypes, all in the context of the complex and highly regulated world of medical device design. ● Students are able to design from a human centred perspective while

	gaining a deep understanding of the underlying science, technology, materials and manufacturing processes which underlie medical device design and development.
Design of non-invasive products (3 credits) - Elective	The objective of the course is cultivate the skill of appreciating the communication between the system and environment and develop suitable principles such as acoustical, photonic, optical, electronic, for non-invasive monitoring in human or machine.
Embedded Systems and Kinetic Art (4 credits) – Elective	The objective of the course is to help students understand the principles of developing dynamic (kinetic) artistic structures through an appreciation of sculptures, designs and leveraging electronic components such as sensors, controllers, actuators and programming
Game Design and Development (3 credits) - Elective	This course is an introduction to the theory and practice of the process of designing games and playful experiences. Students are familiarized with methods, concepts, techniques, and literature used in the design of games. The strategy is process-oriented, focusing on aspects such as rapid prototyping, play testing, and design iteration using a player-centered approach. After completing the course the student should be: • Familiar with the emergence of the academic study of design methods and game design. • Able to select and apply appropriate methods and techniques during different stages of the development cycle. • Able to structure and conduct a game design project from conceptualization to playable prototype. • Proficient in contributing to the collaborative learning and development processes.
Animation Design (3 credits) – Elective	Animation is a field of concept art and is a piece of motion design that is created to convey a particular idea before it is put into a real product. In user interfaces design, conceptual animation may be found in various concepts for interactions, transitions, manipulations with controls, animation marking the feedback from the system etc. Hence, this course provides the essential knowledge of digital animation techniques, demonstrating the processes necessary to develop animation at a professional level, from creation to production. On successful completion of the course, students will be able to: ● understand the process of creating a digital animation; ● create a drawing using motion graphics techniques; ● write a storytelling for animation; ● understand the principles of 2d and 3d animation.

Semester 4:

Design Project – (20 credits)	Design Project Part II allows students to apply research, capabilities, and knowledge gained over the last three semesters. Students are required to submit their design output and a mandated thesis document. Students are mentored during this final project and go through seminars to get feedback from faculty and peer groups.
Elective-6 (3 credits)	

Annexure 3

Eligible Students - Total – 303

LIST OF STUDENTS ELIGIBLE FOR DISTINCTION

S.No.	Roll No.	Name	CGPA	Degree
1	COE16B001	ANEESH D H	9.44	B Tech
2	COE16B006	BALMOORI PRAGNYA	9.08	B Tech
3	COE16B008	BONDU VENKATA KUMARA VAISHNAVI	9.17	B Tech
4	COE16B018	HARINI R	9.68	B Tech
5	COE16B019	HRISHIKESH. P.M	9.33	B Tech
6	COE16B025	MANTRIPRAGADA ANJANI SANKAR	9.24	B Tech
7	COE16B034	SHIVESH M M	9.18	B Tech
8	COE16B037	VALLABHANENI SAI PHANI TEJA	9.01	B Tech
9	COE16B039	YANALA VENI MADHAVI	9.03	B Tech
10	COE16B041	GORANTLA MEGHANA	9.4	B Tech
11	COE16B042	M VINITHA	9.29	B Tech
12	COE16B043	MEGHANA REDDY TELLURI	9.08	B Tech
13	COE16B044	S AJAY NARAYANAN	9.61	B Tech
14	EDM16B001	ABIRAMI A	9.13	B Tech
15	EDM16B015	JEEVA KESHAV S	9.15	B Tech
16	EDM16B016	K BHARATI	9.27	B Tech
17	EDM16B041	DAWARE PRATHAMESH MAHIPATI	9.03	B Tech
18	MDM16B022	PAVITRA BHAGAVATULA	9.02	B Tech
19	MDM16B025	RAHUL NARASIMHAN R	9.18	B Tech
20	MDM16B038	Y ADITYA VARMA	9.73	B Tech
21	MSM16B001	AILONE AKANKSHA	9.03	B Tech
22	MSM16B015	KARAMBOR CHAKRAVARTY SRIYA	9.22	B Tech
23	MSM16B035	THIPPABATTUNI ANTONY ROHIT	9.04	B Tech
24	CED15I002	R MUKESH	9.04	DD
25	CED15I007	GOVIND K P	9.24	DD
26	CED15I009	MANASA KANDIMALLA	9.19	DD
27	CED15I014	VIDHATHRI	9.47	DD
28	CED15I021	ANMOL GUPTA	9.33	DD
29	CED15I024	V DIVYA	9.17	DD
30	CED15I029	PRATHAMESH A DEGWEKAR	9.16	DD
31	CED15I039	V.K. DINGU SAGAR	9.22	DD
32	CED15I040	V.AKASH	9.29	DD
33	CED15I042	G.SARAVANA BALAJI	9.44	DD
34	CED15I043	EASHAN DASH	9.34	DD
35	ESD15I010	S PRANAV KUMAR	9.28	DD
36	ESD15I020	S SANJANA	9.21	DD
37	EVD15I007	F KIRAN ROBERT	9.44	DD
38	EVD15I016	VYSHAK NATH C A	9.02	DD
39	MFD15I004	POTNURU HEMA PRANEETHA NAIDU	9	DD

40	MPD15I019	RATNANJALI TIWARI	9.31	DD
41	CDS18M001	MEDARA SREENIVASULU	9.04	M Tech
42	CDS18M003	GOWRI MURALEEDHARAN B	10	M Tech
43	CDS18M006	SANJANA PAUL	9.29	M Tech
44	CDS18M008	B VENKATA RAGHU RAM	9.08	M Tech
45	CDS18M009	RAKSANTA S	9.13	M Tech
46	EDS18M002	THUMPIRI REDDY MANASA	9.05	M Tech
47	EDS18M010	A.SRIVANI	9.05	M Tech
48	EDS18M013	ARTHI R	9.89	M Tech
49	MDS18M001	VALECHA DHEERAJ KAILAS	9.09	M Tech
50	MDS18M002	BHAVSAR DIVYAKUMAR ASHIT	9.75	M Tech
51	MDS18M003	CHAVAN AJITKUMAR ANKUSH	9.21	M Tech
52	MDS18M006	AVINASH MOHAN M	9.47	M Tech
53	SMT18M003	SHASHWAT PANDEY	9.33	M Tech
54	SMT18M007	VISHAK P M	9.89	M Tech

LIST OF STUDENTS ELIGIBLE FOR BACHELOR OF TECHNOLOGY (Honours)

S.No.	Roll No.	Name	CGPA	Degree
1	COE16B001	ANEESH D H	9.44	B Tech
2	COE16B018	HARINI R	9.68	B Tech
3	COE16B019	HRISHIKESH. P.M	9.33	B Tech
4	COE16B025	MANTRIPRAGADA ANJANI SANKAR	9.24	B Tech
5	COE16B041	GORANTLA MEGHANA	9.4	B Tech
6	COE16B042	M VINITHA	9.29	B Tech
7	COE16B044	S AJAY NARAYANAN	9.61	B Tech
8	EDM16B001	ABIRAMI A	9.13	B Tech
9	EDM16B015	JEEVA KESHAV S	9.15	B Tech
10	MDM16B025	RAHUL NARASIMHAN R	9.18	B Tech
11	MDM16B038	Y ADITYA VARMA	9.73	B Tech
12	MSM16B015	KARAMBOR CHAKRAVARTY SRIYA	9.22	B Tech
13	CED15I042	G.SARAVANA BALAJI	9.44	DD
14	ESD15I010	S PRANAV KUMAR	9.28	DD
15	ESD15I020	S SANJANA	9.21	DD
16	EVD15I007	F KIRAN ROBERT	9.44	DD
17	MPD15I019	RATNANJALI TIWARI	9.31	DD

LIST OF STUDENTS ELIGIBLE FOR DEGREE

B. Tech. in Computer Engineering

S.no.	Roll No.	Name	CGPA
1	COE16B001	ANEESH D H	9.44
2	COE16B002	ANKALUGARI RANGAHARSHAVARDHAN	8.42
3	COE16B003	ARUN NARAYANAN H	8.92
4	COE16B004	ATLURI BHASKARA TEJA	8.14
5	COE16B005	AVULA THOMAS	6.47
6	COE16B006	BALMOORI PRAGNYA	9.08
7	COE16B007	BEJJENKI SPANDANA	8.33
8	COE16B008	BONDU VENKATA KUMARA VAISHNAVI	9.17
9	COE16B011	CHERUKURI GOWTHAMI	8.75
10	COE16B012	D SAI CHARAN	7.94
11	COE16B013	DANDYALA SADWIKA	8.38
12	COE16B014	DEVA SUSHMITHA	8.67
13	COE16B015	DODDI BALAJI NIKHIL	8.77
14	COE16B016	GUGULOTH JANARDHAN	6.7
15	COE16B017	GUNDA HIMAJA	8.97
16	COE16B018	HARINI R	9.68
17	COE16B019	HRISHIKESH. P.M	9.33
18	COE16B020	JAJJARA PRADEEP	7.55
19	COE16B022	KOLLI CHINMAI VIGNYA	7.91
20	COE16B023	KONGATHI MYTHRI	8.86
21	COE16B024	MACHA SADHANA	8.37
22	COE16B025	MANTRIPRAGADA ANJANI SANKAR	9.24
23	COE16B026	MANUKONDA SUDHEER	7.6
24	COE16B027	NANDIGAMA MANOJ PRAVEEN	7.58
25	COE16B028	PALAKURTHY SAIKUMAR	7.44
26	COE16B029	PALLERLA NANDA KISHORE	6.97
27	COE16B030	POLISETTY SANTHOSHI	8.45
28	COE16B031	PRANJALI AJAY PARSE	8.78
29	COE16B032	PULAVARTHI NAGA VENKATA JASWANTH	6.05
30	COE16B033	R LOKESH KUMAR	8.09
31	COE16B034	SHIVESH M M	9.18
32	COE16B035	SREEREDDY SREE CHARAN REDDY	8.79
33	COE16B036	SRIRAM VAISHNAVI	8.47
34	COE16B037	VALLABHANENI SAI PHANI TEJA	9.01
35	COE16B039	YANALA VENI MADHAVI	9.03
36	COE16B040	GOUTHAMAN PREMLAL	7.72
37	COE16B041	GORANTLA MEGHANA	9.4
38	COE16B042	M VINITHA	9.29
39	COE16B043	MEGHANA REDDY TELLURI	9.08
40	COE16B044	S AJAY NARAYANAN	9.61

B. Tech. in Electronics and Communication Engineering

with specialization in Design and Manufacturing

S.no.	Roll No.	Name	CGPA
1	EDM16B001	ABIRAMI A	9.13
2	EDM16B002	AKHIL SARIKI	7.55
3	EDM16B003	BETANABOTLA KAUSHIK	8.46
4	EDM16B004	BHEEMAVARAM DHARANIPRIYA	7.36
5	EDM16B005	BOORGULA KESHAVA	5.95
6	EDM16B006	DEVARAPALLI BHARGAV	6.14
7	EDM16B007	ERROLLA VIVEK	6.29
8	EDM16B008	GATRAM MANOJ VENKATA SAI	8.55
9	EDM16B010	GUNTURU SOWMYA	8.73
10	EDM16B011	HARSHITHA K S	8.42
11	EDM16B012	JASWANTH KUMAR AMBATI	7.49
12	EDM16B013	JAYANTHI PRANITHA	8.06
13	EDM16B014	JAYANTHI VYSHNAVI	8.17
14	EDM16B015	JEEVA KESHAV S	9.15
15	EDM16B016	K BHARATI	9.27
16	EDM16B017	KUNDRAPU VENKATA RAO	7.19
17	EDM16B018	LINGALA SAI MAHESH	7.37
18	EDM16B020	MADHURI DAMARA	7.51
19	EDM16B021	MANDALEEKA PRABHA SAHITI	8.94
20	EDM16B023	MUDIREDDY SNIGDHA REDDY	8.75
21	EDM16B024	N T SUNNY RAJ	7.2
22	EDM16B025	N V SAI VIGNESH PALLIKONDA	7.14
23	EDM16B026	NALAVATH SAI KUMAR	7.21
24	EDM16B027	NEERUGATTI PRATHYUSHA	7.45
25	EDM16B028	NITIN PRIYADARSHINI SHANKAR	8.97
26	EDM16B029	PINNINTI SAI PRIDHVI	7.16
27	EDM16B030	S SIDARTH	8.92
28	EDM16B031	SAI SANDEEP MOOD NAIK	7.45
29	EDM16B032	SANGADI TEJARAM	8.97
30	EDM16B033	SEEMAKURTHI ANAND DINESH	8.84
31	EDM16B034	SRIYA MEGHANA NANDAM	8.28
32	EDM16B035	TAKKELLAPATI HARIKA	8.55
33	EDM16B036	VANCHA SHARATH REDDY	7.92
34	EDM16B037	VENNA SAHITHI	8.69
35	EDM16B038	YADAVALLI AVINASH	7.54
36	EDM16B039	NITHILAVATHI THIRUSENTHILANDA ARASU	8.62
37	EDM16B040	K V JEEVAN KUMAR	6.15
38	EDM16B041	DAWARE PRATHAMESH MAHIPATI	9.03
39	EDM16B042	K DEEPA	8.61

B. Tech. in Mechanical Engineering

with specialization in Design and Manufacturing

S.No.	Roll No.	Name	CGPA
1	MDM16B002	AIYUSH GOYAL	8.53
2	MDM16B003	AMBATI SREECHARAN	7.95
3	MDM16B005	B VIGNESH	8.26
4	MDM16B006	BUSA SATISHYADAV	7.58
5	MDM16B007	CHITRARTHA DIXIT	8.96
6	MDM16B009	GHULAXE TANMAY SHARADKUMAR	6.54
7	MDM16B010	GORINKA ABHILASH	8.02
8	MDM16B011	JADHAV GAUTAM KRISHNA	6.65
9	MDM16B012	JARUPULA ABHILASH NAIK	7.1
10	MDM16B013	KALAL VISHNU JANARDHAN GOUD	7.41
11	MDM16B014	KUCHANA SHARATH CHANDRA	7.72
12	MDM16B015	LINGAREDDY SUSWANTH REDDY	7.98
13	MDM16B016	MAMIDI RAJA HARSHA VARDHAN NAIDU	8.24
14	MDM16B017	NARAYANA BABU P E	8.63
15	MDM16B018	P SIRI CHANDANA REDDY	8
16	MDM16B019	PARALKAR AMEYA VIRENDRA	7.73
17	MDM16B020	PASIKANTI SAI ANURAG	7.41
18	MDM16B021	PASUMARTI SATYA SAI PRANEETH	7.77
19	MDM16B022	PAVITRA BHAGAVATULA	9.02
20	MDM16B024	PUTTI HEMANAGASAI	7.3
21	MDM16B025	RAHUL NARASIMHAN R	9.18
22	MDM16B026	RAM KOWSHIK S	8.51
23	MDM16B027	RAMAVATH GNANESHWAR	7.48
24	MDM16B028	RAPOLE VAMSHI VARDHAN	7.78
25	MDM16B029	RISHAV RAMAN	7.24
26	MDM16B030	RISHIKESH M NANDAKUMAR	8.22
27	MDM16B031	ROSHAN PATEL	8.02
28	MDM16B032	S SIDARTH	7.97
29	MDM16B033	SAI SRI HARSHA SUNDRU	6.92
30	MDM16B034	SASISEKARAN B	7.78
31	MDM16B035	SUYOG GARG	8.65
32	MDM16B036	TATAVARTY ANANTHA LAKSHMI PRASANNA	8.94
33	MDM16B037	VAIRAGADE HIMANSHU VIRENDRA	8.93
34	MDM16B038	Y ADITYA VARMA	9.73
35	MDM16B039	YATHIRAJAM BALA SUBRAHMANYAM	8.32

B Tech in Mechanical Engineering - Smart Manufacturing

S.No.	Roll No.	Name	CGPA
1	MSM16B001	AILONE AKANKSHA	9.03
2	MSM16B002	ARIVETI RANGA HARSHAVARDHAN	8.36
3	MSM16B003	AVVARU SUNAY DURGESH	8
4	MSM16B005	BANDILI MAHESH	6.99
5	MSM16B006	BANKAR ABHISHEK ANIL	7.59
6	MSM16B007	CHAKKA JASWANTH	6.97
7	MSM16B008	CHAMANAPUDI ASA VARA PRAVEEN	6.32
8	MSM16B009	CHATTETI CHANDAN	7.24
9	MSM16B010	GADAMCHETTY MANOJ	8.53
10	MSM16B011	GARREPALLI SRIVANDYA	8.57
11	MSM16B012	JEFIN SOLOMON JP	8.67
12	MSM16B013	JOSHNA LOKAVARAPU	8.43
13	MSM16B015	KARAMBOR CHAKRAVARTY SRIYA	9.22
14	MSM16B016	KUMTAMUKKULA LALIT SUDHIR	8.39
15	MSM16B017	MADUGONDA SAI VIVEK	7.72
16	MSM16B018	MUDAVATH VAMSHI NAIK	6.61
17	MSM16B019	NARLAGIRI VINAY KUMAR	7.79
18	MSM16B020	NARNI JAGADEESH SIVA DURGA PRASAD	7.51
19	MSM16B021	NAVGHARE ADITYA SHRIDHAR	8.75
20	MSM16B022	NISHANT KUMAR	7.36
21	MSM16B024	POTLURI SASIKANTH	8.12
22	MSM16B025	R RAM NARAYAN	8.93
23	MSM16B026	RAJESH KUMAR	8.98
24	MSM16B027	RAM BAHAL TIWARI	8.32
25	MSM16B028	RATHOD UMESH	6.72
26	MSM16B029	S ADITYA	8.52
27	MSM16B031	SAKET KUMAR MONGRE	8.1
28	MSM16B032	SAYANTH SUNIL	6.59
29	MSM16B034	SIDDHANT KARMARKAR	8.73
30	MSM16B035	THIPPABATTUNI ANTONY ROHIT	9.04
31	MSM16B036	VIVEK YADAV	8.57

Dual Degree

B. Tech. in Computer Engineering and M. Tech in Computer Engineering

S.No.	Roll No.	Name	Gender	CGPA
1	CED15I001	PRANAY ANKIT TIRU	Male	7.22
2	CED15I002	R MUKESH	Male	9.04
3	CED15I003	G SRI KRISHNA	Male	8.73
4	CED15I004	R.LAKSHMI NARASIMHAN	Male	6.96
5	CED15I005	MUGUNDHAN K	Male	8.26
6	CED15I007	GOVIND K P	Male	9.24
7	CED15I009	MANASA KANDIMALLA	Female	9.19
8	CED15I010	ANUMULA NIKHIL KUMAR	Male	6
9	CED15I011	FAJAR K	Male	6.46
10	CED15I012	PALAPARTHI ROHITH	Male	6.55
11	CED15I013	VEDANT BASSI	Male	8.74
12	CED15I014	VIDHATHRI	Female	9.47
13	CED15I015	SONATKAR VIRAJ GANESH	Male	7.34
14	CED15I016	MANDADI VASANTHI	Female	7.73
15	CED15I017	YUTIKA CHANDRASHEKHAR KULWE	Female	7.6
16	CED15I018	PUTTA SACHIN	Male	7.29
17	CED15I019	MUNUKUTLA GOWTHAM	Male	7.49
18	CED15I020	VADTHYA CHAITANYA	Female	7.26
19	CED15I021	ANMOL GUPTA	Male	9.33
20	CED15I022	REMALA NIKHILA	Female	7.95
21	CED15I023	RUCHI SAHA	Female	8.89
22	CED15I024	V DIVYA	Female	9.17
23	CED15I025	ADITYA PRAKASH	Male	7.64
24	CED15I026	BRAHMI DWIVEDI	Female	8.84
25	CED15I027	SHWET PRAKASH	Male	7.8
26	CED15I028	NAYAN ADHIKRAO MANE	Female	8.33
27	CED15I029	PRATHAMESH A DEGWEKAR	Male	9.16
28	CED15I030	DANI PRAKASH ESUKAPALLI	Male	8.36
29	CED15I031	AKSHAY KUMAR	Male	8.46
30	CED15I032	Kale Shivani Sunil	Female	8.01
31	CED15I033	KOKKALLA SRINATH	Male	7.92
32	CED15I035	KONDAPALLI AKHILA	Female	7.34
33	CED15I036	JEFFREY SAM JACOB	Male	6.79
34	CED15I037	MUCHINTALA SESHA SAI TRISHUL	Male	8.06
35	CED15I038	Mohit Agarwal	Male	6.6
36	CED15I039	V.K. DINGU SAGAR	Male	9.22
37	CED15I040	V.AKASH	Male	9.29
38	CED15I041	NIMILIKHA VEMPARALA	Female	8.52
39	CED15I042	G.SARAVANA BALAJI	Male	9.44
40	CED15I043	EASHAN DASH	Male	9.34

B. Tech. in Electronics and Communication Engineering

with specialization in Design and Manufacturing and

M. Tech in Signal Processing and Communication Systems Design

S.no.	Roll No.	Name	CGPA
1	ESD15I001	ABHAY PRAHALAD MASLEKAR	6.49
2	ESD15I002	MABBU GANESH VENKAT SAI AKHIL	8.16
3	ESD15I003	S.ABINAYA	8.98
4	ESD15I005	SANDESH V BHARADWAJ	7.36
5	ESD15I006	K.NIRANJAN	8.36
6	ESD15I007	GUTTIKONDA GOWTHAM	8.3
7	ESD15I008	ROYYURU VINEETH CHAND	7.09
8	ESD15I009	BATHALA SIVA CHAITANYA	7.48
9	ESD15I010	S PRANAV KUMAR	9.28
10	ESD15I011	BALAJI V	6.81
11	ESD15I012	K RAJESH	5.87
12	ESD15I013	BANOTH KARUN	6.05
13	ESD15I014	HIMAVANTH REDDY PUNDLA	8.53
14	ESD15I015	M ABHAY VARDHAN	8.83
15	ESD15I016	MADHAN.J	7.68
16	ESD15I018	DHARMESH HARSHA	8.04
17	ESD15I019	GANJI VENKATA GANGA TEJA PRATHAP	7.47
18	ESD15I020	S SANJANA	9.21

B. Tech. in Electronics and Communication Engineering

with specialization in Design and Manufacturing and

M. Tech in VLSI and Electronic Systems Design

S.No.	Roll No.	Name	CGPA
1	EVD15I001	VARSHITHA BHAVNI SRIGANESH	6.69
2	EVD15I002	M.DINESH	7.71
3	EVD15I003	LINGAM SRAVANI	8.68
4	EVD15I004	N V APARAJITHAN	8.47
5	EVD15I005	KOLLI SNEHA LATHA	7.84
6	EVD15I006	A.S.PRAVIN THILAKAR	8.42
7	EVD15I007	F KIRAN ROBERT	9.44
8	EVD15I008	VASTRAD SAKSHI BASAWARAJ	8.84
9	EVD15I009	KOLLA SANDEEP	8.16
10	EVD15I010	DASARI BHAVYA DEEPIKA	7.91
11	EVD15I011	NITTURU GAYATHRI	7.63
12	EVD15I012	BOLAPATI SRAVYA	7.63
13	EVD15I013	RATHLAVATH PRIYANKA	7.77
14	EVD15I014	CHANDRA SAI SRINIVAS	8.62

15	EVD15I015	GOLLAPUDI VENKATA SAI KUMAR	8.81
16	EVD15I016	VYSHAK NATH C A	9.02
17	EVD15I018	KRITI PATHAK	7.98
18	EVD15I019	S HARISH MANIKANDAN	8.16
19	EVD15I020	AMRUTHA MANOHARAN	8.95

B. Tech. in Mechanical Engineering

with specialization in Design and Manufacturing and

M. Tech in Advanced Manufacturing

S.No.	Roll No.	Name	CGPA
1	MFD15I001	NIYAZI ADEEB KHASIM KHAN	6.63
2	MFD15I002	MANCHALA VAISHNAVI	8.36
3	MFD15I003	GALLA PRASANTH KUMAR	6.94
4	MFD15I004	POTNURU HEMA PRANEETHA NAIDU	9
5	MFD15I006	RAGI LAKSHMAN KUMAR	8.08
6	MFD15I007	REDDI SRIHARI NAIDU	8.36
7	MFD15I008	SAI UDAY KIRAN Y	7.98
8	MFD15I009	KOTHA RAJ KUMAR REDDY	8.75
9	MFD15I010	PARTH LAL	8.58
10	MFD15I011	P ROKESH	8.59
11	MFD15I012	PRAKASH CHANTIBABU DIDLA	7.42
12	MFD15I013	ROHAN KUMAR PANDA	7.97
13	MFD15I014	VIVEK KHATUA	8.98
14	MFD15I015	AJAY KUMAR BYRI	8.05
15	MFD15I016	DEVALLA SAI TEJA	8.33
16	MFD15I017	BANOTH SRINU	7.5
17	MFD15I018	A.NIVAAS	8.02
18	MFD15I019	PILLI INDU PRIYA	8.13

B. Tech. in Mechanical Engineering

with specialization in Design and Manufacturing and

M. Tech in Product Design

S.No.	Roll No.	Name	CGPA
1	MPD15I001	HADI MOOTHAPILAKATH KOYA	6.53
2	MPD15I002	KAMBALLI HARSHA VARDHINI	8.29
3	MPD15I003	D DEEKSHITH REDDY	8.43
4	MPD15I004	SAI PRASATH K J	8.25
5	MPD15I005	RAVI TEJA M V L	7.75
6	MPD15I007	KARTIK BITRA	7.5
7	MPD15I008	ELSURI HARISH BABU	6.33

8	MPD15I009	MOHIT PATHAK	6.33
9	MPD15I010	SARANYA S	8.69
10	MPD15I011	GAJARAJ G	8.74
11	MPD15I012	VIJAYKUMAR T C	8.33
12	MPD15I013	VIKAS GAURAV	7.57
13	MPD15I014	ARAVIND.C.B	8.53
14	MPD15I015	SEEDARI SRINIVAS	6.54
15	MPD15I016	T.SURYAPRAKASH	8.83
16	MPD15I018	SUMUKI R	8.72
17	MPD15I019	RATNANJALI TIWARI	9.31

M Tech in Electronics and Communication Engineering
with Specialization in Communication Systems Design

S.No.	Roll No.	Name	CGPA
1	CDS18M001	MEDARA SREENIVASULU	9.04
2	CDS18M002	V L NIKITHA	7.72
3	CDS18M003	GOWRI MURALEEDHARAN B	10
4	CDS18M004	CHANDAVARAM VYSHNAVI	7.76
5	CDS18M006	SANJANA PAUL	9.29
6	CDS18M007	PALANCHU JYOTHIRMAI	8.3
7	CDS18M008	B VENKATA RAGHU RAM	9.08
8	CDS18M009	RAKSANTA S	9.13
9	CDS18M010	CHAITANYA D GOWDA	8.58

M Tech in Electronics and Communication Engineering
with Specialization in Electronic Systems Design

S.No.	Roll No.	Name	CGPA
1	EDS18M001	VIKASH SINGH	7.89
2	EDS18M002	THUMPIRI REDDY MANASA	9.05
3	EDS18M003	P RAMYA PRIYA	8.78
4	EDS18M004	SOWMIYA S	8.7
5	EDS18M005	NEERAJ DUBEY	6.91
6	EDS18M009	SWAATHI S	8.83
7	EDS18M010	A.SRIVANI	9.05
8	EDS18M011	PINTU KUMAR	7.34
9	EDS18M013	ARTHI R	9.89

M Tech in Mechanical Engineering
with Specialization in Mechanical Systems Design

S.no.	Roll No.	Name	CGPA
1	MDS18M001	VALECHA DHEERAJ KAILAS	9.09
2	MDS18M002	BHAVSAR DIVYAKUMAR ASHIT	9.75
3	MDS18M003	CHAVAN AJITKUMAR ANKUSH	9.21
4	MDS18M004	NAVEEN M	6.76
5	MDS18M005	KETAN VINAYAK WARGHAT	8.66
6	MDS18M006	AVINASH MOHAN M	9.47
7	MDS18M007	GEMBALI VIDYASAGAR	8.82
8	MDS18M008	NAGENDRA KUMAR CHAURASIA	8.55
9	MDS18M009	NISANTH KUMAR P	8.87
10	MDS18M013	AKASH KUMAR	7.91
11	MDS18M014	VECHALAPU NAGA VENKATA SAI KIRAN	8.49

M Tech in Mechanical Engineering
with Specialization in Smart Manufacturing

S.No.	Roll No.	Name	CGPA
1	SMT18M001	ROHIT KUMAR JHA	8.8
2	SMT18M002	PRADEEP KUMAR VERMA	8.18
3	SMT18M003	SHASHWAT PANDEY	9.33
4	SMT18M005	PRAVEEN KUMAR	8.79
5	SMT18M006	S RAJA RAMANAN	7.99
6	SMT18M007	VISHAK P M	9.89
7	SMT18M008	ASHISH OMAR	7.88
8	SMT18M009	BAFNA SHUBHAM AJIT	8.55
9	SMT18M010	MEVALAL NISHAD	8.01
10	SMT18M011	RAMASHANKAR YADAV	8.57
11	SMT18M012	ABHINAV GOVIND PATEL	7.61
12	SMT18M013	MD TANWEER AHMAD	8.42

PH.D. SCHOLARS

S.No.	Roll No.	Name	Batch
1	MDM11D003	C. GURUNATHAN	MDM
2	MDM13D003	VINAYAGA MURUGA PANDY. N	MDM
3	EDM14D004	XAVIER AROCKIARAJ S	EDM
4	MDM11D001	K BALAJI	MDM
5	PHY13D001	ASHISH KUMAR	PHY

Indian Institute of Information Technology, Design and Manufacturing, Kancheepuram

Revised Academic Calendar – Odd Semester – July – November 2020

DAY	JULY 20			AUGUST 20			SEPTEMBER 20			OCTOBER 20			NOVEMBER 20			DECEMBER 20	
	Date		Days	Date		Days	Date		Days	Date		Days	Date		Days	Date	
TUE							1									1	End Semester / Jan-May 2021 Fee Payment Portal open
WED	1						2									2	End Semester / PG Project Review / DD Comprehensive Exam / Viva
THU	2						3			1		1				3	End Semester PG Project Review / DD Comprehensive Exam / Viva
FRI	3						4			2	Gandhi Jayanthi					4	End Semester PG Project Review / DD Comprehensive Exam / Viva
SAT	4			1	Id-ul-Zuha-Bakrid		5			3	Special Classes	2				5	
SUN	5			2			6			4			1			6	
MON	6			3			7			5		3	2	Pre-Registration for Jan-May 2021 Starts	1	7	
TUE	7			4			8	Commencement of Classes / Enrolment		6		4	3		2	8	
WED	8			5			9		1	7		5	4		3	9	
THU	9			6			10		2	8		6	5		4	10	
FRI	10			7			11		3	9		7	6		5	11	
SAT	11			8			12	Special Classes	4	10	Special Classes	8	7	Special Classes	6	12	
SUN	12			9			13			11			8			13	
MON	13			10			14	Last date for enrolment with fine	5	12	Class Committee	9	9		7	14	Last date for submission of grades
TUE	14			11			15		6	13	Class Committee	10	10		8	15	
WED	15			12			16		7	14		11	11		9	16	
THU	16			13			17		8	15		12	12		10	17	
FRI	17			14			18		9	16		13	13		11	18	Declaration of Results
SAT	18			15	Independence Day		19	Special Classes	10	17	Special Classes	14	14	Diwali/ Deepavali		19	
SUN	19			16			20			18			15			20	
MON	20			17			21	Last date to apply for change of electives	11	19		15	16		12	21	Jan-May 2021 Registration Starts
TUE	21			18			22	Class Committee	12	20		16	17		13	22	
WED	22			19			23	Class Committee	13	21		17	18		14	23	
THU	23			20			24		14	22		18	19		15	24	
FRI	24			21			25		15	23		19	20		16	25	Christmas Day
SAT	25			22			26	Special Classes	16	24	Special Classes	20	21	Special Classes Compilation of Attendance	17	26	
SUN	26			23			27			25	Dussehra/ Vijay Dashmi		22			27	
MON	27			24			28		17	26		21	23	End Semester		28	
TUE	28			25			29		18	27		22	24	End Semester		29	
WED	29			26			30		19	28		23	25	End Semester		30	Jan-May 2021 Registration Ends
THU	30			27						29		24	26	End Semester		31	Jan-May 2021 Fee Payment Portal close
FRI	31			28						30	Id-E-Milad		27	End Semester			
SAT				29						31	Special Classes	25	28				
SUN				30	Muharram								29				
MON				31									30	Guru Nanak's Birthday			

Month	Mondays	Tuesdays	Wednesdays	Thursdays	Fridays	Saturday	Total
September	3	3	4	3	3	3	19
October	4	4	4	5	3	5	25
November	3	3	3	3	3	2	17
Total	**10**	**10**	**11**	**11**	**9**	**10**	**61**

ANNEXURE A

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, DESIGN AND MANUFACTURING KANCHEEPURAM

ACADEMIC CALENDAR FOR B TECH 2020 BATCH
Semester 1

	November 2020			December 2020			January 2021			February 2021			March 2021		
	Date		Days	Date		Days	Date		Days	Date		Days	Date		Days
Sat															
Sun	1														
Mon	2									1	Opening of Pre-Registration for Semester 2	1	1	End Semester	
Tue	3			1		1				2		2	2	End Semester	
Wed	4			2		2				3		3	3	End Semester	
Thu	5			3		3				4		4	4	End Semester	
Fri	6			4		4	1		1	5		5	5		
Sat	7			5	Wednesday's Timetable	5	2	Tuesday's Timetable	2	6	Wednesday's Timetable	6	6		
Sun	8			6			3			7			7		
Mon	9			7	Class Committee	6	4		3	8	Last date to apply for Makeup Quiz II	7	8		
Tue	10			8	Class Committee	7	5		4	9	Last date to announce Quiz II Marks	8	9		
Wed	11			9	Class Committee	8	6		5	10		9	10		
Thu	12			10		9	7		6	11		10	11		
Fri	13			11		10	8	Last date to apply for Makeup Quiz I	7	12		11	12		
Sat	14			12	Tuesday's Timetable	11	9	Wednesday's Timetable	8	13	Thursday's Timetable	12	13	Last date for submission of Grades	
Sun	15			13			10			14			14		
Mon	16			14		12	11	Last date to announce Quiz I Marks	9	15	Closing of Pre-Registration for Semester 2	13	15	Closing of Semester 2 Fee payment window	
Tue	17			15		13	12		10	16	Opening of Semester 2 Fee payment window	14	16	Declaration of Semester 1 Results	
Wed	18			16		14	13	Class Committee	11	17		15	17	Registration Portal to open for Semester 2	
Thu	19			17		15	14	Pongal		18		16	18		
Fri	20			18		16	15	Class Committee	12	19		17	19		
Sat	21			19	Friday's Timetable	17	16	Class Committee Thursday's Timetable	13	20	Friday's Timetable	18	20		
Sun	22			20			17			21			21		
Mon	23	Commencement of Classes / Enrolment	1	21		18	18		14	22	Compilation of Attendance	19	22		
Tue	24		2	22		19	19		15	23			23		
Wed	25		3	23		20	20		16	24	End Semester		24	Registration Portal to close for Semester 2	
Thu	26		4	24		21	21		17	25	End Semester		25		
Fri	27		5	25	Christmas Day		22		18	26	End Semester		26		
Sat	28	Tuesday's Timetable	6	26	Monday's Timetable	22	23	Friday's Timetable	19	27			27		
Sun	29			27			24			28			28		
Mon	30		7	28	Quiz I		25		20				29	Commencement of Classes/ Enrolment For Semester 2	
Tue				29	Quiz I		26	Republic Day					30		
Wed				30	Quiz I		27	Quiz II					31		
Thu				31		23	28	Quiz II							
Fri							29	Quiz II							
Sat							30	Thursday's Timetable	21						
Sun							31								

Month	Mon	Tue	Wed	Thu	Fri	Total
November	2	2	1	1	1	**7**
December	4	5	5	5	4	**23**
January	4	4	4	4	5	**21**
February	4	3	4	4	4	**19**
March	-	-	-	-	-	-
Total	**14**	**14**	**14**	**14**	**14**	**70**

ANNEXURE A

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, DESIGN AND MANUFACTURING KANCHEEPURAM

ACADEMIC CALENDAR FOR B TECH 2020 BATCH

Semester 2

	March 2021			April 2021			May 2021			June 2021			July 2021		
	Date		Days	Date		Days	Date		Days	Date		Days	Date		Days
Sat							1	Friday's Timetable	1						
Sun							2								
Mon	1						3		2						
Tue	2						4		3	1	Quiz II				
Wed	3						5		4	2	Quiz II				
Thu	4			1		1	6		5	3		1	1	End Semester	
Fri	5			2	Good Friday		7		6	4	Opening of Pre-Registration for Semester 3	2	2	End Semester	
Sat	6			3	Friday's Timetable	2	8	Wednesday's Timetable	7	5	Tuesday's Timetable	3	3		
Sun	7			4			9			6			4		
Mon	8			5		3	10	Last date to apply for Makeup Quiz I	8	7		4	5	End Semester	
Tue	9			6		4	11	Last date to announce Quiz I Marks	9	8		5	6	End Semester	
Wed	10			7		5	12		10	9		6	7	End Semester	
Thu	11			8		6	13		11	10		7	8	End Semester	
Fri	12			9	Last date for enrolment with fine	7	14	Id-Ul-Fitr		11	Last date to apply for Makeup Quiz II	8	9		
Sat	13			10	Wednesday's Timetable	8	15	Friday's Timetable	12	12	Wednesday's Timetable	9	10		
Sun	14			11			16			13			11		
Mon	15			12		9	17		13	14	Last date to announce Quiz II Marks	10	12		
Tue	16			13	Class Committee	10	18	Class Committee	14	15	Closing of Pre-Registration for Semester 3	11	13		
Wed	17			14	Class Committee	11	19	Class Committee	15	16	Opening of Semester 3 Fee payment window	12	14		
Thu	18			15	Class Committee	12	20	Class Committee	16	17		13	15	Closing of Semester 3 Fee payment window	
Fri	19			16		13	21		17	18		14	16	Last Date for submission of Grades	
Sat	20			17	Thursday's Timetable	14	22	Thursday's Timetable	**18**	**19**	Friday's Timetable	15	17		
Sun	21			18			23			20			18		
Mon	22			19		15	24		19	21		16	19	Declaration of Semester 2 Results	
Tue	23			20		16	25		20	22		17	20	Opening of Registration for Semester 3	
Wed	24			21		17	26	Buddha Purnima Vesak		23		18	21	Id-Ul-Zuha (Bakrid)	
Thu	25			22		18	27		21	24		19	22		
Fri	26			23		19	28		22	25		20	23		
Sat	27			24	Wednesday's Timetable	20	29	Monday's Timetable	23	26	Tuesday's Timetable	21	24	Closing of Registration for Semester 3	
Sun	28			25	Mahavir Jayanti		30			27			25		
Mon	29	Commencement of Classes / Enrolment	1	26		21	31	Quiz II		28	Compilation of Attendance	22	26	Commencement of Classes/ Enrolment For Semester 3	
Tue	30		2	27		22				29			27		
Wed	31		3	28	Quiz I					30	End Semester		28		
Thu				29	Quiz I								29		
Fri				30	Quiz I								30		
Sat													31		
Sun															

Month	Mon	Tue	Wed	Thu	Fri	Total
March	1	1	1	-	-	**3**
April	4	4	5	5	4	**22**
May	5	4	4	5	5	**23**
June	4	5	4	4	5	**22**
July	-	-	-	-	-	**-**
Total	**14**	**14**	**14**	**14**	**14**	**70**

ANNEXURE B

<u>Master of Design (M.Des.) Curriculum and Syllabus</u>

Indian Institute of Information Technology, Design & Manufacturing Kancheepuram, Chennai 600 127

ANNEXURE B

Introduction:

IIITDM Kancheepuram is launching a new M.Des. program in Integrated Product Design from July 2021 and a Dual Degree in M.Des. from 2023. The purpose of the program is to produce design leaders who have the courage and confidence to identify and resolve paradoxical challenges through creative, smart and contextually relevant products. This document outlines the program objectives, key principles informing curriculum design, the curriculum structure and syllabus.

Program Objectives:

1. To nurture curiosity, aesthetic sense, creative confidence and self-directed learning
2. To cultivate critical thinking, and social and environmentally responsible behaviors
3. To develop the courage and ability to lead change and demonstrate design leadership
4. To encourage product innovation in areas that can lead to Atmanirbhar Bharat

Key principles informing curriculum design:

1. Student and Practice-centered learning:
    a. A two-week foundation course at the beginning of the program to help students rediscover their creative selves, set goals and take ownership for their learning
    b. The program lays strong emphasis on experiential learning and whole-body engagement through sketching, model making, and reflexive narratives to cultivate the qualities of presence, responsiveness and improvisation in a context (learning-by-doing: 60% credits; theory: 40% credits)
2. Integration of design with technology and business:
    a. Exposure to digital tools and AI for collaborative design
    b. Emerging technologies (Kinetic Art, Electric Vehicles, Wearables, Context Aware)
    c. Strategic management of design & innovation and Product-Service Systems
3. Thrust on Product Innovation:
    a. Vertically integrated projects across semesters to encourage product innovation

ANNEXURE B

Curriculum structure:

Figure 1 below shows the overall curriculum structure and the logical flow of courses.

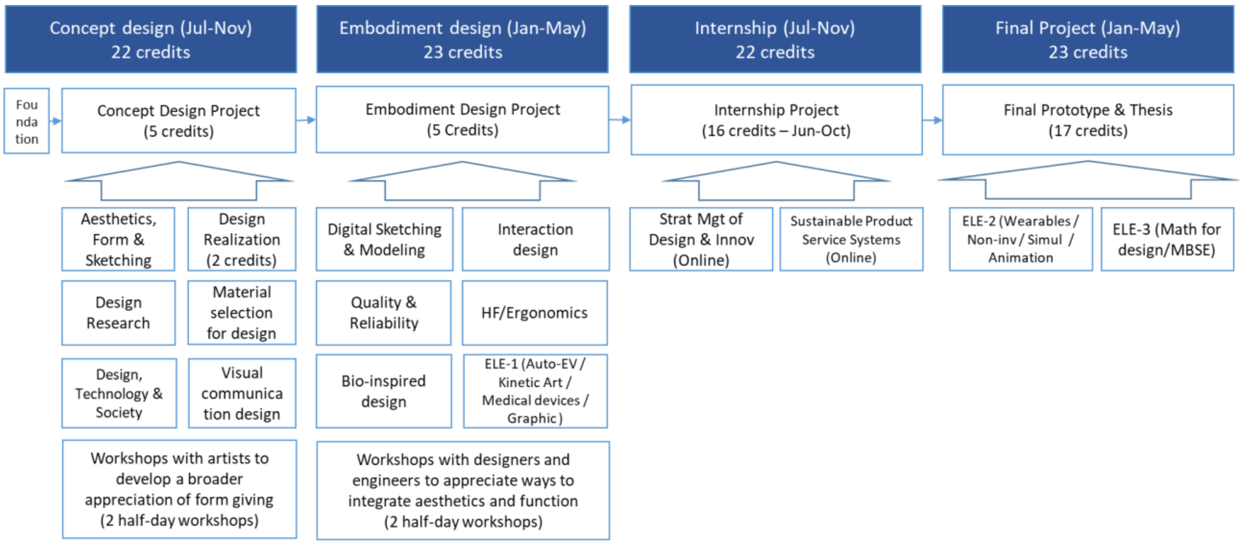


Figure 1: M.Des. curriculum structure

The courses in the first two semesters are designed to aid the concept and embodiment design projects of the students. The course delivery will be coordinated by faculty to ensure that they add value to the students and their projects. The courses will also be augmented by a series of workshops with external experts. The students will be encouraged to leverage the power of digital tools from the second semester. As a policy, the school will encourage students to mix and match open-source tools. An overview of industry grade tools will be provided through workshops. The vertical specific electives will help the students understand practices in specific industries of interest. A full-semester internship provides an option for the students to experience product development in the industry or develop their own product/startup or work on faculty-led products. Internships will be co-supervised by the faculty.

The evaluation process will include class assignments, project reviews by industry mentors and an external jury, and reflection on their experience and theoretical concepts. The assessments will look into the ability of the student to produce highest quality of work with available tools. The internship report will require the student to reflect on his/her participation and the process of product development in the chosen context. The final project evaluation will not only assess the product prototype, but also a thesis where the student is expected to reflect on his/her experience in design and innovation vis-à-vis the theoretical concepts learnt. The above activities are expected to challenge the thinking of students and instil the spirit of action research.

ANNEXURE B

Syllabus for M.Des. courses (Semester 1):

Course Title	Foundation for integrated product design	**Course No**					
Specialization	Integrated Product Design	**Structure (LTPC)**	2	1	0	3	
Offered for	Master of Design (Semester 1)	**Status**	Core X		Elective		
Prepared by	Dr Sudhir Varadarajan						
Prerequisite	None	**To take effect from**	44th Senate				
Course Objectives	1. Unlearn limiting assumptions, risk avoidance, fear of failure 2. Awaken their senses & rediscover their creative selves **3.** Experience the impact of design and technology in everyday objects This course is expected to be conducted as part of the induction process (first two weeks)						
Course Outcomes	At the end the course, the students are expected to: ● unlearn key limiting assumptions ● demonstrate qualities of immersion in a task ● be excited by the potential of technology and design in improving lives ● become comfortable with sketch-thinking and develop skills in design sketching						
Contents of the course (With approximate break up of hours)	**Module-1: Induction: (16 hrs)** ● History of the place; the industrial ecosystem; institution ● Exercises to improve interaction; local visits; **Module-2: Learn to observe nature and self (32 hrs)** ● Know your context - physical and social; ● Unlearning activities; Start journaling ● Observe wholes-parts (trees-leaves); variety of leaves; colors ● Document in a variety of ways - collage; sketch, paint, photograph, video **Module-3: Learn to observe everyday objects (32 hrs)** ● Unbundle everyday objects, observe, reorganize ● Whole-part relations; System physics; ● Observe interplay of art, design, culture, technology in everyday objects **Module 4: Take ownership for your learning** • Understanding learning strategies • Self-reflection & purpose for being						
Texts & References	1. Frank R Wilson (1998), The hand: How it shapes the brain, language and human culture, Vintage Books, NY, ISBN: 9780679740476 2. Keri Smith (2008), How to be an Explorer of the World: Portable Life Museum, Penguin Group, ISBN:9780241953884						

ANNEXURE B

<table>
<tr><td>Course Title</td><td>Aesthetics, Forms and Sketching</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Integrated Product Design</td><td>Structure (LTPC)</td><td>1</td><td>0</td><td>3</td><td>3</td></tr>
<tr><td>Offered for</td><td>Master of Design (Semester 1)</td><td rowspan="2">Status</td><td colspan="2" rowspan="2">Core
X</td><td colspan="2" rowspan="2">Elective</td></tr>
<tr><td>Prepared by</td><td>Dr Gurunathan</td></tr>
<tr><td>Prerequisite</td><td>None</td><td>To take effect from</td><td colspan="4">2021 Batch</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To introduce elements of art and their application in aesthetics and design
2. To provide in-depth understanding of principles of design, concepts of form, 2D/3D geometries, exploration of surface textures in different materials, relationship between form, materials and process.
3. To provide hands-on training in sketching to enable the students to communicate the design ideas and also to stimulate design improvements</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">At the end of the course the students will be able to:
● Understand aesthetic principles governing the design
● Use freehand sketching to communicate the design ideas through realistic product representations</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="6">Module 1: Art-Design-Aesthetics Interrelation (8 hrs)
Role of art in design and idea communication; Aesthetics in design; Drawing tools and materials; Basic sketching; Emotive qualities of line; line wight and style

Module 2: 2D and 3D forms (12 hrs)
Geometric and organic shapes; Shape modifications; Basics of forms; Constructing complex forms from solids; Freehand representation of shapes and forms using orthographic drawings

Module 3: Spatial thinking and visualization (20 hrs)
Rendering space in 2D paper – basics of perspective; +/- ve space; white space – composition of objects; Concepts of isometric and perspective drawing and sketching of regular shapes; Scale and proportion; Principles of design in sketching – balance, alignment, emphasis, proportion, movement, pattern, contrast, unity; Freehand generation of complex forms and structures; Product sketching, exploded views and cutaway sections; Quality of light on the forms - Value study and value techniques.

Module 4: Surface qualities and color (12 hrs)
Representation of surface characteristics and materials through texture; Relating form to materials and processes of manufacture; Color theory and color harmony; Introduction to color psychology and its application in design – case studies.

Hands-on practice will focus on presentation of design ideas through sketches using conventional tools.</td></tr>
<tr><td>Texts & References</td><td colspan="6">1. J.Itten (1975), Design and Form, John Wiley and Sons, ISBN:9780471289302
2. Robert H McKin (1980), Experiences in visual thinking, Brooks/Cole, ISBN: 978-0818504112
3. D’Arcy Thompson (1992), On growth and form, Cambridge University Press, ISBN:9780521066228
4. Shyamala Gupta (1999), Art, beauty and creativity: Indian and Western Aesthetics, D.K.Printworld , ISBN: 9788124601334
5. Betty Edwards (2001), The New Drawing on the right side of the brain, Harper Collins, ISBN:9780007116454
6. Hannah. G. G (2002), Elements of design: Rowena Reed Kostellow and the structure of visual relationships, Princeton Architectural Press, ISBN:9781568983295
7. M. Macnab (2011), Design by nature: Using universal forms and principles in design, New Riders, ISBN:9780321747761
8. D. Puhalla (2011), Design elements, form & space: a graphic style manual for understanding structure and design, Rockport Pub, ISBN:9781592537006
9. K. Eissen, and S. Roselien (2012), Sketching: basics, Stiebner Verlag GmbH, ISBN:9783830714101</td></tr>
</table>

ANNEXURE B

Course Title	Design, Technology and Society	**Course No**	
Specialization	Integrated Product Design	**Structure (LTPC)**	2 | 1 | 0 | 3
Offered for	Master of Design (Semester 1)	**Status**	Core X | Elective
Prepared by	Dr Sudhir Varadarajan		
Prerequisite	None	**To take effect from**	2021 Batch
Course Objectives	1. To provide an understanding of the social and cultural history of design and technology 2. To develop critical thinking skills and ability to surface unstated needs / hidden meanings		
Course Outcomes	At the end of the course the students will develop • An appreciation of historical development of design and technology • Use sociological perspectives to understand the context of design & navigate the same • Apply ethnographic methods to surface cultural and social aspects for concept development		
Contents of the course (With approximate break up of hours)	**Module-1: History of Design & Technology (9)** ● Industrialization, technology and design ● Design movements - The Bauhaus, Ulm school of design and Indian design ● What is ‘Indian’ and how it has been defined over time - artifacts, rituals, myths **Module-2: Sociology of Design (12)** ● Key sociological perspectives – functionalist, conflict and interactionist ● Material / temporal / relational dimensions & Actor Network Theory ● What drives creative design teams - Interactionism and Reflexivity **Module-3: Ethnographic observations (21)** ● Immersive observation of everyday objects and interactions ● Gigamapping/rich pictures to capture observations ● Journaling, synthesizing observations ● Field visits: Urban/Rural context/needs/problems Evaluation: 70% assignments/activities + 30% End Semester		
Texts & References	1. Gyorgy Kepes ed. (1966), Vision + Value series (The man-made object), George Braziller, ISBN:9781122190879 2. Papanek, Victor (1985); Design for the Real World: Human Ecology and Social Change, Academy Chicago Publishers; 2nd Revised edition, ISBN:9780897331531 3. Vance Packard (2007), The hidden persuaders, Ig Publishing, Reissue edition, ISBN:9780978843106 4. Balaram, S. (2010), Thinking Design, Sage India, ISBN:9788132103141 5. Trevor Pinch (Editors) (2012), The Social Construction of Technological Systems: New directions in the sociology and history of technology, MIT Press, Anniversary Edition, ISBN:9780262517607 6. Wendy Gunn, Ton Otto & Rachel Smith (2013), Design Anthropology: Theory and practice, Bloomsbury, ISBN:9781472518231 7. Adrian Forty (1992), Objects of desire: Design and society since 1750s, Thames & Hudson, ISBN:9780500274125 8. Bernhard E Burdek (2015), History, theory and practice of product design, second revised edition, ISBN:9783035603965 9. Bloomsbury (2015), The Bloomsbury encyclopedia of design, Bloomsbury Academic, ISBN:9781472521576 10. Swapnaa Tamhane and Rashmi VarmSar (2016), The Essence of Indian Design, Phaidon Press, ISBN:978071480502		

ANNEXURE B

<table>
<tr><td>Course Title</td><td>Design Research: Theory and Methods</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Integrated Product Design</td><td>Structure (LTPC)</td><td>2</td><td>1</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>Master of Design (Semester 1)</td><td rowspan="2">Status</td><td colspan="2" rowspan="2">Core
X</td><td colspan="2" rowspan="2">Elective</td></tr>
<tr><td>Prepared by</td><td>Dr Sudhir Varadarajan</td></tr>
<tr><td>Prerequisite</td><td>None</td><td>To take effect from</td><td colspan="4">2021 Batch</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To introduce students to a variety of theories and methods used in new concept development
2. To enable students to pick and choose appropriate methods for the context</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">At the end of the course, students are expected to
• Apply a set of methods to inquire into a problem situation and define product requirements
• Reflect on the methodological assumptions and strengths and weaknesses of different methods</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="6">Module-1: Introduction (6 hrs)
• Product development process
• Complexity in the fuzzy front-end of new product development
• Product ontology (form-function-structure-behavior)
Module-2: Introduction to design theories and methods of inquiry (6 hrs)
• Developments in design methodology – phenomenology, semiotics, information-aesthetic
• Qualitative, quantitative, speculative, experiential modes of research
Module-3: Methods to capture requirements/surface needs (12 hrs)
• Understanding social, economic (competition, value chains) and technology trends
• Human/User-centered design theory and methods; Systems theory and methods
Module-4: Methods to synthesize findings and writing design briefs (18 hrs)
• Developing a design brief (problem statement)
• Methods of divergent and convergent thinking to ideate concepts
Evaluation: 70% assignments/activities + 30% End Semester</td></tr>
<tr><td>Texts & References</td><td colspan="6">1. Dan Norman (2010); Living with complexity, MIT Press, ISBN:9780262014861
2. Brenda Laurel (ed.) (2003), Design research: Methods and perspectives, MIT Press, ISBN:9780262122634
3. Sanders L & Stappers P J (2013), Convivial Toolbox: Generative research for the front end of design, BIS, ISBN:9789063692841
4. Peter Dowtown (2013), Design Research, Elizabeth James Productions, Melbourne
5. Bruce Hanington and Bella Martin (2019), Universal methods of design, Rockport Publishers, Rev edn, ISBN:9781631597497
6. Edward De Bono (2015), Lateral Thinking: creativity step by step, Harper Perennial, Reissue edition, ISBN:9780060903251
7. Annie Gentes (2017), The in-discipline of design, Springer, ISBN:9783319659848
8. Toshiharu Taura (2016), Creative design engineering: An interdisciplinary approach, Elsevier, London, ISBN:9780128042267</td></tr>
</table>

ANNEXURE B

<table>
<tr><td>Course Title</td><td>Material selection for product designers</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Integrated Product Design</td><td>Structure (LTPC)</td><td>2</td><td>1</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>Master of Design (Semester 1)</td><td rowspan="2">Status</td><td colspan="2" rowspan="2">Core
X</td><td colspan="2" rowspan="2">Elective</td></tr>
<tr><td>Prepared by</td><td>Dr Raguraman M & Dr Gurunathan C</td></tr>
<tr><td>Prerequisite</td><td>None</td><td>To take effect from</td><td colspan="4">2021 Batch</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To introduce a range of materials used in different stages of product devp (concept to prototype)
2. To provide detailed understanding of the behavior of different classes of materials with respect to temperature stability, thermal and electrical conductivity, strength, toughness and chemical resistance
3. To introduce analytical tools and methods for qualified materials selection for product design</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">After completion of this course, students are able to:
• Apply systematic and objective materials selection based on the principles of Ashby model/ Cambridge Engineering Selector (CES)
• Define correct conditions and objectives regarding materials selection and analyze and evaluate the role of geometrical aspects in materials selection</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="6">Module-1: Introduction and overview (18 hrs)
• Properties of Metals, Ceramics and Polymers
• Basics of design calculations and design-oriented materials selection,
• Introduction to Material Property Charts
Module-2: Material selection process (18 hrs)
• Rationalizing and Critical Assessment of Material Properties
• Selecting materials and shape with multiple constraints and objectives
• Materials selection for industrial design
Module-3: Advanced materials & environment (6 hrs)
• Advanced materials design – Composites and Hybrids
• Materials and environment
Evaluation: 70% assignments/activities + 30% End Semester</td></tr>
<tr><td>Texts & References</td><td colspan="6">1. Ashby, M.F. (1992), Materials Selection in Mechanical Design, Elsevier, 5th and 4th editions, ISBN:9780081005996
2. Gordon, M. Joseph (2002); Industrial design of plastics products, ISBN:9780471231516
3. Karana, Elvin, Owain Pedgley, and Valentina Rognoli, eds. (2013), Materials Experience: fundamentals of materials and design. Butterworth-Heinemann, ISBN:9780080993591
4. Maleque, Md Abdul, and Mohd Sapuan Salit (2013); Materials selection and design. Springer Singapore, ISBN:9789814560375</td></tr>
</table>

ANNEXURE B

<table>
<tr><td>Course Title</td><td>Design Realization Skills Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Integrated Product Design</td><td>Structure (LTPC)</td><td>0</td><td>0</td><td>3</td><td>2</td></tr>
<tr><td>Offered for</td><td>Master of Design (Semester 1)</td><td rowspan="2">Status</td><td colspan="2" rowspan="2">Core
X</td><td colspan="2" rowspan="2">Elective</td></tr>
<tr><td>Prepared by</td><td>Dr Jayachandra Bingi</td></tr>
<tr><td>Prerequisite</td><td>None</td><td>To take effect from</td><td colspan="4">2021 Batch</td></tr>
<tr><td>Course Objectives</td><td colspan="6">To help students develop workshop practice and rapid prototyping skills to realize mockups and concept prototypes</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">Students will develop skills in workshop practice and rapid prototyping; project management and focusing on delivering outcomes</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="6">Module-1: Exposure to tools/equipment to machine external appearance of simple shapes. (20 hours)
a. Wood carving
b. Plastic welding and cutting
c. Engraving
d. Sheet metal works
e. Wire cutting
Module-2: Exposure to rapid prototyping tools – subtractive, additive and electronic (8 hours)

Module-3: Practice in realizing simple products in terms of shape, size and functionality etc. (14 hours)

Evaluation: Assignments / Activities (70%); End Semester (30%)</td></tr>
<tr><td>Texts & References</td><td colspan="6">1. Bjarki Hallgrimsson (2012), Prototyping and Modelmaking for Product Design, Lawrence King Publishing, ISBN:9781856698764</td></tr>
</table>

ANNEXURE B

Course Title	Visual Communication Design	Course No				
Specialization	Integrated Product Design	Structure (LTPC)	2	1	0	3
Offered for	Master of Design (Semester 1)	Status	Core X		Elective	
Prepared by	Dr Raguraman Munusamy					
Prerequisite	None	To take effect from	2021 Batch			
Course Objectives	To introduce students to a practice-based, hands-on approach to visual communication design					
Course Outcomes	On completion of this course, students will be able to: ● Understand differences between visual UX, UI, graphic, and web design and construct an artist's statement ● Apply the concepts found within elements and principles of design to incorporate theories and concepts when discussing visual communication, ● Create a brand identity such as business cards, packaging, and advertising, design logos, especially as related to brand identity ● Use digital tools to design graphical images, understand the difference between different graphics and image file formats.					
Contents of the course (With approximate break up of hours)	**Module 1: Introduction to Visual Communication Design (6 hrs)** ● Definition, Graphic design vs art, Design thinking, Visual design tools and Image files ● Semiotics and design **Module 2: Typography and typographic elements (6 hrs)** ● Historical evolution, Serif vs sans-serif fonts, Legibility vs readability, Use in ads, signs, movie posters **Module 3: Composition, Creativity, Artistry, Aesthetics and the design process (6 hrs)** ● Focus, Leading lines, Scale/hierarchy, Contrast, Repetition, White space and Rule of thirds ● Creativity vs Innovation, Aesthetics and their evolution, Creative/Design Process and flow **Module 4: Symbolism and collage (12 hrs)** ● Symbols and signs, Psychoanalytical symbols, Metaphor in visual design, Evolution of symbols and metaphor ● Collage, Photomontage, Assemblage, Digital collage/e-Collage, Influence of movements: Dada, Surrealism, Expressionism **Module 5: Visual identity and branding (12 hrs)** ● Visual identity, branding, logo design, UI/UX and design for the web, advertising, brochures, print and posters. Evaluation: 70% assignments/activities + 30% End Semester					
Texts & References	1. Umberto Eco (1978), A theory of semiotics, John Wiley & Sons, ISBN:9780253202178 2. Edward Tufte (1990), Envisioning information, Graphics Pr, ISBN:9780961392116 3. Carolyn Handa (2004), Visual rhetoric in a digital world: A critical sourcebook, Bedford/St Martin's, ISBN:9780312409753 4. Lidwen W, Holder K and Butler J (2010), Universal principles of design, Rockport publishers, ISBN:9781592535873 5. M. Davis and J. Hunt (2017), Visual Communication Design, Bloomsbury Academic, New Edition, ISBN:9781474221573					

ANNEXURE B

<table>
<tr><td>Course Title</td><td>Concept Design Project</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Integrated Product Design</td><td>Structure (LTPC)</td><td>1</td><td>0</td><td>6</td><td>5</td></tr>
<tr><td>Offered for</td><td>Master of Design (Semester 1)</td><td rowspan="2">Status</td><td colspan="2" rowspan="2">Core
X</td><td colspan="2" rowspan="2">Elective</td></tr>
<tr><td>Prepared by</td><td>Dr Sudhir Varadarajan</td></tr>
<tr><td>Prerequisite</td><td>None</td><td>To take effect from</td><td colspan="4">2021 Batch</td></tr>
<tr><td>Course Objectives</td><td colspan="6">To encourage the students to identify a domain and problem of interest, and conceptualize and showcase a new product concept using all the theories, methods and tools learnt in the 1st semester courses</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">At the end of the course, the student is expected to:
• gain confidence in dealing with the fuzzy front end of product innovation
• gain practical hands-on experience in doing design research, making design choices
• conceptualizing and pitching a new product concept to external industry experts</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="6">The concept design project is expected to be done in a team. The team must experience the process of norming, forming and performing

The process followed will be based on the methods learnt in the Design Research course, supplemented by the content and skills learnt in other courses

Project management, documentation and presentation skills will be key aspects that will be monitored

The activity will be carried out in the design studio, and supported by regular design reviews with peers, faculty, and mentors

Evaluation: Evaluation: 70% Continuous assessment + 30% Final Concept Presentation</td></tr>
<tr><td>Texts & References</td><td colspan="6">1. Dan Cuffaro and Isaac Zaksenberg (2013), The Industrial Design Reference & Specification Book: Everything Industrial Designers Need to Know Every Day, Rockport publishers, ISBN:9781610587891
2. Bruce Hanington and Bella Martin (2017), The Pocket Universal Methods of Design: 100 Ways to Research Complex Problems, Develop Innovative Ideas and Design Effective Solutions, Rockport publishers, ISBN:9781631593741
3. Donald A Schon (1984), The reflective practitioner: How professionals think in action, Basic Books, ISBN:9780465068784</td></tr>
</table>

ANNEXURE B

Syllabus for M.Des courses (Semester 2):

<table>
<tr><td>Course Title</td><td>Digital Sketching and Modeling</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Integrated Product Design</td><td>Structure (LTPC)</td><td>1</td><td>0</td><td>3</td><td>3</td></tr>
<tr><td>Offered for</td><td>Master of Design (Semester 2)</td><td rowspan="2">Status</td><td colspan="2" rowspan="2">Core
X</td><td colspan="2" rowspan="2">Elective</td></tr>
<tr><td>Prepared by</td><td>Dr Gurunathan C</td></tr>
<tr><td>Prerequisite</td><td>Studies of Form and Design Sketching</td><td>To take effect from</td><td colspan="4">2021 Batch</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To introduce the advanced sketching and modeling concepts needed for product design
2. To provide hands-on training in computer-based sketching and 3D modeling tools.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">Students will be able to demonstrate drawing and modeling skills to communicate the design ideas/concept products using computer-based tools</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="6">Module-1: Digital Product Sketching (21 hrs)
● Introduction to computer-based sketching tools (3 hrs)
● Digital sketching of planar shapes, curved shapes and objects (6 hrs)
● Digital sketching of concept products (9 hrs)
● Colors and material representation using software (3 hrs)
Module-2: 3D Modeling (21 hrs)
● Introduction to computer-based modeling tools (6 hrs)
● Development of 3D forms and objects using software (6 hrs)
● Photorealistic rendering using software tools (3 hrs)
● Product animation and concept presentation / AR/VR immersive experience (3 hrs)
● Artificial intelligence led improvisation in design (generative design) (3 hrs)
Evaluation: 70% assignments/activities + 30% End Semester</td></tr>
<tr><td>Texts & References</td><td colspan="6">1. Caplin. S, Banks. A, Holmes. N (2003); The Complete Guide to Digital Illustration, Watson-Guptill Publications, ISBN:9780823007844
2. R. Gil (1991); Basic Rendering: Effective Drawing for Designers, Artists and Illustrators, Thames & Hudson, ISBN:9780500276341
3. S. Robertson and B. Thomas (2012); How to Render: the fundamentals of light, shadow and reflectivity, Design Studio Press, ISBN:9781933492964</td></tr>
</table>

ANNEXURE B

<table>
<tr><td>Course Title</td><td>Bio-inspired design</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Integrated Product Design</td><td>Structure (LTPC)</td><td>2</td><td>1</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>Master of Design (Semester 2)</td><td rowspan="2">Status</td><td rowspan="2" colspan="2">Core X</td><td rowspan="2" colspan="2">Elective</td></tr>
<tr><td>Prepared by</td><td>Dr Jayachandra Bingi</td></tr>
<tr><td>Prerequisite</td><td>Design Research</td><td>To take effect from</td><td colspan="4">2021 Batch</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To give the student an exposure of bio-inspired design principles
2. To train the student in applying the bio-inspired methodologies for innovation
3. To introduce different perspectives of bio-inspired design and future scope of this valuable domain</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">After completion of this course, the student is expected to:
• Describe methods for creative design
• Identify mechanical working principles of biological phenomena - explain their construction, motion, and/or processing mechanisms - formalize the essence, derive non-conventional design principles
• Implement them in innovative devices - summarize the transition process from the biological to the mechanical domain - present their design in drawings and working models.</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="6">Module 1: Introduction (6 hrs)
• Basic principles, building blocks, material property charts, how the study of nature's designs can help engineers, examples of successful biomimetic designs. Mechanical design – hierarchical construction, bio-composites, structure & properties of bamboo, silks, bones, teeth, shells, antlers and beaks, impact resistance, fracture mitigation, damping, self-healing.
Module 2: The Bio-inspired Design Approach (3 hrs)
• Finding the biological information, Dealing with friction, Innovative designing with ACRREx (Abstracting, Categorizing, Reflecting, Reformulating and Extending) method.
Module 3: Bio-inspired Design Methodology (6 hrs)
• Problem solving, TRIZ, innovation and efficiency, functions, integration between biology design and innovation, methodology chart.
Module 4: Bio-designing Perspectives (27 hrs)
• Materials and surfaces: Muscles and artificial muscles, lotus effect, gecko adhesion, Desert beetle, pitcher plants, bio-fouling, coatings. Silver ant and heat dissipation, insulation of fur and feathers, constructal theory.
• Sensors: Biological sensors, Bio-inspired sensors
• Control: Robot controllers, Soft robotics, Bio-inspired Artificial intelligence (Evolutionary & Developmental Systems, Neural Systems, Immune Systems, Behavioral Systems and Collective systems)
• Bio-optics – structural colors, compound eyes, antireflection, stealth, imaging
• Navigation – short- and long-range navigation techniques of bees, ants, turtles & migratory birds.
• Bio-inspired design task
Evaluation: 70% assignments/activities + 30% End Semester</td></tr>
<tr><td>Texts & References</td><td colspan="6">1. Dario Floreano and Claudio Mattiussi (2008), Bio-Inspired Artificial Intelligence, MIT Press, ISBN:9780262062718
2. Reich Y (1995), A critical review of General Design Theory. Research in Engineering Design, 7 (1) 1-18, https://doi.org/10.1007/BF01681909
3. Maria G. Trotta (2011), Bio-inspired Design Methodology, Intl Journal of Info Science 1(1), pp 1-11, doi: 10.5923/j.ijis.20110101.01
4. Yoseph Bar-Cohen (2016), Biomimetics: Nature-Based Innovation, CRC Press, ISBN:9781439834763
5. Ashok K G, Daniel A McAdams, Robert B. Stone (2013), Biologically inspired designs, Springer London, ISBN:9781447152477
6. Lakhtakia A, Martin-Palma RJ (eds) (2013), Engineered biomimicry; Elsevier, ISBN:9780124159952
7. Lawrence Shapiro (2019), Embodied Cognition, Routledge, 2nd Edition, ISBN:9781351719162</td></tr>
</table>

ANNEXURE B

Course Title	Design for quality and reliability	**Course No**	
Specialization	Integrated Product Design	**Structure (LTPC)**	2 1 0 3
Offered for	Master of Design (Semester 2)	**Status**	Core X / Elective
Prepared by	Dr Raguraman Munusamy		
Prerequisite	Probability and Statistics at undergraduate level	**To take effect from**	2021 Batch
Course Objectives	The objectives of the course are to help engineering students understand: 1. To understand concepts of quality and reliability 2. To evaluate the overall reliability of a system from component reliability.		
Course Outcomes	On completion of the course, students are able to: ● Model repairable and non-repairable systems and calculate failure/repair rate, reliability, availability ● Use various probability density distributions significant to reliability calculations ● Fit a given failure dataset of a product into a Weibull distribution and estimate the reliability		
Contents of the course (With approximate break up of hours)	**Module 1: Concepts of Product Quality and testing (6)** ● Quality Function Deployment / House of Quality ● Software testing for quality ● Electronic products testing for quality **Module 2: Concepts of Reliability (9)** ● Basic concepts of repairable and non-repairable systems ● Reliability, Availability and Maintainability **Module 3: Failure data analysis (9)** ● Fitting discrete and continuous distributions to failure data sets, Weibull analysis, estimation of important reliability parameters **Module 4: Calculation of System Reliability from Component reliabilities (12)** ● Markov modeling of repairable and non-repairable systems ● Reliability Logic Diagrams ● Fault-tree analysis **Module 5: Preventive and Predictive maintenance (6)** ● Failure Modes and Effects Analysis Evaluation: 70% assignments/activities + 30% End Semester		
Texts & References	1. B.L. Hansen & P.M. Ghare (1997), Quality Control and Applications, Prentice-Hall, ISBN:9788120307940 2. Louis Cohen, Joseph P. Ficalora (2009), Quality Function Deployment and Six Sigma, Prentice Hall, 2nd Ed, ISBN:9780133364439 3. Patrick O'Connor (2012), Practical Reliability Engineering, John Wiley, ISBN:9780470979815 4. VNA Naikan (2010), Reliability Engineering and Life Testing, PHI Learning, ISBN:9788120335936 5. Singiresu S Rao (2014), Reliability Engineering, Pearson Education, ISBN:9780136015727		

ANNEXURE B

<table>
<tr><td>Course Title</td><td>Interaction design (UX / UI)</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Integrated Product Design</td><td>Structure (LTPC)</td><td>2</td><td>1</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>Master of Design (Semester 2)</td><td rowspan="2">Status</td><td colspan="2" rowspan="2">Core
X</td><td colspan="2" rowspan="2">Elective</td></tr>
<tr><td>Prepared by</td><td>Dr Raguraman Munusamy</td></tr>
<tr><td>Prerequisite</td><td></td><td>To take effect from</td><td colspan="4">2021 Batch</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To introduce students to interaction design for a variety of applications.
2. To provide principles, patterns and processes for interaction design, rapid prototyping, user interface (UI) and user experience (UX) design
3. To develop skills that can be applied to web publishing, mobile app development, game development, entertainment and artistic performances</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">Upon successful completion of this course, students are able to:
● Identify basics of both analog and digital interactions
● Apply disciplined visualization and the design process, implementing design principles
● Understand the history of interaction design and explore current trends in user experience design</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="6">Module:1: Introduction and State of the Art (12 hrs)
● Touch Screens vs. real touch and feeling
● Inspirations from food, fashion, and fitness
● Interaction paradigms and materials for real “touch”
Module-2: Going beyond heads-down interaction (24 hrs)
● Building interfaces that allow users to be adventurous and individual
● UX as performance
● Moving towards mindful interaction
● The bigger picture
Evaluation: 70% assignments/activities + 30% End Semester</td></tr>
<tr><td>Texts & References</td><td colspan="6">1. Don Norman (1988), Design of everyday things, Basic books, ISBN:9780465003945
2. Donald A Norman (2007), The design of future things, Basic Books, New York, ISBN:9780465002276
3. Garrett J J (2010), The elements of user experience: User-centered design for the web, New Riders, ISBN:9780321624642
4. Dan Saffer (2009), Designing for interaction: Creating innovative applications & devices, New Riders, ISBN:9780321643391
5. Greenberg, S., Carpendale, S., Marquardt, N., & Buxton, B. (2011), Sketching user experiences: The workbook, Morgan Kaufmann, ISBN:9780123819598
6. Steve Krug (2015), Don’t make me think, Revisited, 3rd edition, Pearson Books, ISBN:9789332542860
7. Simon Robinson, Gary Marsden, Matt Jones (2014), There’s Not an App for That – Mobile User Experience Design for Life, Morgan Kaufmann Publishers, ISBN:9780124166912</td></tr>
</table>

ANNEXURE B

<table>
<tr><td>Course Title</td><td>Human Factors & Ergonomic Design</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Integrated Product Design</td><td>Structure (LTPC)</td><td>2</td><td>1</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>Master of Design (Semester 2)</td><td rowspan="2">Status</td><td colspan="2" rowspan="2">Core
X</td><td colspan="2" rowspan="2">Elective</td></tr>
<tr><td>Prepared by</td><td>Dr Raguraman Munusamy</td></tr>
<tr><td>Prerequisite</td><td></td><td>To take effect from</td><td colspan="4">2021 Batch</td></tr>
<tr><td>Course Objectives</td><td colspan="6">The objective of this course is to help students understand
1. Different physical, physiological and psychological capabilities and limitations of human beings,
2. Generation of ergonomic specifications
3. Application of ergonomic principles to various products, interfaces and environments for maximizing user satisfaction and minimizing risk involved in the usage of the design</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of the course, students will be able to:
● Apply the concepts of the human factors and ergonomics in design to complete the several projects in relation to various disciplines</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="6">Module 1: Introduction and overview (10 hrs)
● History of human factors, multi-disciplinary engineering, human machine system, characteristics of system, information theory, types of information, selection of display modality, coding of information, compatibility, memory, decision making, attention, text, graphics, symbols, quantitative visual display, representational display, auditory, tactual and olfactory displays.
Module 2: Anthropometry (10 hrs)
● Need for anthropometry, data collection methodology, measuring procedures, tools, statistical analysis of data for percentile calculation, anthropometric measurements, percentile calculation, usage of the anthropometric percentile values, ergonomic guidelines for products, equipment and accessories, anthropometry in applications
Module 3: Biomechanics (12 hrs)
● Biostatics – static equilibrium equations, musculoskeletal system, problems in mechanics of upper extremity and hand, lower extremity and foot, bending, lifting and carrying,
● Biodynamics – linear kinematics, angular kinematics, human body kinetics, human body impact and collision, surface electromyogram, electrocardiogram and heart rate measurement
Module 4: Virtual ergonomics (10 hrs)
● Digital Human Modeling (DHM), anthropometric models, models for production design, biomechanical models, anatomical models, cognitive models,
● DHM packages – selection strategies, Functionalities, Virtual ergonomics evaluation techniques – Rapid Upper Limb Assessment, field of vision, reach envelopes, accessibility and clearance analysis, discomfort analysis, Applications of DHM

Evaluation: 70% assignments/activities + 30% End Semester</td></tr>
<tr><td>Texts & References</td><td colspan="6">1. M. S. Sanders and Ernest J. McCormick (1992), Human Factors in engineering and Design, McGraw-Hill International Editions, ISBN:9780070549012
2. Duffy V G (2009), “HandBook of Digital Human Modeling: Research for Applied Ergonomics and Human Factor Engineering”, Taylor & Francis, ISBN:9780805856460
3. Chandler Allen Phillips (2000), “Human Factor Engineering”, John Wiley & Sons, Inc, ISBN:9780471240891
4. D Chakrabarti (1997), “Indian Anthropometric Dimensions for Ergonomic Design Practice”, National Institute of Design, Ahmedabad, doi:10.1177/106480469900700210
5. G Salvendy (1997), “Handbook of Human Factors and Ergonomics”, John Wiley & Sons, Inc., ISBN:0471116904</td></tr>
</table>

ANNEXURE B

<table>
<tr><td>Course Title</td><td>Embodiment Design Project</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Integrated Product Design</td><td>Structure (LTPC)</td><td>1</td><td>0</td><td>6</td><td>5</td></tr>
<tr><td>Offered for</td><td>Master of Design (Semester 2)</td><td rowspan="2">Status</td><td colspan="2" rowspan="2">Core
X</td><td colspan="2" rowspan="2">Elective</td></tr>
<tr><td>Prepared by</td><td>Dr Sudhir Varadarajan</td></tr>
<tr><td>Prerequisite</td><td>None</td><td>To take effect from</td><td colspan="4">2021 Batch</td></tr>
<tr><td>Course Objectives</td><td colspan="6">The objective of this course is to encourage the students to translate their concepts into a minimum viable product (PoC) using all the theories, methods and tools learnt in the 1^{st} and 2^{nd} semester courses</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">Students will develop skills in workshop practice and rapid prototyping; project management and focusing on delivering outcomes</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="6">Module-1: Minimum viable product plan (3 hours)
● Markets and Needs
● Business Goals
● Key features
Module-2: Core Product Architecture (6 hours)
● Storyboarding of the product core
● Framework for mechanical, electronics and computing paradigm
Module-3: Design for Manufacture & Assembly (3 hours)
● Manufacturing Process: Form
● Assembly constraints: Fit
● HF/Ergonomic considerations
● Interaction design
● Quality and Reliability considerations
Module-4: Developing the Proof of Concept (30 hours)
● Build
● Assemble
● Iterate
● Validate
● Pitch
Evaluation: 70% Continuous assessment + 30% Final Demo</td></tr>
<tr><td>Texts & References</td><td colspan="6">1. Snyder, C. (2003); Paper prototyping: The fast and easy way to design and refine user interfaces, Morgan Kaufmann, ISBN:9781558608702
2. Bjarki Hallgrimsson (2012), Prototyping and Modelmaking for Product Design, Lawrence King Publishing, ISBN:9781856698764
3. Elaine Chen (2015), Bringing a Hardware Product to Market: Navigating the Wild Ride from Concept to Mass Production, ISBN:9781505380835
4. Sean Michael Ragan (2017), The Total Inventors Manual: Transform Your Idea into a Top-Selling Product, Weldon Owen, ISBN: 9781681881584
5. Jake Knapp, John Zeratsky, Braden Kowitz (2016), How to Solve Big Problems and Test New Ideas in Just Five Days, Transworld Digital, ISBN:9781501121746</td></tr>
</table>

ANNEXURE B

Elective-1:

<table>
<tr><td>Course Title</td><td>Design of Hybrid and Electric Vehicle</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Integrated Product Design</td><td>Structure (LTPC)</td><td>2</td><td>1</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>Master of Design (Semester 2)</td><td rowspan="2">Status</td><td colspan="2" rowspan="2">Core</td><td colspan="2" rowspan="2">Elective
X</td></tr>
<tr><td>Prepared by</td><td>Dr Raguraman Munusamy</td></tr>
<tr><td>Prerequisite</td><td>B.Tech (Mechanical / Electrical)</td><td>To take effect from</td><td colspan="4">2021 Batch</td></tr>
<tr><td>Course Objectives</td><td colspan="6">This course will provide a broad technical knowledge and practical expertise of hybrid and electric vehicle (HEV) technologies, analysis, design, component selection and sizing at both system and vehicle level.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On successful completion of this course students will be able to:
● Analyse the different powertrain architecture options and select the appropriate solutions within realistic performance and commercial constraints.
● Evaluate various technology options for (electrical and mechanical) energy generation, storage, transmission, and management for a HEV
● Size various HEV systems, within the constraints like performance, fuel economy and packaging.</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="6">Module 1: Introduction to Electric Vehicle (3 hrs)
● History and Components of Electric Vehicle, Comparison with Internal combustion Engine : Technology, Benefits and Challenges, EV classification and their electrification levels and terminologies
Module 2: Motor Torque Calculations for Electric Vehicle (6 hrs)
● Calculating the rolling resistance, grade resistance, acceleration, force and finding the total tractive effort, torque required on the drive wheel.
Module 3: Electric Vehicle Architecture Design (9 hrs)
● Types of EV and components, electrical protection and system requirement, Photovoltaic solar based EV design, Battery Electric vehicle (BEV), Hybrid electric vehicle (HEV)
● Plug-in hybrid vehicle (PHEV), Fuel cell electric vehicle (FCEV), Electrification Level of EV
Module 4: Electric Drive and controller (6 hrs)
● Types of motors, selection and sizing of motor, RPM and torque calculation of motor, motor controllers, component sizing, physical locations, mechanical and electrical connection of motor
Module 5: Energy Storage Solutions (ESS) (6 hrs)
● Cell Types (Lead Acid/Li/NiMH), battery charging and discharging calculation, cell selection and sizing, battery lay outing design, battery pack Configuration, construction and selection criteria.
Module 6: Battery Management System(BMS)/Energy Management System (EMS) (6 hrs)
● Need of BMS, rule based control and optimization based control, software-based high level supervisory control, mode of power, behavior of motor etc
Module 7:Electric Vehicles charging station (6 hrs)
● Type of charging station, selection and sizing of charging station, components of charging station, single line diagram of charging station

Evaluation: 70% assignments/activities + 30% End Semester</td></tr>
<tr><td>Texts & References</td><td colspan="6">1. C.M. Jefferson & R.H. Barnard (2002), Hybrid Vehicle Propulsion, WIT Press, ISBN: 9781853128875
2. James Larminie and John Lowry (2012), Electric Vehicle Technology Explained, Oxford Brookes University, Oxford, UK, ISBN:9781119942733
3. John Miller (2010), Propulsion Systems for Hybrid Vehicles, Institute of Electrical Engineers, UK, ISBN: 9781849191470
4. Iqbal Husain (2010), Electric and Hybrid Vehicles – Design Fundamentals, CRC Press, ISBN:9781439811757
5. Chris Mi, M A Masrur, D W Gao (2011), Hybrid Electric Vehicles – Principles and applications with practical perspectives," Wiley, ISBN:9780470747735
6. Vivek D Bhise (2017), Automotive product development: A systems engineering implementation, CRC Press, ISBN:9781498706810</td></tr>
</table>

ANNEXURE B

<table>
<tr><td>Course Title</td><td>Design of Medical Devices</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Integrated Product Design</td><td>Structure (LTPC)</td><td>2</td><td>1</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>Master of Design (Semester 2)</td><td rowspan="2">Status</td><td colspan="2" rowspan="2">Core</td><td colspan="2" rowspan="2">Elective
X</td></tr>
<tr><td>Prepared by</td><td>Dr Raguraman Munusamy</td></tr>
<tr><td>Prerequisite</td><td>None</td><td>To take effect from</td><td colspan="4">2021 Batch</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. Introduce the process of medical device design - the non-technical factors that impact a medical technology’s clinical and market success, and to emerging themes that are shaping healthcare innovation
2. Challenge students to apply design thinking to the broader healthcare system.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On successful completion of this course,
• Students gain exposure to clinical need identification, stakeholder interviews, ideation, and prototyping.
• Students will become experts on intellectual property, FDA regulation, reimbursement, and startup financing introduce non-technical factors that help shape an innovation’s path to impact.</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="6">● Introduction – Medical Device Development: Academia vs. Industry
● Project Management – How corporations manage medical projects
● Pre-clinical Device Development – Research projects
● Regulatory considerations for medical device development
● Manufacturing, Quality Control, and Quality Assurance
● Business – What makes corporations tick and research labs tock
● Marketing medical devices, and the basics of sales forces
● Clinical trials, CRA’s, and CRO’s
● Design Controls: DHF, Proposal, DDP, Inputs, Outputs, Specifications
● Design Controls: Verification, Validation, Transfer
● Risk Analysis: FMECA, Risk analysis document
● Organization types, putting together project teams, Project Management: The Sequel
● Consultants – Role in medical device development, Advamed, Anti-kickback statute, Confidentiality

Evaluation: 70% assignments/activities + 30% End Semester</td></tr>
<tr><td>Texts & References</td><td colspan="6">1. Paul H. King, Richard C. Fries (2009), Design of Biomedical Devices and Systems, CRC Press, ISBN:9781420061796
2. Richard C. Fries (2001), Handbook of Medical Device Design, Taylor & Francis, ISBN:9780429285141
3. Peter Ogrodnik (2019), Medical Device Design, Academic Press, ISBN:9780128149638
4. Paul Davim (2012), The Design and Manufacture of Medical Devices, Woodhead Publishing, ISBN:9781908818188</td></tr>
</table>

ANNEXURE B

<table>
<tr><td>Course Title</td><td>Embedded Kinetic Artwork</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Integrated Product Design</td><td>Structure (LTPC)</td><td>2</td><td>1</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>Master of Design (Semester 2)</td><td rowspan="2">Status</td><td rowspan="2" colspan="2">Core</td><td rowspan="2" colspan="2">Elective
X</td></tr>
<tr><td>Prepared by</td><td>Dr Noor Mohammad</td></tr>
<tr><td>Prerequisite</td><td>Undergraduate engineering</td><td>To take effect from</td><td colspan="4">2021 Batch</td></tr>
<tr><td>Course Objectives</td><td colspan="6">• Introduce the concept of sculpture and history.
• Design concepts of the sculpture and kinetic sculpture
• Aesthetics and kinetic art work in building sculpture.
• Embedded systems, sensors, actuators and programming models to realize the kinetic sculptures.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">Students understand creative problem solving both in engineering and the arts.
Students can understand and design the moving and innovative sculptures</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="6">Module-1: Programming and Electronics fundamentals (18 hrs)
• Programming fundamentals
• Electronics fundamentals– Input sensors (switches, potentiometers, resistive sensors including light, temperature, flex, etc., rangefinders, optical switches, etc.)– Output actuators (servos, DC motors, stepper motors, LEDs, relays, switching transistors, etc.)
• Programming reactive systems– External chip interfacing with protocols such as SPI – Interrupt prog
Module-2: Constructing Kinetic Art (24 hrs)
• Art history review of kinetic art
• Discussion of contemporary kinetic artists (Jim Campbell, Jack Dollhausen, Arthur Ganson, Rebecca Horn, Dan Rozin, Sabrina Raaf, Alan Rath, Peter Vogel, etc.)
• Formal elements of 3d art such as aesthetics, proportion, and balance
• Material studies (plastic, metal, paper, wood, etc.)
• Mechanical linkages and physical construction
• Concepts and meaning in art– Artistic design process
Evaluation: 70% assignments/activities + 30% End Semester</td></tr>
<tr><td>Texts & References</td><td colspan="6">1. Candy, Linda, Edmonds, Ernest, Poltronieri, Fabrizio Augusto (2018), Explorations in Art and Technology, Edition 2, Springer-Verlag London,ISBN:9781447173663
2. T. Igoe (2004). Physical Computing: Sensing and Controlling the Physical World with Computers, Edition 1, Premier Press,ISBN:9781592003464
3. Massimo Banzi (2011), Getting Started with Arduino, Edition 2, O′Reilly, ISBN-13: 9781449309879.
4. J. Noble. Programming Interactivity: A Designer’s Guide to Processing, Arduino, and Open Frameworks, O’Reilly Media, Inc., ISBN:9781449311445
5. C. Reas, B. Fry, and J. Madea (2015), Processing: A Programming Handbook for Visual Designers and Artists. The MIT Press, ISBN:9780262028288
6. H. Yanco, H. J. Kim, F. G. Martin, and L. Silka (2006), Artbotics: Combining art and robotics to Broaden participation in computing. In AAAI: Resources forAI Education, Stanford, CA.
7. H. J. Kim, D. Coluntino, F. G. Martin, L. Silka, and H. A. Yanco (2007), Artbotics: community- based collaborative art and technology education. In SIGGRAPH ’07: Educators Program, San Diego, California,</td></tr>
</table>

ANNEXURE B

Syllabus for M.Des courses (Semester 3):

<table>
<tr><td>Course Title</td><td>Strategic management of design and innovation</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Integrated Product Design</td><td>Structure (LTPC)</td><td>2</td><td>1</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>Master of Design (Semester 3); Delivered Online</td><td rowspan="2">Status</td><td colspan="2" rowspan="2">Core
X</td><td colspan="2" rowspan="2">Elective</td></tr>
<tr><td>Prepared by</td><td>Dr Sudhir Varadarajan</td></tr>
<tr><td>Prerequisite</td><td></td><td>To take effect from</td><td colspan="4">2021 Batch</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To help designers understand the innovation challenge from entrepreneurial/managerial perspectives
2. To introduce designers to the different paradigms and processes of managing product innovation</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of the course, students will have a familiarity with:
● Innovation processes and structures such as R&D team, the pros and cons of various R&D organizational structures, and challenges of innovation in large and small firms;</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="6">Module 1: Introduction (9hrs)
● Innovation – multi-disciplinary perspective
● Innovation as a new management object
● Processes used to explore innovations along the technology, market and strategy dimensions
Module 2: Design activity and Innovation capability (9hrs)
● Design: An activity underlying all innovations
● Innovative design – an approach for transforming identity of objects
Module 3: Design capacities in innovative firms (12hrs)
● Case studies of highly innovative firms
Module 4: Innovative design: tools & organizational strategies (12 hrs)
• Strategies to effectively exploit the value of innovation, including innovation platforms that include multiple products, portfolios, standards and business models
• Processes, structures and strategies for exploring, executing and exploiting innovations that established firms can use to renew their foundations in the face of disruptive innovations
Evaluation: 70% assignments/activities + 30% End Semester</td></tr>
<tr><td>Texts & References</td><td colspan="6">1. Christensen, Clayton M. (2003), The innovator's solution: creating and sustaining successful growth, Harvard Business Press, ISBN:9781578518524
2. Joe Tidd and John Bessant (2013), Managing Innovation: Integrating Technological, Market and organizational change, Wiley, ISBN:9781118360637
3. Paul Trott (2011), Innovation Management and New Product Development, Pearson, 5th Edition, ISBN:9780273736561
4. Ralph D Stacey (2012), The Tools and Techniques of Leadership and Management: Meeting the challenge of complexity. Routledge, London, ISBN:9780415531177
5. Pascal Le Masson, Benoit Weil and Armand Hatchel (2012), Strategic management of innovation and design, Cambridge University Press
6. Raymond Turner (2016), Design Leadership: Securing the Strategic Value of Design, Routledge, ISBN:9781138247635
7. Tan, Garry, Chapman, Anne (2017), Design Leadership & Mgmt: A Case Study in Singapore, Springer, ISBN:9789463511551</td></tr>
</table>

ANNEXURE B

Course Title	Sustainable Product Service Systems	**Course No**				
Specialization	Integrated Product Design	**Structure (LTPC)**	2	1	0	3
Offered for	Master of Design (Semester 3) (Delivered Online)	**Status**	Core	X	Elective	
Prepared by	Dr Raguraman Munusamy					
Prerequisite	None	**To take effect from**	2021 Batch			
Course Objectives	1. To introduce concepts of sustainable design of product-service systems 2. To provide an understanding of methods and tools for sustainable design					
Course Outcomes	At the end of the course, the students should be able to appreciate • Product-service systems which are also referred to as servicizing, resource-efficient business models, green business models, or circular business models • create designs that are sustainable in terms of environmental burden and resource use, whilst developing product concepts as parts of sustainable whole systems, that provide a service or function to meet essential needs					
Contents of the course (With approximate break up of hours)	**Module 1: Introduction to Product Services systems (6hrs)** ● Socio-technical systems ● Environmental Impact **Module 2: Environmentally-responsive design methodologies (18hrs)** ● Industrial ecology ● Dematerialization ● Design for reuse / modularity ● Design for recycling ● Remanufacturing: issues/problems, current and future developments **Module 3: Alternative resources (10 hrs)** ● Alternative energy ● Alternative materials ● Sustainable packaging. **Module 4: Life-cycle assessment methods (8hrs)** Evaluation: 70% assignments/activities + 30% End Semester					
Texts & References	1. Victor Papanek (1995), The Green Imperative: Ecology and ethics, Thames and Hudson, ISBN:9780500278468 2. William McDonough and Michael Braungart (2002), Cradle to Cradle, North Point Press, ISBN:9780865475878 3. Stuart Walker (2006), Sustainable by Design: Explorations in Theory and Practice, Routledge, ISBN:9781844073535 4. Charter, Tischner (2001), Sustainable Solutions, Green Leaf Publishing, ISBN:9781351282482 5. Cattanach, Holdreith, Reinke, Sibik (1994), The Handbook of Environmentally Conscious Manufacturing, ISBN:9780786301478 6. Sim van der Ryn, Stuart Cowan (2013), Ecological Design, Island Press, ISBN:9781559633895 7. Paul Hawken (2010), The Ecology of Commerce, Collins Business Essentials, ISBN:9780061252792 8. Nattrass & Altomare (1999), The Natural Step for Business, New Society Publishers, ISBN:9780865713840 9. Vance Packard (2011), The waste makers, Ig Publishing, Reprint edition, ISBN:9781935439370					

ANNEXURE B

Syllabus for M.Des courses (Semester 4):

Elective-2:

Course Title	Mathematics for Designers	**Course No**				
Specialization	Integrated Product Design	**Structure (LTPC)**	2	1	0	3
Offered for	Master of Design (Semester 4)	**Status**	Core		Elective X	
Prepared by	Dr Nachiketa Mishra					
Prerequisite	Basic mathematics	**To take effect from**	2021 Batch			
Course Objectives	To develop an understanding of mathematical principles behind algorithms for innovative design by bringing together mathematics, computer science, engineering design and art					
Course Outcomes	• Understand mathematical logic behind structures; • Ability to develop mathematical models for generative art					
Contents of the course (With approximate break up of hours)	**Module 1: Origami and paper folding (9 hrs)** ● History of Origami, ● Physical and geometric properties of paper and folding, ● Special types of origami: pureland, box-pleating, tiling, circle packing **Module 2: Geometry and mathematical design (15 hrs)** ● Basic on fractal geometry and dimensions. ● Fractal concepts applied to design ● Julia set, Mandelbrot set ● Phi, golden ratio and golden angle in product design, ● Polyhedra and platonic solids. **Module 3: Geometric folding algorithms (18 hrs)** ● Upper and lower bounds ● Planner linkage mechanism ● Rigid frameworks ● Reconfiguration of chains ● Locked chains Evaluation: 70% assignments/activities + 30% End Semester					
Texts & References	1. Bovill, Carl (1996), Fractal Geometry in Architecture and Design, Boston: Birkhäuser, ISBN:9781461269182 2. Demaine, Erik, and Joseph O'Rourke (2007), Geometric Folding Algorithms: Linkages, Origami, Polyhedra. Cambridge University Press, ISBN:9780521857574 3. George Stiny (2008), Shape – Talking about seeing and doing, MIT Press, ISBN:9780262693677 4. Lang, Robert (2011), Origami Design Secrets: Mathematical Methods for an Ancient Art, CRC Press, ISBN:9781568814360					

ANNEXURE B

<table>
<tr><td>Course Title</td><td>Model Based Design and Manufacturing</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Integrated Product Design</td><td>Structure (LTPC)</td><td>2</td><td>1</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>Master of Design (Semester 4)</td><td rowspan="2">Status</td><td colspan="2" rowspan="2">Core</td><td colspan="2" rowspan="2">Elective
X</td></tr>
<tr><td>Prepared by</td><td>Dr Raguraman Munusamy</td></tr>
<tr><td>Prerequisite</td><td></td><td>To take effect from</td><td colspan="4">2021 Batch</td></tr>
<tr><td>Course Objectives</td><td colspan="6">This course will provide a broad technical knowledge and practical expertise of system requirements, design, analysis, verification and validation activities to enhance design and manufacturing capabilities. Students will gain an understanding of systems engineering, the model-based approach to design and manufacturing, the Digital Twin, and a roadmap toward a model-based enterprise.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On successful completion of this course students will be able to:
● Explain the value and expectations of systems engineering and model-based systems engineering, and the underlying motivations and opportunities represented by a model-based enterprise. They will develop the knowledge necessary to perform a baseline assessment of an organization’s potential to leverage model-based systems engineering.</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="6">Module 1: Introduction to Systems Engineering (6 hours)
● Definition and properties of a system
● Systems Engineering and the LifeCycle
● Systems Engineering Process Overview
● Business Impacts of Systems Engineering
Module 2: Model-Based Systems Engineering (8 Hours)
● Model-Based Definition
● Model-Based Systems Engineering Methodologies
● Systems Modelling Language (SysML)
● Model-Based Systems Engineering (MBSE) Application Strategies
● Verification and Validation Strategies
Module 3: Applications of Model-Based Systems Engineering (4 hours)
● Model-Based Enterprise
● Digital Thread& Digital Twin
● Business Aspects of the Model-Based Enterprise
● Realizing a Model-Based Enterprise
Module 4: Model-Based Enterprise (8 hours)
● Design Activities
● Configuration Management and Document Management
● Manufacturing Planning Activities
● Quality Requirements and Quality Planning Activities
● Enterprise Activities
● Your 4.0 Roadmap to Success
Evaluation: 70% assignments/activities + 30% End Semester</td></tr>
<tr><td>Texts & References</td><td colspan="6">1. David Long and Zane Scott (2012), A primer for model-based systems engineering, Vitech Corporation, ISBN:9781105588105
2. Jose L. Fernandez and Carlos Hernandez (2019), Practical Model Based Systems Engineering, ARTECH, ISBN:9781630815790
3. Sanford Friedenthal, Alan Moore and Rick Steiner (2015), A practical guide to SysML – The Systems Modelling Language, The MK/OMG Press, ISBN:9780128002025</td></tr>
</table>

ANNEXURE B

Elective-3:

<table>
<tr><td>Course Title</td><td>Simulation Driven Design</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Integrated Product Design</td><td>Structure (LTPC)</td><td>2</td><td>1</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>Master of Design (Semester 4)</td><td rowspan="2">Status</td><td colspan="2" rowspan="2">Core</td><td colspan="2" rowspan="2">Elective
X</td></tr>
<tr><td>Prepared by</td><td>Dr Raguraman Munusamy</td></tr>
<tr><td>Prerequisite</td><td></td><td>To take effect from</td><td colspan="4">2021 Batch</td></tr>
<tr><td>Course Objectives</td><td colspan="6">This course will give theory and hand-on-training to conduct simulation across the product lifecycle from concept design to in-service operation across multiple disciplines encompassing structures, motion, fluids, thermal management, electromagnetics, system modelling and embedded systems, while also providing data analytics and true-to-life visualization and rendering..</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On successful completion of this course students will be able to:
● Demonstrate their software skills in the multi-disciplinary simulations including structural, fluids, thermal, manufacturing, systems modelling, IoT and multiphysics.</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="6">Topics to be covered:
• Basic concept of finite element method
• Modelling techniques
• Mesh types
• Boundary constraints
• Material and Properties
• Mechanical and thermal stress analyses
• Dynamic response – impact and crashworthiness
• Product optimization in terms of product size, shape and material
• Non-linear stress analysis
• Casting and deep drawing
• Structural Optimization
• System Modelling and Control Systems
• Composite Analysis & Optimization
• Design of Experiment (DoE) Studies
• Electromagnetic simulation
Evaluation: 70% assignments/activities + 30% End Semester</td></tr>
<tr><td>Texts & References</td><td colspan="6">1. S.S. Rao (2018), The finite element method in engineering, Butterworth-Heinemann Publishers, UK, ISBN:9781856176613
2. Nam-Ho Kim (2018), Introduction to Non-linear finite element analysis, Springer, ISBN:9781441917454
3. NAFEMS (1992), A finite element primer, Bookcraft Ltd.
4. Paul Jacob and Lee Goulding (2002), An explicit finite element primer, NAFEMS Ltd., ISBN:9781874376453
5. A.A. Becker (2001), Understanding Non-linear finite element analysis, NAFEMS Ltd., ISBN:9781874376354</td></tr>
</table>

ANNEXURE B

Course Title	Design of non-invasive systems	**Course No**				
Specialization	Integrated Product Design	**Structure (LTPC)**	2	1	0	3
Offered for	Master of Design (Semester 4)	**Status**	Core		Elective X	
Prepared by	Dr Jayachandra Bingi					
Prerequisite	None	**To take effect from**	2021 Batch			
Course Objectives	This course is to cultivate the skill of appreciating the communication between system (Bio and mechanical) and environment. Further, plan the device to diagnose systems using suitable tools of noninvasive monitoring.					
Course Outcomes	After the completion of the course students will be in a position to appreciate the system-environment interaction and them decide on suitable tools such as electronic, acoustical, optical, photonic etc.					
Contents of the course (With approximate break up of hours)	**Module 1 (6 hrs)** ● Introduction to non-invasive technologies, future perspectives ● System - environment interaction, modes and ways: Understanding **Module 2 (6 hrs)** ● Design considerations for interaction quantification **Module 3 (30 hrs)** ● Tools for noninvasive medical and machine monitoring ● Acoustic (Sonic) ● Electronic and electrical ● Photonic ● Optical ● Exploiting DSP, AI and ML Evaluation: 70% assignments/activities + 30% End Semester					
Texts & References	1. Jessica Fitzgerald and Hicham Fenniri (2017), Cutting Edge Methods for Non-Invasive Disease Diagnosis Using E-Tongue and E-Nose Devices, Biosensors (Basel). Dec; 7(4): 59, https://doi.org/10.3390/bios7040059 2. Irfan Muhammad (2018), Advanced Condition Monitoring and Fault Diagnosis of Electric Machines, IGI Global, ISBN:9781522569909 3. John G. Webster (2020), Minimally Invasive Medical Technology, CRC Press, ISBN:9780367455415					

ANNEXURE B

<table>
<tr><td>Course Title</td><td>Wearable Technologies</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Integrated Product Design</td><td>Structure (LTPC)</td><td>2</td><td>1</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>Master of Design (Semester 4)</td><td rowspan="2">Status</td><td rowspan="2" colspan="2">Core</td><td rowspan="2" colspan="2">Elective
X</td></tr>
<tr><td>Prepared by</td><td>Dr Pandiyarasan Veluswamy</td></tr>
<tr><td>Prerequisite</td><td>None</td><td>To take effect from</td><td colspan="4">2021 Batch</td></tr>
<tr><td>Course Objectives</td><td colspan="6">This course aims to present wearable product designers with realistic, reliable knowledge of human anatomy and function from a design perspective.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">After completing the course, students will be able to structure wearable products that enhance health, performance, safety, and pleasure.</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="6">Module 1 (6 hrs)
● Wearables: Fundamentals, Advancements, and a Roadmap for the Future
● Human Body Diversity: Opportunity and Challenge
● Wearable Product as Mediator between Environment and Human Body
● Anthropometry and pattern grading
Module 2 (12 hrs)
● Stability and Motion: Interactions in a Neuro-Musculo-Skeletal System
● Integumentary System: Coverage and Protection
● Wearable Electronics from Foils to Textiles: Materials, Devices, and Assembly
● Energy Harvesting at the Human Body
Module 3 (12 hrs)
● Low-Power Integrated Circuit Design for Wearable Biopotential Sensing
● Mining Techniques for Body Sensor Network Data Repository
● Modeling Physical Activity Behavior Change
● Wireless Body Area Networks
Module 4: (12 hrs)
● Wearable Sensors for the Monitoring of Physical and Physiological Changes in Daily Life
● Wearing Sensors Inside/ Outside of the Human Body for the Early Detection of Diseases
● Wearable and Non-Invasive Assistive Technologies
Evaluation: 70% assignments/activities + 30% End Semester</td></tr>
<tr><td>Texts & References</td><td colspan="6">1. Edward Sazonov and Michael R. Neuman (2014), "WEARABLE SENSORS Fundamentals, Implementation and Applications", Elsevier, ISBN:9780124186620
2. Sahrye Cohen and Hal Rodriguez (2018), Make It, Wear It: Wearable Electronics for Makers, Crafters, and Cosplayers, McGraw-Hill Education, ISBN:9781260116151
3. Karen L. LaBat and Karen S. Ryan (2019), "Human Body - A Wearable Product Designer’s Guide", CRC Press Taylor & Francis group, ISBN:9781498755719
4. Gang Wang, Chengyi Hou and Hongzhi Wang (2020), "Flexible and Wearable Electronics for Smart Clothing", Wiley, ISBN:9783527818556</td></tr>
</table>

ORDINANCES AND REGULATIONS

Master of Technology and

Master of Design

Programmes

ANNEXURE C

ANNEXURE C

Ordinance

O.1 Candidates who have qualified for the award of the Bachelor's degree in Engineering / Technology or Master's degree in Science from educational Institutions approved by AICTE/UGC/Government and who have a valid GATE (Graduate Aptitude Test in Engineering) score are eligible to apply for admission to the M.Tech programme. Graduates from IITs/IIITs/NITs with minimum CGPA of 8 out of 10 for GC and 7.5 out of 10 in case of SC/STs are eligible for admission without GATE Score.

O.1(a) Candidates who have qualified for the award of the Bachelor's degree in Engineering / Technology/Design/ Architecture from educational Institutions approved by AICTE/UGC/Government and who have a valid CEED (Common Entrance Exam for Design) score are eligible to apply for admission to the M.Des. programme.

O.1(b) B.Tech Students of the institute having minimum CGPA of 6/10 upto 5th semester and opting M.Des. as Dual Degree at the end of their 5th Semester are also eligible for consideration.

O.2 Associate Membership holders of the professional bodies for admission into their parent disciplines from the following – (i) The Institution of Engineers (India) (AMIE) (ii) The Indian Institute of Metals (AMIM) (iii) The Institution of Electronics and Tele-Communication Engineering (AMIETE) with valid GATE Score can also apply.

O.3 Candidates working and sponsored (with full pay and allowances for 24 months) by industry / government organizations / private and public enterprises recognized by DST engaged in R & D work/ engineering colleges recognized by AICTE/UGC or QIP candidates possessing at least two years of professional experience as on the last date of receipt of applications at IIITD&M can apply for M.Tech program provided they hold:

1. B.E./ B.Tech. degree from AICTE/UGC recognized Engineering Colleges/university with first class or 60% aggregate marks in all the four years; or
2. AMIE and other Associate memberships (listed above) with a valid GATE Score.
3. For M.Des. programme, the candidates shall have Bachelor's degree in Engineering / Technology/Design/ Architecture from educational Institutions approved by AICTE/UGC/Government.

O.4 The exact eligibility criteria for admission to the M.Tech/M.Des. programme shall be as approved by the Senate of the Institute from time to time and announced by the Institute on an annual basis.

O.5 The normal duration of the M.Tech/ M.Des. programme including project work shall be four semesters. Candidates may be permitted to do their project work in industry and other approved organizations as prescribed in the regulations.

O.6 The award of Half-time Teaching Assistantship (HTTA) to the candidates admitted to the M.Tech/ M.Des. programme shall be in accordance with the regulations of the Senate of the Institute.

O.7 The award of the /M.Tech/M.Des. degree shall be in accordance with the regulations of the Senate of the Institute.

ANNEXURE C

REGULATIONS

R.1.0 ADMISSION

R.1.1 Candidates who have valid GATE (Graduate Aptitude Test in Engineering) score are eligible to apply for M.Tech programme as full time scholars of Institute HTTA.

R.1.1(a) Candidates who have valid CEED (Common Entrance Exam for Design) score are eligible to apply for M.Des. programme as full time students of the institute with HTTA.

R.1.1.(b) B.Tech Students of the institute having minimum CGPA of 6/10 up to 5th semester are eligible to opt M.Des. as Dual Degree at the end of their 5th Semester. The candidates who have valid CEED score at the end of their 8th Semester are eligible for HTTA.

R.1.2 Candidates sponsored under Quality improvement Programme or other similar programmes are eligible to apply for both the programme.

R.1.3 Candidates sponsored by the Industries, established Institutes/R&D Organisations/National laboratories are eligible to apply for both the programme.

R.1.4 Foreign nationals whose applications are received through Indian Council of Cultural Relations, Government of India are eligible to apply for both the programme. Foreign Nationals are also eligible under self-financing scheme for which applications are invited through their embassy.

R.1.5 Announcements for M.Tech/M.Des. Admission will be made by the Institute and the candidates under categories R.1.1, R.1.2 and R.1.3 mentioned above should apply in the prescribed form on or before the specified dates.

R.1.6 The eligibility criteria for admission including the minimum GATE/CEED score required for admission as full time students with HTTA or as sponsored or other candidates mentioned under R.1.1, R1.2 and R.1.3 will be decided by the Senate.

R.1.7 The Senate of the Institute will decide on the number of seats for various specialisations / Departments / Centres. Seats are reserved for SC, ST, OBC and physically challenged candidates as per the Government of India rules. However, to be considered for admission they should have a valid GATE score and satisfy the Senate requirements.

R.1.8 The Post-Graduate Admissions Committee constituted by the Chairman, Senate will decide on the operational aspects of selection of candidates based on the criteria laid down by the Senate. However, in the case of service officers under the control of Army / Navy / Air force / DRDO, the selection will be through a central selection committee/s with the Institute faculty serving on the selection committee.

R.1.9 Vacancies that are to be filled up after the admission date will be decided by the Chairman, Senate and reported to the Senate for post-facto approval.

R.1.10 In all matters concerning selection of candidates, the decision of the Chairman, Senate or his nominee viz. Chairman, Post-Graduate Admissions Committee is final.

R1.11 In addition to satisfying the conditions given in the information Brochure for M.Tech/M.Des. Admission sent along with the application forms, the selected candidates should satisfy the other admission requirements indicated in the letter of offer of admission. However, if at any time the Dean Academic Courses / Director finds any of the requirements not fulfilled by the candidate, the Dean / Director may revoke his/her admission to the programme.

R1.12 The institute shall also participate in Centralized Counselling process for admission of students to M.Tech/M.Des. programme.

R.2.0 STRUCTURE OF THE M.Tech/M.DES. PROGRAMME

R.2.1 The programme of instruction for each stream of specialization will consist of

i. core courses (compulsory)
ii. elective courses
iii. project work

The student may be required to give one or more seminars and undergo industrial / practical training during the programme.

R.2.2 The complete programme will be of 4 semester duration. The academic programmes in each semester may consist of course work and/or project work as specified by the Senate for each specialisation. The total contact hours are normally about 32 hours per week.

R.2.3. Every stream of specialisation in the programme will have a curriculum and syllabi for the courses approved by the Senate. The curriculum should be so framed such that the minimum number of credits for successful completion of the M.Tech and M.Des programmes of any stream is not less than 88 and not more than 92.

R.2.4 Credits will be assigned to the courses based on the following general pattern:

i. One credit for each lecture period
ii. One credit for each tutorial period
iii. One credit for each laboratory or practical session of two periods for M.Tech programme
iv. Two credits for each laboratory or practical session of three periods for M.Des programme
v. Credit for the seminar, project work and industrial / practical training will be as specified in the curriculum approved by the Senate.

R.2.5 A student will have to register for all the core courses listed in the curriculum of his/her selected area of specialization and successfully complete all of them.

However, the Departmental Consultative Committee may grant permission to a student not to register for some of the core courses and substitute them by some other courses depending on the courses successfully completed by the student in the undergraduate programme. This has to be intimated to and approved by the Dean of Academic Courses / Director.

R.2.6 Electives will have to be taken from the courses offered by the Department in that particular semester from among the list of approved courses.

However, most departments permit selection of electives other than those listed against the Department provided they have relevance to the area of specialisation and subject to the approval of the Faculty Adviser. (For Faculty Adviser-see below).

R.2.7 In some specialisations students may be permitted to register for a maximum of two B.Tech courses. The concerned departments will identify such courses and get prior approval of the Senate.

R.2.8 The medium of instruction, examination, seminar and project reports will be in English.

R.3.0 Faculty Adviser

R.3.1 To help the students in planning their courses of study and for getting general advice on academic programme, the concerned Department will assign a certain number of students to a Faculty Member who will be called as Faculty Adviser.

R.4.0 CLASS COMMITTEE

R.4.1 For I and II semesters of M.Tech/M.Des. branch wise class committees will be constituted by the Heads of the Departments as follows:

i. Course teacher / coordinators of all subjects (not covered under R.4.2) with registration not less than five;
ii. One Professor preferably not offering courses for the class as chairman and
iii. Four student members or 20% of the class strength, whichever is less
iv. Faculty Adviser – Ex-Officio Member

R.4.2 Common class committee for Mathematics and Humanities courses of I and II M.Tech/ M.Des. will also be formed if the courses open to all engineering departments are offered by the above two departments. These committees will be constituted by the Heads of Mathematics/Humanities department as follows:

i. Course teacher of all subjects:
ii. One Professor preferably not offering courses for the class as Chairman and
iii. Four student members.

R.4.3 The basic responsibilities of the class committee are:

a) to review periodically the progress of the classes to discuss issues faced by students.
b) The type of assessment for the course will be decided by the teacher in consultation with the class committee and will be announced to the students at the beginning of the semester.
c) Each class committee will communicate its recommendations to the Head of the Department and the Dean of Academic courses.
d) The class committee without the student members will also be responsible for the finalisation of the semester results.

R.4.4 The class committee is required to meet at least twice in a semester once at the beginning of the semester and another time after the end-semester examination to finalise the grades.

R.5.0 Change of Branch

Change of branch is not permitted once a student is given admission to M.Tech/M.Des. programme.

R.6.0 Registration Requirement

The M.Tech/ M.Des. students are eligible to take extra courses apart from the courses prescribed in the curriculum viz. one course in 3rd semester and not more than two courses in 4th semester subject to a maximum of 9 credits, provided a student has no backlog and should have earned CGPA of 7.0 & above by the end of the previous semester. Students taking extra courses should obtain the prior approval of Dean (Academic Courses)/ Head, SIDI.

R.6.1 During the final project semester, students are not normally permitted to register for courses. However, students who are short of a few credits required for the degree may be allowed by the Dean to register for one or two courses along with the project under the specific recommendation from the Head of the department.

In such cases the project duration may have to be extended beyond the normal period suitably. However, the HTTA will be paid for a maximum period of 24 months only, as per the existing Government of India rules.

R.6.2 Withdrawal from a course registered is permitted up to two weeks from the date of commencement of the semester. Substitution by another course is not permitted.

The number of courses remaining registered after withdrawal should enable the student to earn the credits required to continue the studies as indicated under R.10.

Courses withdrawn will have to be taken when they are offered next, if they belong to the list of core courses (Compulsory courses).

R.6.3 In extraordinary circumstances like medical grounds, a student may be permitted by the Dean of Academic Courses to withdraw from a semester completely. Normally a student will be permitted to withdraw from the programme only for a maximum continuous period of two semesters.

R.7.0 MINIMUM REQUIREMENT TO CONTINUE THE PROGRAMME

R.7.1 A student should have earned not less than 12 successful credits in the first semester, 30 successful credits by the end of second semester and 50 successful credits by the end of third semesters.

The student will be asked to leave the programme failing to satisfy this requirement

R.7.2 In addition to the above, to be eligible to continue in the programme the student should have a minimum CGPA of 5.0, calculated according to the formula in R.22.2. However, in calculating the CGPA for eligibility to continue the programme only courses the student has successfully completed upto the point under consideration will be taken into account. If the CGPA of any student so calculated falls below 5.0 the student will be issued a warning and if he/she does not make good and get a CGPA less than 5.0 in the following semester also then he/she will be asked to leave the programme.

R.8.0 MAXIMUM DURATION OF THE PROGRAMME

R.8.1 A student is ordinarily expected to complete the M.Tech/M.Des. programme in four semesters. However, students who do not complete their project work in four semesters are permitted to submit the report in the fifth semester with the prior approval. Students should complete the course work in not more than 5 semesters and the entire programme in 8 semesters including the project work from the date of admission to the programme.

R.9.0 DISCONTINUATION FROM THE PROGRAMME

R.9.1 Students may be permitted to discontinue the programme and take up a job provided they have completed all the course work. The project work can be done during a later period either in the organisation where they work if it has R and D facility, or in the Institute.

Such students should complete the project within six semesters from the date of admission to the programme.

Students desirous of discontinuing their programme at any stage with the intention of completing the project work at a later date should seek and obtain the permission of the Dean before doing so.

R.10.0. DISCIPLINE

R.10.1 Every student is required to observe discipline and decorous behavior both inside and outside the campus and should not indulge in any activity which bring down the prestige of the Institute.

R.10.2 Any act of indiscipline of a student reported to the Dean will be referred to Discipline and Welfare Committee constituted by the Senate from time to time.

The Committee will enquire into the charges and recommend suitable punishment if the charges are substantiated. The Board of Academic Courses will consider the recommendation of the Discipline and Welfare Committee and authorize the Dean, Academic Courses to take appropriate action.

R.10.3. APPEAL: The student may appeal to the Chairman, Senate whose decision will be final. The Dean will report the action taken at the next meeting of the Senate.

R.10.4 Ragging of any dimension is a criminal and non-bailable offence in our country and current State and Central legislations provide for stringent punishment including imprisonment. Once the involvement of a student is established in ragging, the offending student will be dismissed from the Institution and will not be admitted into any other Institution. Avenues also exist for collective punishment, if individuals cannot be identified in this inhuman act. Every senior student of the Institute along with the parent shall give an undertaking every year in this regard and this should be submitted at the time of enrolment.

R.11.0. ATTENDANCE

R.11.1 Every teaching staff member handling a class will take attendance till 3 calendar days before the last instructional day in the Semester.

Students with attendance >=85% will only be allowed to appear in the end semester examinations. Students failing to meet the minimum attendance percentage will have to repeat the course when it is offered next.

R.11.2 The teacher handling the course must finalise the attendance 3 calendar days before the last instructional day of the course in the semester.

The particulars of all students who have attendance less than 85% in that course will be announced in the class by the teacher himself.

Copies of the same should also be sent to the Dean, Academic Courses and Head of the Departments concerned.

R.12.0. LEAVE RULES

R.12.1 All M.Tech/M.Des. students should apply to the Head of the Department / Faculty Advisor for leave stating the reasons whenever they are not in a position to attend classes/project work. They will not be eligible for HTTA for the period of absence, if it is unauthorized leave even if they have not fully utilised the eligible leave.

R.12.2 Students are eligible for leave of 30 days in a year which will be regularised 15 days per semester with a provision of carryover from first to second semester and from the third to fourth semester (i.e unutilized leave from the first year cannot be carried over to second year).

The intervening holidays will be treated as part of leave with provision of suffixing and prefixing holidays.

R.13.0. ASSESSMENT PROCEDURE: TESTS AND EXAMINATIONS

R.13.1 For Lecture or / Lecture and Tutorial based subjects a minimum of two sessional assessments will be made during the semester. The sessional assessment may be in the form of periodical tests, assignments or a combination of both, whichever suits the subject best. The assessment details as decided at the Class Committee will be announced to the students right at the beginning of the semester by the teacher.

R.14.0. END SEMESTER EXAMINATION

R.14.1 There will be one end semester examination of 3 hours' duration in each lecture based subject. In case of laboratory based subjects a final examination may or may not be conducted. In the case of projects, a viva-voce examination will be conducted on the completion of the project work. In case of M.Des. the pedagogy and evaluation will follow a problem based learning approach.

R.15.0. PROJECT EVALUATION

R.15.1 Evaluation of Project work will be taken up only after the student completes all the core as well as elective course requirements satisfactorily.

R.16.0. WEIGHTAGE

R.16.1 The following will be the weightages for the different subjects for M.Tech program.

a. Lecture or lecture and tutorial based subjects:

Sessional assessment : Minimum of 40%

End semester examination : Minimum of 40%

b. Laboratory based subjects:

Similar to a.

Sessional work 75 to 100%

Final examination, if held 25%

R.16.2 The following will be the weightages for the different subjects for M.Des. program.

a. Lecture or lecture and tutorial based subjects:

Continuous Assessment (Assignment and activities) : Minimum of 70%

End semester examination : Minimum of 30%

(End sem exam will probe the student's ability to reflect on the practical experience and concepts learnt)

b. Laboratory based subjects:

Similar to a.

Sessional work 75 to 100%

Final examination, if held 25%

c. Internship

Jointly supervised by faculty and industry	: 70%
Evaluation by Faculty Committee	: 30%

R.16.3 The markings for all tests tutorial assignments (if any), laboratory work and examinations will be on an absolute basis. The final percentages of marks are calculated in each subject as per the weightages given in R.19.1.

R.17.0. Make-up Examination

R.17.1 Students who have missed sessional assessments on valid reasons should apply to the Examination Cell indicating the reasons for the absence and the teacher shall consider these requests suitably.

R.17.2 Students who have missed the end semester examinations on valid reasons, should make an application to the Dean of Academic Courses / Director / Examination Cell within ten days from the date of the examination missed. Permission to sit for a make-up examination in the subject/s is given under exceptional circumstances like hospitalization or accident to the student. A student who misses this make-up examination will not be normally given another make-up examination.

However, in exceptional cases of illness resulting in the students missing a make-up examination, the Dean of Academic Courses / Examination Cell in consultation with the Chairman of the Senate may permit the student to appear for a second make-up examination.

R.17.3 For application on medical grounds, students residing in the hostels should produce a Medical Certificate issued by an Institute Medical Officer only.

Students staying outside the campus permanently/temporarily should produce a medical certificate from registered medical practitioners and the same should be forwarded by the parents \guardians for the purpose of make-up examinations.

The Dean of Academic Coursed can use his discretion in giving permission to a student to take a make-up examination, recording the reasons for his decision.

R.18.0. Subject wise Grading of Students into Categories

R.18.1 Letter Grades

Based on the semester performance, each student is awarded a final letter grade at the end of the semester in each subject. The letter grades and the corresponding grade points are as follows.

Grade	Points
S	10
A	9
B	8
C	7
D	6
E	4
U	0
W	Registration cancelled for want of minimum attendance

P,H	Pass / Completed
F,L	Fail / Incomplete

R.18.2 A student is deemed to have completed a subject successfully and earned the credit if he/she secures an overall letter grade other than U/F.

A letter grade U/F in any subject implies failure in that subject. A subject successfully completed cannot be repeated.

R.19.0. METHODS OF AWARDING GRADES

R.19.1 A final meeting of the Class Committee without the student members will be convened within seven days after the last day of the end semester examination.

The letter grades to be awarded to the students for different subjects will be finalised at this meeting.

R.19.2 Two copies of the result sheets for each subject containing the final grade and two copies with absolute marks, the final grade should be submitted by the teacher to the concerned Class Committee Chairman.

After finalisation of the grades at the Class Committee Meeting: one copy with absolute marks and one without the absolute marks but having only the grades will be forwarded by the Class Committee Chairman to the Dean.

One copy with absolute marks, the final grade will be sent to the Head of the Department in which the course is offered.

R.20.0. DECLARATION OF RESULTS

R.20.1 The letter grades awarded to the students in each subject will be released through the student portal / put up on the departmental notice boards soon after the final Class Committee meeting.

R.20.2 The U or W grade once awarded stays in the record of the student and is deleted when he/she completes the same subject later, indicating also the numbers of attempts made in that course. The CGPA based on the successfully completed courses is calculated excluding the ‘U’ or ‘W’ grades.

R.21.0. RE-EXAMINATION OF ANSWER PAPERS

R.21.1 In case a student feels aggrieved; he/she can contact the teacher concerned for a second look at his/her performance but not later than two weeks from the commencement of the semester following the announcement of the results. The student shall have access to his/her answer paper/s in the end semester examination which may be shown to him/her by the teacher/s concerned.

If the teacher feels that the case is genuine he/she may re-examine and forward the revised grade, if any, to the Dean of Academic Courses through the Chairman of the Class Committee with justification for the revision and intimate the Head of the Department.

R.22.0. COURSE REPETITION

R.22.1 A student securing ‘U’ grade in any subject has to repeat it compulsorily when offered next, if the subject is listed as a core subject.

R.22.2 If it is an elective subject, the student has an option to repeat it in order to get a successful grade.

R.23.0. GRADE CARD

R.23.1 The grade card issued at the end of the semester to each student will contain the following:

a) the credits for each course registered for that semester.
b) the performance in each subject by the letter grade obtained vide R.21.1.
c) the total number of credits earned by the student upto the end of that semester.
d) the Cumulative Grade Point Average (CGPA) of all the courses taken form the first semester is shown in the final semester grade card.

R.23.2 The Grade Point Average (GPA) will be calculated by the formula.

$$GPA = \frac{\sum_i C_i \times GP}{\sum_i C_i}$$

Where C_i = credit for the course, GP = the grade point obtained for the course and $\Sigma_i C_i$ = the sum of credits in overall courses taken in that semester, including those in which the student has secured U or W grades.

For the cumulative Grade Point Average (CGPA) a similar formula is used except that the ΣiCi is the sum of credits in overall courses taken in all the semesters completed upto the point in time, including those in which the student has secured U or W grades.

R.23.3 No class/division/rank will be awarded to the students at the end of the M.Des. programme.

R.24.0. PROJECT WORK IN INDUSTRY OR OTHER ORGANISATION

R.24.1 Sponsored candidates from organisations which have R and D units and facilities for research work and those students who get employment in such organisation after completion of the courses work may be permitted to carry out their project work in such organisations during the final semester under the following conditions:

R.24.2 A departmental committee shall examine the requests from such students, and fix in advance

i. An internal guide (a faculty member of the institute)
ii. Area of project work and
iii. External guide (Scientists or Engineer in the Industry).

R.24.3 The above details should be submitted to the Dean through the Head of the Department and the Dean's approval should be obtained before the commencement of the project.

R.24.4 The students who are permitted to do the project work in an industry will have to pay the tuition and other fees to the Institute for the third and fourth semester as well.

R.25.0. HALF-TIME TEACHING ASSISTANTSHIP

R.25.1 Students who are qualified for M.Tech admission through valid GATE score and are admitted as full time scholars of the Institute, will be eligible for the award of the HTTA notified by the Institute from time to time.

R.25.1(a) Students who are qualified for M.Des. admission through valid CEED score and are admitted as full time scholars of the Institute, will be eligible for the award of the HTTA notified by the Institute from time to time.

R.25.1(b) B.Tech Students of the institute who have opt for M.Des. as Dual Degree at the end of their 5^{th} Semester and have valid CEED score at the end of their 8^{th} Semester are eligible for HTTA.

R.25.2 Students joining the M.Tech programme under sponsorship scheme / QIP will not be granted any HTTA even if they are qualified in GATE.

R.25.2(a) Students joining the M.Des. programme under Self/ sponsorship scheme/QIP will not be granted any HTTA even if they are qualified in CEED

R.25.3 Self-financing foreign nationals are not eligible for HTTA.

R.26.0. ELIGIBILITY FOR THE AWARD OF M.Tech/M.DES. DEGREE

R.26.1 A student shall be declared to be eligible for the award of M.Tech/M.Des. degree if he/she has

(1) Registered and successfully completed all the core courses and the project.

(2) Successfully acquired the minimum number of credits prescribed in the curriculum of the given stream within the stipulated time vide R.7 and R.8.

(3) No dues to the Institute, Library and Hostels and

(4) No disciplinary action pending against him/her.

(5) For students visiting Universities abroad under Exchange programme the following will be followed for credit transfer:

The credits / grades indicated in the grade sheet obtained from the university where the student has done courses should be used by the student as part of his transcripts.

IIITDM Kancheepuram transcripts should only indicate the courses, credits and grades completed at IIITDM Kancheepuram and the courses and credits (without grades) done in other Universities in a particular semester.

R.26.2 The final award of the Degree must be recommended by the Senate and approved by the Board of Governors of the Institute.

R.27.0. POWER TO MODIFY

Notwithstanding all that has been stated above the Senate has the right to modify any of the regulations from time to time.

IIITDM Kancheepuram

CONSTITUTION OF BOARD OF STUDIES

COMPUTER SCIENCE AND ENGINEERING

Industrial Experts:

Sl.No.	Name of the expert	Affiliation (with designation)
1	Mr. Murari Krishnan	Head-Engineering, Trimble Inc
2	Mr.Chandra Mouleswaran Sundaram	Head-Engineering, GAVS Tech.

Academician

Sl.No.	Name of the expert	Affiliation (with designation)
4	Prof. Madhu Mutyam	IIT Madras (Prof)
5	Prof. Krishna Nandivada	IIT Madras (Prof)

ELECTRONICS AND COMMUNICATION ENGINEERING

Industrial Experts

1.	Prof. Dr. Sankaran, Krish	CEO, Guest Professor IIT Bombay, Visiting Faculty, Swiss Federal Institutue of Technology, ETH Zurich Radical Innovations Group - RIG, Finland
2.	Dr. Paramasivam S.	Head R&D Division Power Electronics, Electrical Drives, Controls, Embedded Systems, New Product Design

#

Academician

3.	Dr Boby George	Professor Dept. of EE, IIT Madras
4.	Dr. K. Gopakumar	Professor Department of Electronic Systems Engineering Indian Institute of Science (IISc)

MECHANICAL ENGINEERING

Industrial Experts

1	Dr. K V M Raju	Head, Chassis group TVS Motor Company Limited, Hosur
2	Dr-Ing. Machina Gangadhar	Director Sree Arka Greentech Pvt. Ltd

Academician

3.	Dr. Krishna Kannan	Professor Dept. of Mechanical Engg., IIT Madras
4.	Prof. Amaresh Chakrabarti	Professor CPDM, IISc Bangalore

PHYSICS

Academician

1.	Dr. C. Vijayan	Professor Dept. of Physics, IIT Madras
2.	Prof. Sibasish Ghosh	Professor Institute of Mathematical Sciences, Taramani, Chennai

Revised Curriculum for second semester

B.Tech. Electronics and Communication Engineering 2020 Batch

Semester 2					
Category	Course Name	L	T	P	C
BSC	Differential Equations	3	1	0	4
SEC	Science Elective 1	3	1	0	4
BEC	Engineering Graphics	2	0	4	4
ITC	Elementary Data Structures and Logical Thinking	3	0	0	3
DSC	Sociology of Design	1	2	0	3
ITC	Design and Manufacturing Lab	0	0	2	1
PCC	Digital Circuits	3	1	0	4
ITC	Elementary Data Structures and Logical Thinking Practice	0	0	4	2
HMC	NSO/NCC/SSG/NSS	0	0	2	P/F
HMC	Earth, Environment and Design	1	0	0	P/F
					25.0

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Electronics and Communication Engineering

Course Title	Differential Equations	Course No	**MA1001**				
Department/ Specialization	Mathematics	Structure (LTPC)	L	T	P	C	
			3	1	0	4	
Offered for	UG & DD	Status	Core	Elective			
Faculty		Type	New	Modification			
Pre-requisite		Submitted for approval	44th Senate				
To take effect from	March 2021						
Objectives	To provide an exposure to the theory of ODEs & PDEs and the solution techniques.						
Contents of the course	Linear ordinary differential equations with constant coefficients, method of variation of parameters – Linear systems of ordinary differential equations (10L, 3T) Power series solution of ordinary differential equations and Singular points Bessel and Legendre differential equations; properties of Bessel functions and Legendre Polynomials (12L,3T) Fourier series (6L,2T) Laplace transforms elementary properties of Laplace transforms, inversion by partial fractions, convolution theorem and its applications to ordinary differential equations (6L,2T) Introduction to partial differential equations, wave equation, heat equation, diffusion equation (8L,2T)						
Textbooks	1. Simmons. G.F, Differential Equations, Tata McGraw Hill, 2003. 2. Kreyszig. E, Advanced Engineering Mathematics, Wiley, 2007.						
References	1. William. E. Boyce and R. C. Diprima, Elementary Differential Equations and Boundary Value Problems, John Wiley, 8 Edn, 2004. 2. Sneddon. I, Elements of Partial Differential Equations, Tata McGraw Hill, 1972. 3. Ross. L.S, Differential Equations, Wiley, 2007. 4. Trench, W, Elementary Differential Equations, http://digitalcommons.trinity.edu/mono						

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Electronics and Communication Engineering

<table>
<tr><td>Course Title</td><td>Engineering Optics</td><td>Course No</td><td colspan="4">PH2000</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Physics</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Dr. Vivek Kumar</td><td>Status</td><td colspan="2">Core □</td><td colspan="2">Elective ■</td></tr>
<tr><td>Offered for</td><td>UG</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce the principles of physical optics and application of the physical concepts to topical engineering domains.
• Understand basic lasing action, study various types of lasers and to have basic idea of fiber optics.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• Interpret the intensity variation of light due to Polarization, interference and diffraction.
• Learn the concept and operating principles of optical instruments.
• State the working principle of lasers and describe its applications.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Module 1: Wave Optics (L17+T8)
• Interference- Introduction to waves, Coherence (Spatial and Temporal), Principle of Superposition, Young's double slit experiment, Interference by wave front division and by amplitude division and examples.
• Diffraction- Fresnel and Fraunhofer diffraction, Fraunhofer diffraction due to double slit. Diffraction grating and its applications.
• Polarization- Introduction, Malus' law, Polarization by reflection and Brewster's law and applications.
Module 2: Laser Basics (L8+T3)
• Laser operation, Absorption, Spontaneous Emission and Stimulated Emission, Population & Inversion, Three- and FourLevel Laser Systems, Laser Characteristics- Types of Lasers: Solid-State Lasers, Gas Lasers, Semiconductor Lasers.
Module 3: Applications (L16+T3)
• Interferometers: Michelson interferometer, Fabry-Perot interferometer, Mach-Zehnder interferometer, Sagnac interferometer.
• Fiber optics: Fermat's principle and Snell's law, optical fiber: principle and construction, acceptance cone, numerical aperture, types of fibers, Applications.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Eugene Hecht, Optics (5th edition), Pearson (2019).
2. A. Ghatak, Optics (4th edition), Tata Mcgraw Hill (2009).</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. William T. Silfvast, Laser Fundamentals, Cambridge University Press (2004).
2. John Crisp and Barry Elliott, Introduction to Fiber Optics, Elsevier (2005).
3. Warren J. Smith, Modern Optical Engineering, McGraw-Hill (2007).</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Electronics and Communication Engineering

<table>
<tr><td>Course Title</td><td>Waves and Vibrations</td><td>Course No</td><td colspan="4">PH2001</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Physics</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Dr. Naveen Kumar</td><td>Status</td><td colspan="2">Core □</td><td colspan="2">Elective ■</td></tr>
<tr><td>Offered for</td><td>UG</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To improve the conceptual, physical and mathematical comprehension of the phenomenon of waves and vibrations
• To Implement the understanding of waves and vibrations in real-time applications/devices design</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students would be able to conceptualize the physical phenomenon of waves/and vibrations for varieties of interdisciplinary product design applications</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Module 1: Sources (electrical/mechanical/oceanic/optical) of waves and vibrations; Importance and applications of vibrations and waves in life; Free, damped, forced oscillations (Mathematical models) (L8+T3)
• Module 2: Wave equations, Classifications of Waves: transverse, longitudinal, plane, cylindrical, spherical, periodic, aperiodic, sinusoidal, square, triangular, saw tooth waves, polarization, circularly, plane, elliptically polarized waves with mathematical representation and examples/case studies from nature and real-time applications (L10 + T4)
• Module 3: Superposition of waves, beats, wave packet, phase velocity, group velocity, dispersion, modulation, wave plates, stationary and traveling waves, energy density (L8+T2)
• Module 4: Energy harvesting techniques along with basic electronic circuitry for product design applications (L8+ T3)
• Module 5: Wave guiding and fiber Interferometers for smart sensing and measurement applications (L8 +T2)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Frank S Crawford Jr., Waves: Berkeley Physics Course Volume 3, McGraw Hill, 2008</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. E. Hecht, Optics, Pearson, 5th edition, 2016
2. Shashank Priya and Daniel J Inman, Energy Harvesting Technologies, Springer, 2009
3. Daniele Tosi and Guido Perrone, Fiber-Optic Sensors for Biomedical Applications, Artech House, 2018</td></tr>
</table>

ANNEXURE E-I

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Electronics and Communication Engineering

<table>
<tr><td>Course Title</td><td>Physics of Materials</td><td>Course No</td><td colspan="4">PH2002</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Physics</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Dr. Y Ashok Kumar Reddy</td><td>Status</td><td colspan="2">Core □</td><td colspan="2">Elective ■</td></tr>
<tr><td>Offered for</td><td>UG</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• The objective of the course is to provide the insights of various states of material and their properties, nanotechnology, existing energy resources and their applications for next generation Engineers.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Upon successful completion, students can gain the knowledge to:
• Applied Physics concepts towards materials and their applications;
• Evaluation and selection of suitable materials for different energy, medical and industrial applications.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Physics of Matter: Atoms in crystals, Atomic bonding, Free electron theory, Band theory, Fermi Level, Energy bands, Conductors, Insulators, Semiconductors, Superconductors, Dielectrics, Magnetic and Plasmonic materials (L12+T3)
• Physics of Nano: Introduction to nanomaterials, Properties of nanomaterials, Types of nanomaterials, Synthesis of Nanomaterials-Top-down and Bottom-up approaches, Quantum confinement, Quantum well, Wire and Dot, Carbon Nano-tubes (CNTs), Nanotechnology for medical and industrial applications (L14+T4)
• Physics of Energy: Introduction to energy sources, Solar energy- Solar production and Radiation, Photovoltaic solar cells; Nuclear energy- Nuclear energy processes, Fission and Fusion; Electrochemical energy- Storage and Conversion; Thermal Energy- Conduction, Convection and Radiation; Wind Energy- Turbines and Utility scale wind; Bio energy- Sources and Biomass (L16+T5)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, 7th Edition, 2017.
2. Charles P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology, A John Wiley-Interscience publication, 2003.
3. M.N. Avadhanulu, P.G. Kshirsagar, T.V.S. Arun Murthy, A Textbook of Engineering Physics, S. Chand Publishing, 11th Edition, 2018.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Charles Kittel, Introduction to Solid State Physics, 8th Edition, 2004.
2. A.P. Zambare, R.B. Bhise, A.B. Bhise, V.D. Kulkarni, H.R. Kulkarni, Physics of Nanomaterials, Nirali Prakashan, 2019.
3. Robert L. Jaffe, Washington Taylor, The Physics of Energy, Cambridge University Press, 2018.</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2^{nd} Semester Curriculum 2020 B Tech

Electronics and Communication Engineering

Course Title	**Engineering Graphics**	Course No	**ME1001**			
Department/ Specialization	Mechanical Engineering	Credits	L	T	P	C
			2	0	4	4
Faculty proposing the course	Faculty, Department of Mechanical Engineering	Status	Core ■		Elective □	
Offered for	B.Tech EC/CS/ME/MSM	Type	New ■		Revision □	
To take effect from	March 2021	Submitted for approval	____ Senate			
Prerequisite	Nil					
Learning Objectives	• To introduce the basic concepts and techniques of technical drawing. • 2D and 3D representation of various shapes/objects and its engineering applications.					
Learning Outcomes	Students will acquire visualization skills and will be able to prepare technical drawings and 3D models using computer aided tools.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Role of technical drawing in product development process, Basics of technical drawing, Standards, Dimensioning principles. *(L2+P4 hrs)* • Computer aided drafting. *(L2+P8 hrs)* • Engineering curves and its applications. *(L4+P8 hrs)* • Principles of orthographic projection. Orthographic projection of points, lines, planes and regular solids, Exercises related to engineering applications. *(L7+P8 hrs)* • Principles of isometric projections. Orthographic to isometric and isometric to orthographic transformation of objects. *(L3+P8 hrs)* • Section and intersection of regular solids and their lateral developments. *(L6+P12 hrs)* • Introduction to 3D modelling of shapes and objects; electrical CAD. *(L2+P4 hrs)*					
Essential Reading	2. K. Venugopal and V Prabhu Raja, Engineering Drawing + AutoCAD, New Age International (P) Limited. 5th Edition Reprint: July, 2016 3. Narayana. K.L, and Kannaiah. P, Engineering Drawing, Scitech Pub. Pvt. Ltd, 3rd Edition.					
Supplementary Reading	4. PI Varghese, Engineering Graphics, McGraw Hill Education, 2013. 5. Bhatt. N.D, Engineering Drawing – Plane and Solid Geometry, Charotar Publishing House Pvt. Ltd., 53 Edition 2014.					

ANNEXURE E-I

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Electronics and Communication Engineering

Course Title	**Elementary Data Structures and Logical Thinking**	Course No	**CS1002**
Department/ Specialization	ECE/ME	Credits	L: 3, T: 0, P: 0, C: 3
Faculty proposing the course	Faculty, Department of CSE	Status	Core ■ Elective □
Offered for	B.Tech ECE/ME	Type	New ■ Revision □
To take effect from	March 2021	Submitted for approval	44th Senate
Prerequisite	Nil		
Learning Objectives	The focus is to discuss how data is organized and retrieved in computers. Elementary data structures with supporting operations shall be discussed. Students will be exposed to art of logical thinking through algorithmic puzzles.		
Learning Outcomes	At the end of the course, given a computational problem, students are expected to come up with an algorithm and a suitable data structure, and implement the same using a programming language.		
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• History of Computing and Computers – the need for data organization – introduction to abstract data types and data structures (3L) • Introduction to logical thinking (algorithmic thinking) through simple examples. Introduction to Elementary data structures - Discussion on Stacks and Queues with supporting operations – implementation using arrays and lists – implementation of stack using queues and vice-versa – variants of stacks and queues – algorithmic puzzles (10L) • Arrays and applications - algorithmic puzzles involving arrays- sorting and searching. (8L) • Discussion on linked lists with various supporting operations- algorithmic puzzles involving lists. Types of Lists – double, circular – the need for double and circular linked lists – puzzles involving lists (10L) • Introduction to trees, binary trees, search trees (7L) • Applications of elementary data structures in computer science and engineering. (7L)		
Essential Reading	1. M. A. Weiss, Data Structures and Algorithm Analysis in C, 2nd ed., Pearson, 2002. 2. Anany Levitin and Maria Levitin, Algorithmic Puzzles, Oxford University Press, 2011		
Supplementary Reading	1. Narasimha Karumanchi, Data Structure and Algorithmic Thinking with Python, Careermonk Publications, 2017		

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Electronics and Communication Engineering

<table>
<tr><td>Course Title</td><td>Sociology of Design</td><td>Course No</td><td colspan="4">DS1001</td></tr>
<tr><td rowspan="2">Specializ ation</td><td rowspan="2">Design Spine (Semester 2)</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>1</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>B.Tech & DD All streams</td><td rowspan="2">Status</td><td colspan="2" rowspan="2">Core</td><td colspan="2" rowspan="2">Elective</td></tr>
<tr><td>Prepared by (Faculty Name)</td><td></td></tr>
<tr><td>Prerequi site</td><td>Foundation Program</td><td>To take effect from</td><td colspan="4">March 2021</td></tr>
<tr><td>Course Objectiv es</td><td colspan="6">The objective of the course is to introduce engineering students to the importance of understanding the social context of technology and product design:
1. Observing the problem context and surfacing unstated user/customer needs / new product concepts,
2. Understanding people, team dynamics and working in multicultural / cross-functional / distributed teams.</td></tr>
<tr><td>Contents of the course (With approxi mate break up of hours)</td><td colspan="6">Module 1: Technology, Design and Society - [9 hrs]
● Observe the way people interact with objects
● Understanding the relationship between people and a variety of objects
● Actor Network Theory; History of Technology and Design; 2-3 Case studies
● Discover your passion and domain of interest & network to identify partners
Module 2: Understanding user/customer contexts [21 hrs]
● Ethnography - immersion in a problem context
● Learning to observe - see and listen;
● Developing rich pictures; Gigamapping
● Introduction to signs and semiotic analysis
Module 3: Understanding groups (multicultural/cross-functional teams) [12 hrs]
● Learning team formation and dynamics through a movie;
● Introduction to sociological imagination - Functionalism, Conflict Theory, Symbolic Interactionism; Interaction Ritual Chains
● Values, culture, methods of engineers and designers and how they shape the quality of our lives;
● Group dynamics within organizations and across organizations and implications for innovation and change
Evaluation: Continuous assessment (40%); Final ethnography report (20%); End Semester (40%)</td></tr>
<tr><td>Text and References</td><td colspan="6">1. Trevor Pinch (Editors) (2012), The Social Construction of Technological Systems: New directions in the sociology and history of technology, MIT Press, Anniversary Edition
2. Wendy Gunn, Ton Otto and Rachel Smith (2013), Design Anthropology: Theory and practice, Bloomsbury
3. Adrian Forty (2014), Objects of desire: Design and society since 1750s, Thames & Hudson
4. Bernhard E Burdek(2015), History, theory and practice of product design, second revised edition
5. Keri Smith (2008), How to be an Explorer of the World: Portable Life Museum, Penguin Group</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">At the end of the course, the students should be in a position to:
● Understand the need and the process of doing an ethnographic study
● Surface unstated needs and articulate the high level product requirements
● Connect with people, form teams and collaborate towards a common goal</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Electronics and Communication Engineering

<table>
<tr><td>Course Title</td><td>Design and Manufacturing Lab.</td><td>Course No</td><td colspan="4">ID1000</td></tr>
<tr><td>Specialization</td><td>Interdisciplinary</td><td>Structure (LTPC)</td><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td>Offered for</td><td>UG & DD</td><td>Status</td><td colspan="2">Core</td><td colspan="2">Elective</td></tr>
<tr><td>Faculty</td><td>Dr. Avinash Kumar/ Dr. Karthik S.</td><td>Type</td><td colspan="2">New</td><td colspan="2">Modification</td></tr>
<tr><td>Pre-requisite</td><td>----</td><td>To take effect from</td><td colspan="4">December 2020</td></tr>
<tr><td>Submission date</td><td>December, 2020</td><td>Date of approval by Senate</td><td colspan="4">NA</td></tr>
<tr><td>Objectives</td><td colspan="6">The objective of this course is to give an exposure on the basic practices followed in the domain of mechanical, electrical, electronics and communication engineering. The exercises will train the students to acquire skills which are very essential for the engineers through hands-on sessions.</td></tr>
<tr><td>Contents of the course</td><td colspan="6">Experiments will be framed to train the students in following common engineering practices:

Basic manufacturing processes: Fitting, Drilling & tapping, Material joining processes, Carpentry, Sheet-metal work, Adhesive bonding and plastic welding, Arc Welding, 3D Printing. (10 hours)

Familiarization of electronic components by Nomenclature, meters, power supplies, function generators and Oscilloscope – Bread board assembling of simple circuits: IR transmitter and receiver
– LED emergency lamp – Communication study: amplitude modulation and demodulation. (6 hours)

Domestic wiring practice: Fluorescent lamp connection, Staircase wiring – Estimation and costing of domestic and industrial wiring – power consumption by Incandescent, CFL and LED lamps. (2 Hours)

Dismantle and assembly of PC. Installing OS and disk management. (4 hours)</td></tr>
<tr><td>Textbook</td><td colspan="6">1. Uppal S. L., “Electrical Wiring & Estimating”, 5Edn, Khanna Publishers, 2003.
2. Chapman. W. A. J., Workshop Technology, Part 1 & 2, Taylor & Francis.</td></tr>
<tr><td>References</td><td colspan="6">1. Clyde F. Coombs, “Printed circuits hand book”, 6Edn, McGraw Hill, 2007.
2. John H. Watt, Terrell Croft, “American Electricians' Handbook: A Reference Book for the Practical Electrical Man”, Tata McGraw Hill, 2002.</td></tr>
</table>

ANNEXURE E-I

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Electronics and Communication Engineering

<table>
<tr><td>Course Title</td><td>Digital Circuits</td><td>Course No</td><td colspan="4">EC1001</td></tr>
<tr><td rowspan="2">Department/
Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech ECE</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The key objective of this course is to provide a good understanding on the design and implementation of digital circuits and systems</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">The course would equip the students to
• Understand Digital Logics and circuits design.
• Design Combinational & Sequential digital circuits.
• Develop Digital Circuits/Systems for practical problems.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Introduction to Digital Systems: Introduction to Digital Logic, Data Representations, Number systems, Code conversion (L5+T1)
• Boolean Algebra & Logic: Laws and theorems of Boolean Algebra, Truth Table and algebraic form, Boolean Logic Minimization, Design using MSI Components, K Maps, QM method, SOP, POS; NAND and NOR implementations, Digital Circuit Characterization (L7+T2)
• Combinational Circuit Design: Design Procedure, Multiplexer, Decoder, Encoder, Comparator, Seven-segment display, Parity generator, Design of large circuits. (L8+T2)
• Sequential Circuit Design: Asynchronous and Synchronous Design, Flip Flops & Latches, Design of sequential modules – SR, D, T and J-K Flip-flops, applications, Clock generation, Registers and Counters. (L10 +T3)
• State Machine Design: Moore and Mealy Machines, State Table and Diagram, State machine Design Approach, Digital Implementation of State Machine. (L8+T3)
• Introduction to HDL and Design Examples : (L3+T1)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. C. H. Roth, Jr., Fundamentals of Logic Design, 7th Edition, Cengage Learning, ISBN: 9781133628477, 2013.
2. S. Brown and Z. Vranesic, Fundamentals of Digital Logic with VHDL Design, 3rdEdition, TMH, ISBN: 9780077221430, 2008.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. R. J. Tocci, N. S. Widmer, and G. L. Moss, Digital Systems Principles and applications, 10th Edition, Pearson Prentice Hall Edition, ISBN:9780131725799, 2006.
2. V.A.Pedroni, Digital Electronics and Design with VHDL, 1st Edition, Elsevier, ISBN: 978-0-12-374270-4, 2008.
3. Taub and Schilling, Digital Principles and Applications, 7th Edition, TMH, ISBN: 978-0-07-014170-4., 2011.
4. J. F. Wakerly, Digital Design- Principles and Practices, 3rd Edition, Pearson, ISBN:9332508135, 2008.
5. M Morris Mano, Digital Design, 5th Edition, Pearson, ISBN:9332535763, 2014.
6. M Morris Mano, Digital Design with an Introduction to the Verilog HDL, VHDL & System Verilog, 6th Edition, Pearson, ISBN:9353062019, 2018.
7. T. L. Floyd and R. P. Jain, Digital Fundamentals, 8th Edition, Pearson, ISBN:9332584600, 2017.</td></tr>
</table>

ANNEXURE E-I

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Electronics and Communication Engineering

<table>
<tr><td>Course Title</td><td>Elementary Data Structures and Logical Thinking Practice</td><td>Course No</td><td colspan="4">CS1003</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">ECE/ME</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech ECE/ME</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The focus is to discuss how data is organized and retrieved in computers. Elementary data structures with supporting operations shall be discussed. Students will be exposed to art of logical thinking through algorithmic puzzles.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, given a computational problem, students are expected to come up with an algorithm and a suitable data structure, and implement the same using a programming language.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Case studies that motivates logical thinking (algorithmic thinking) – implementation using C programming
• Case studies involving arrays and implementation - Arrays with various supporting operations- algorithmic puzzles involving arrays – sorting and searching
• Examples on linked lists with various supporting operations- algorithmic puzzles involving singly, doubly and circular linked lists. – puzzles involving lists
• Case studies on Stacks and Queues with supporting operations – implementation using arrays and lists – implementation of stack using queues and vice-versa – variants of stacks and queues – algorithmic puzzles
• Applications of elementary data structures in computer science and engineering and implementation</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. M. A. Weiss, Data Structures and Algorithm Analysis in C, 2nd ed., Pearson, 2002.
2. Anany Levitin and Maria Levitin, Algorithmic Puzzles, Oxford University Press, 2011</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Narasimha Karumanchi, Data Structure and Algorithmic Thinking with Python, Careermonk Publications, 2017</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Electronics and Communication Engineering

<table>
<tr><td>Course Title</td><td>Earth, Environment and Design</td><td>Course No</td><td colspan="4">HS1002</td></tr>
<tr><td rowspan="2">Department / Specialization</td><td rowspan="2">Interdisciplinary</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>P/F</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of SIDI</td><td>Status</td><td colspan="2">Core</td><td colspan="2">Elective</td></tr>
<tr><td>Offered for</td><td>UG & DD</td><td>Type</td><td colspan="2">New</td><td colspan="2">Modification</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td></td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The course aims to provide an understanding of systems and processes in aquatic and terrestrial environments, and to explore changes in the atmosphere, lithosphere, hydrosphere, biosphere, and the evolution of organisms, since the origin of life on earth.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Introduction to environment and ecology – Ecosystems
Impacts of natural and human activities on ecosystems
Environmental policies, acts and standards, Environmental Impact Assessment
Prediction and assessment of the impacts on air, water, land, and biological environments
Assessment of impacts of the cultural, socioeconomic and ecosensitive environments</td></tr>
<tr><td>Textbook</td><td colspan="6">1. Rubin. E. S, Introduction to Engineering and the Environment, McGraw Hill, 2000.
2. Masters. G. M., Introduction to Environmental Engineering & Science, Prentice Hall, 1997.</td></tr>
<tr><td>References</td><td colspan="6">1. Henry. J. G, and Heike, G. W, Environmental Science & Engineering, Prentice Hall International, 1996.
2. Dhameja. S. K, Environmental Engineering and Management, S. K. Kataria and Sons, 1999.
3. Shyam Divan and Armin Rosancranz, Environmental Law and Policy in India, Cases, Materials and Statutes, Oxford University Press, 2001.</td></tr>
</table>

Revised Curriculum for second semester

B.Tech. Computer Science and Engineering 2020 Batch

Semester 2					
Category	Course Name	L	T	P	C
BSC	Differential Equations	3	1	0	4
SEC	Science Elective 1	3	1	0	4
BEC	Engineering Graphics	2	0	4	4
ITC	Data Structures and Algorithms	3	0	0	3
DSC	Sociology of Design	1	2	0	3
ITC	Design and Manufacturing Lab	0	0	2	1
PCC	Discrete Structures for Computer Science	3	1	0	4
ITC	Data Structures and Algorithms practice	0	0	4	2
HMC	NSO/NCC/SSG/NSS	0	0	2	P/F
HMC	Earth, Environment and Design	1	0	0	P/F
					25.0

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Computer Science and Engineering

<table>
<tr><td>Course Title</td><td>Differential Equations</td><td>Course No</td><td colspan="4">MA1001</td></tr>
<tr><td rowspan="2">Specialization</td><td rowspan="2">Mathematics</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Offered for</td><td>UG & DD</td><td>Status</td><td colspan="2">Core</td><td colspan="2">Elective</td></tr>
<tr><td>Faculty</td><td></td><td>Type</td><td colspan="2">New</td><td colspan="2">Modification</td></tr>
<tr><td>Pre-requisite</td><td></td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>To take effect from</td><td>March 2021</td></tr>
<tr><td>Objectives</td><td colspan="6">To provide an exposure to the theory of ODEs & PDEs and the solution techniques.</td></tr>
<tr><td>Contents of the course</td><td colspan="6">Linear ordinary differential equations with constant coefficients, method of variation of parameters – Linear systems of ordinary differential equations (10L, 3T)
Power series solution of ordinary differential equations and Singular points
Bessel and Legendre differential equations; properties of Bessel functions and Legendre Polynomials (12L,3T)
Fourier series (6L,2T)
Laplace transforms elementary properties of Laplace transforms, inversion by partial fractions, convolution theorem and its applications to ordinary differential equations (6L,2T)

Introduction to partial differential equations, wave equation, heat equation, diffusion equation (8L,2T)</td></tr>
<tr><td>Textbooks</td><td colspan="6">1. Simmons. G.F, Differential Equations, Tata McGraw Hill, 2003.
2. Kreyszig. E, Advanced Engineering Mathematics, Wiley, 2007.</td></tr>
<tr><td>References</td><td colspan="6">1. William. E. Boyce and R. C. Diprima, Elementary Differential Equations and Boundary Value Problems, John Wiley, 8 Edn, 2004.
2. Sneddon. I, Elements of Partial Differential Equations, Tata McGraw Hill, 1972.
3. Ross. L.S, Differential Equations, Wiley, 2007.
4. Trench, W, Elementary Differential Equations, http://digitalcommons.trinity.edu/mono</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Computer Science and Engineering

<table>
<tr><td>Course Title</td><td>Engineering Optics</td><td>Course No</td><td colspan="4">PH2000</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Physics</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Dr. Vivek Kumar</td><td>Status</td><td colspan="2">Core □</td><td colspan="2">Elective ■</td></tr>
<tr><td>Offered for</td><td>UG</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce the principles of physical optics and application of the physical concepts to topical engineering domains.
• Understand basic lasing action, study various types of lasers and to have basic idea of fiber optics.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• Interpret the intensity variation of light due to Polarization, interference and diffraction.
• Learn the concept and operating principles of optical instruments.
• State the working principle of lasers and describe its applications.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Module 1: Wave Optics (L17+T8)
• Interference- Introduction to waves, Coherence (Spatial and Temporal), Principle of Superposition, Young's double slit experiment, Interference by wave front division and by amplitude division and examples.
• Diffraction- Fresnel and Fraunhofer diffraction, Fraunhofer diffraction due to double slit. Diffraction grating and its applications.
• Polarization- Introduction, Malus' law, Polarization by reflection and Brewster's law and applications.
Module 2: Laser Basics (L8+T3)
• Laser operation, Absorption, Spontaneous Emission and Stimulated Emission, Population & Inversion, Three- and FourLevel Laser Systems, Laser Characteristics- Types of Lasers: Solid-State Lasers, Gas Lasers, Semiconductor Lasers.
Module 3: Applications (L16+T3)
• Interferometers: Michelson interferometer, Fabry-Perot interferometer, Mach-Zehnder interferometer, Sagnac interferometer.
• Fiber optics: Fermat's principle and Snell's law, optical fiber: principle and construction, acceptance cone, numerical aperture, types of fibers, Applications.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Eugene Hecht, Optics (5th edition), Pearson (2019).
2. A. Ghatak, Optics (4th edition), Tata Mcgraw Hill (2009).</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. William T. Silfvast, Laser Fundamentals, Cambridge University Press (2004).
2. John Crisp and Barry Elliott, Introduction to Fiber Optics, Elsevier (2005).
3. Warren J. Smith, Modern Optical Engineering, McGraw-Hill (2007).</td></tr>
</table>

ANNEXURE E-I

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Computer Science and Engineering

<table>
<tr><td>Course Title</td><td>Waves and Vibrations</td><td>Course No</td><td colspan="4">PH2001</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Physics</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Dr. Naveen Kumar</td><td>Status</td><td colspan="2">Core ☐</td><td colspan="2">Elective ■</td></tr>
<tr><td>Offered for</td><td>UG</td><td>Type</td><td>New</td><td>■</td><td colspan="2">Revision ☐</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To improve the conceptual, physical and mathematical comprehension of the phenomenon of waves and vibrations
• To Implement the understanding of waves and vibrations in real-time applications/devices design</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students would be able to conceptualize the physical phenomenon of waves/and vibrations for varieties of interdisciplinary product design applications</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Module 1: Sources (electrical/mechanical/oceanic/optical) of waves and vibrations; Importance and applications of vibrations and waves in life; Free, damped, forced oscillations (Mathematical models) (L8+T3)
• Module 2: Wave equations, Classifications of Waves: transverse, longitudinal, plane, cylindrical, spherical, periodic, aperiodic, sinusoidal, square, triangular, saw tooth waves, polarization, circularly, plane, elliptically polarized waves with mathematical representation and examples/case studies from nature and real-time applications (L10 + T4)
• Module 3: Superposition of waves, beats, wave packet, phase velocity, group velocity, dispersion, modulation, wave plates, stationary and traveling waves, energy density (L8+T2)
• Module 4: Energy harvesting techniques along with basic electronic circuitry for product design applications (L8+ T3)
• Module 5: Wave guiding and fiber Interferometers for smart sensing and measurement applications (L8 +T2)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Frank S Crawford Jr., Waves: Berkeley Physics Course Volume 3, McGraw Hill, 2008</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. E. Hecht, Optics, Pearson, 5th edition, 2016
2. Shashank Priya and Daniel J Inman, Energy Harvesting Technologies, Springer, 2009
3. Daniele Tosi and Guido Perrone, Fiber-Optic Sensors for Biomedical Applications, Artech House, 2018</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Computer Science and Engineering

<table>
<tr><td>Course Title</td><td>Physics of Materials</td><td>Course No</td><td colspan="4">PH2002</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Physics</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Dr. Y Ashok Kumar Reddy</td><td>Status</td><td colspan="2">Core □</td><td colspan="2">Elective ■</td></tr>
<tr><td>Offered for</td><td>UG</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• The objective of the course is to provide the insights of various states of material and their properties, nanotechnology, existing energy resources and their applications for next generation Engineers.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Upon successful completion, students can gain the knowledge to:
• Applied Physics concepts towards materials and their applications;
• Evaluation and selection of suitable materials for different energy, medical and industrial applications.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Physics of Matter: Atoms in crystals, Atomic bonding, Free electron theory, Band theory, Fermi Level, Energy bands, Conductors, Insulators, Semiconductors, Superconductors, Dielectrics, Magnetic and Plasmonic materials (L12+T3)
• Physics of Nano: Introduction to nanomaterials, Properties of nanomaterials, Types of nanomaterials, Synthesis of Nanomaterials-Top-down and Bottom-up approaches, Quantum confinement, Quantum well, Wire and Dot, Carbon Nano-tubes (CNTs), Nanotechnology for medical and industrial applications (L14+T4)
• Physics of Energy: Introduction to energy sources, Solar energy- Solar production and Radiation, Photovoltaic solar cells; Nuclear energy- Nuclear energy processes, Fission and Fusion; Electrochemical energy- Storage and Conversion; Thermal Energy- Conduction, Convection and Radiation; Wind Energy- Turbines and Utility scale wind; Bio energy- Sources and Biomass (L16+T5)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, 7th Edition, 2017.
2. Charles P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology, A John Wiley-Interscience publication, 2003.
3. M.N. Avadhanulu, P.G. Kshirsagar, T.V.S. Arun Murthy, A Textbook of Engineering Physics, S. Chand Publishing, 11th Edition, 2018.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Charles Kittel, Introduction to Solid State Physics, 8th Edition, 2004.
2. A.P. Zambare, R.B. Bhise, A.B. Bhise, V.D. Kulkarni, H.R. Kulkarni, Physics of Nanomaterials, Nirali Prakashan, 2019.
3. Robert L. Jaffe, Washington Taylor, The Physics of Energy, Cambridge University Press, 2018.</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Computer Science and Engineering

<table>
<tr><td>Course Title</td><td>Engineering Graphics</td><td>Course No</td><td colspan="4">ME2000</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>4</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech EC/CS/ME/MSM</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">_____ Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce the basic concepts and techniques of technical drawing.
• 2D and 3D representation of various shapes/objects and its engineering applications.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students will acquire visualization skills and will be able to prepare technical drawings and 3D models using computer aided tools.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Role of technical drawing in product development process, Basics of technical drawing, Standards, Dimensioning principles. (L2+P4 hrs)
• Computer aided drafting. (L2+P8 hrs)
• Engineering curves and its applications. (L4+P8 hrs)
• Principles of orthographic projection. Orthographic projection of points, lines, planes and regular solids, Exercises related to engineering applications. (L7+P8 hrs)
• Principles of isometric projections. Orthographic to isometric and isometric to orthographic transformation of objects. (L3+P8 hrs)
• Section and intersection of regular solids and their lateral developments. (L6+P12 hrs)
• Introduction to 3D modelling of shapes and objects; electrical CAD. (L2+P4 hrs)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">2. K. Venugopal and V Prabhu Raja, Engineering Drawing + AutoCAD, New Age International (P) Limited. 5th Edition Reprint: July, 2016
3. Narayana. K.L, and Kannaiah. P, Engineering Drawing, Scitech Pub. Pvt. Ltd, 3rd Edition.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">4. PI Varghese, Engineering Graphics, McGraw Hill Education, 2013.
5. Bhatt. N.D, Engineering Drawing – Plane and Solid Geometry, Charotar Publishing House Pvt. Ltd., 53 Edition 2014.</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Computer Science and Engineering

<table>
<tr><td>Course Title</td><td>Data Structures and Algorithms</td><td>Course No</td><td colspan="4">CS1004</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science & Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech CSE</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">Given a computational problem, the focus is on design of algorithms, implementation of algorithms using a suitable data structures. The notion time and space complexity and design of efficient algorithms and data structures shall also be explored.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students are expected to design efficient algorithms and data structures for computational problems</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">
Review of elementary data structures – time and space complexity – step count method based computation – asymptotic analysis and bounds – big oh, little oh, omega, theta notation (5L)
Analysis using recurrence relations – solving recurrence relations through guess method, recurrence tree method, masters theorem (5L)
Analysis of sorting/searching algorithms - Incremental Design - insertion sort, Decremental Design - Celebrity problem - Divide and Conquer- merge sort, quick sort – comparison/ non-comparison based sorting algorithms on restricted inputs – counting, radix sorting - discussion on inputs with best/worst case complexities (7L)
Binary Trees - Tree representation, traversal, Introduction to expression trees: traversal vs post/pre/infix notation. Recursive traversal and other tree parameters (depth, height, number of nodes etc.) (6L)
Dictionary: Binary search trees, balanced binary search trees - AVL Trees – search tree variants such as B-trees. (7L)
Hashing - collisions, open and closed hashing, properties of good hash functions. (4L)
Priority queues: Binary heaps with application to in-place sorting (5L)
Graphs: Representations (Matrix and Adjacency List), basic traversal such as BFS, DFS with complexity (6L)
</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. M. A. Weiss, Data Structures and Algorithm Analysis in C, Pearson, 2nd edition, 2002.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Cormen T.H, Leiserson C.E and Rivest R.L, Introduction to Algorithms, Prentice Hall India, 2nd Edition, 2001.
2. Aho, Hopcroft and Ullmann, Data Structures and Algorithms, Addison Wesley, 1983.
3. Adam Drozdek, Data structures and Algorithms in C, 1994.
4. R G Dromey, How to solve it by Computer, Prentice Hall India, 1982.
5. Horowitz, Sahni and Anderson-Freed, Fundamentals of Data Structures in C, Silicon Press, 2007.</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Computer Science and Engineering

Course Title	Sociology of Design	Course No	DS1001			
Department/ Specialization	Design Spine (Semester 2)	Structure (LTPC)	L	T	P	C
			1	2	0	3
Offered for	B.Tech & DD All streams	Status	Core	Elective		
Prepared by (Faculty Name)						
Prerequisite	Foundation Program	To take effect from	March 2021			

Course Objectives	The objective of the course is to introduce engineering students to the importance of understanding the social context of technology and product design: 1. Observing the problem context and surfacing unstated user/customer needs / new product concepts, 2. Understanding people, team dynamics and working in multicultural / cross-functional / distributed teams.
Contents of the course (With approxi mate break up of hours)	**Module 1: Technology, Design and Society - [9 hrs]** ● Observe the way people interact with objects ● Understanding the relationship between people and a variety of objects ● Actor Network Theory; History of Technology and Design; 2-3 Case studies ● Discover your passion and domain of interest & network to identify partners **Module 2: Understanding user/customer contexts [21 hrs]** ● Ethnography - immersion in a problem context ● Learning to observe - see and listen; ● Developing rich pictures; Gigamapping ● Introduction to signs and semiotic analysis **Module 3: Understanding groups (multicultural/cross-functional teams) [12 hrs]** ● Learning team formation and dynamics through a movie; ● Introduction to sociological imagination - Functionalism, Conflict Theory, Symbolic Interactionism; Interaction Ritual Chains ● Values, culture, methods of engineers and designers and how they shape the quality of our lives; ● Group dynamics within organizations and across organizations and implications for innovation and change Evaluation: Continuous assessment (40%); Final ethnography report (20%); End Semester (40%)
Text and References	1. Trevor Pinch (Editors) (2012), The Social Construction of Technological Systems: New directions in the sociology and history of technology, MIT Press, Anniversary Edition 2. Wendy Gunn, Ton Otto and Rachel Smith (2013), Design Anthropology: Theory and practice, Bloomsbury 3. Adrian Forty (2014), Objects of desire: Design and society since 1750s, Thames & Hudson 4. Bernhard E Burdek(2015), History, theory and practice of product design, second revised edition 5. Keri Smith (2008), How to be an Explorer of the World: Portable Life Museum, Penguin Group
Course Outcomes	At the end of the course, the students should be in a position to: ● Understand the need and the process of doing an ethnographic study ● Surface unstated needs and articulate the high level product requirements ● Connect with people, form teams and collaborate towards a common goal

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Computer Science and Engineering

<table>
<tr><td>Course Title</td><td>Design and Manufacturing Lab.</td><td>Course No</td><td colspan="4">ID1000</td></tr>
<tr><td>Department/ Specialization</td><td>Interdisciplinary</td><td>Structure (LTPC)</td><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td>Offered for</td><td>UG & DD</td><td>Status</td><td colspan="2">Core</td><td colspan="2">Elective</td></tr>
<tr><td>Faculty</td><td>Dr. Avinash Kumar/ Dr. Karthik S.</td><td>Type</td><td colspan="2">New</td><td colspan="2">Modification</td></tr>
<tr><td>Pre-requisite</td><td>----</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>To take effect from</td><td>March 2021</td></tr>
<tr><td>Objectives</td><td colspan="6">The objective of this course is to give an exposure on the basic practices followed in the domain of mechanical, electrical, electronics and communication engineering. The exercises will train the students to acquire skills which are very essential for the engineers through hands-on sessions.</td></tr>
<tr><td>Contents of the course</td><td colspan="6">Experiments will be framed to train the students in following common engineering practices:

Basic manufacturing processes: Fitting, Drilling & tapping, Material joining processes, Carpentry, Sheet-metal work, Adhesive bonding and plastic welding, Arc Welding, 3D Printing. (10 hours)

Familiarization of electronic components by Nomenclature, meters, power supplies, function generators and Oscilloscope – Bread board assembling of simple circuits: IR transmitter and receiver
– LED emergency lamp – Communication study: amplitude modulation and demodulation. (6 hours)

Domestic wiring practice: Fluorescent lamp connection, Staircase wiring – Estimation and costing of domestic and industrial wiring – power consumption by Incandescent, CFL and LED lamps. (2 Hours)

Dismantle and assembly of PC. Installing OS and disk management. (4 hours)</td></tr>
<tr><td>Textbook</td><td colspan="6">1. Uppal S. L., “Electrical Wiring & Estimating”, 5Edn, Khanna Publishers, 2003.
2. Chapman. W. A. J., Workshop Technology, Part 1 & 2, Taylor & Francis.</td></tr>
<tr><td>References</td><td colspan="6">1. Clyde F. Coombs, “Printed circuits hand book”, 6Edn, McGraw Hill, 2007.
2. John H. Watt, Terrell Croft, “American Electricians' Handbook: A Reference Book for the Practical Electrical Man”, Tata McGraw Hill, 2002.</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Computer Science and Engineering

<table>
<tr><td>Course Title</td><td>Discrete Structures for Computer Science</td><td>Course No</td><td colspan="4">CS1005</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science & Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech CSE</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course introduces logical reasoning, inferences, and proof techniques. Relations, Functions, Counting principles are also discussed. Graph theory and various properties of graphs are also taught as part of this course.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">The learner would appreciate the importance of combinatorics and the various proof techniques, and in particular, in proving the correctness of algorithms. Counting principles learnt as part of the course will help the learner in counting various combinatorial objects</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Mathematical Reasoning – Propositions – Predicates –First order logic – Nested quantifier – logical puzzles (9L+3T)
• Set theory – Relations between sets – Operation on sets –Inductive definition of sets - Proof techniques – Direct proof , proof by contradiction, mathematical induction (8L+3T)
• Binary relation and digraphs – Special properties of relations – Composition of relations – Closure operations on relations – counting special relations (7L+3T)
• Basic properties of functions – Special classes of functions – counting functions (5L+1T)
• Pigenhole principle – onto functions – derangements (5L+1T)
• Basic counting techniques – Finite and Infinite sets –Countable and uncountable sets–Cardinal numbers (6L+1T)
• Graph Theory –Graphs – Sub graphs – Isomorphic and Homeomorphic graphs – Paths – Connectivity Bridges of Konigsberg – Labeled and Weighted Graphs– Complete, Regular and Bipartite Graphs –Planar Graphs – Coloring (5L+2T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. K. H. Rosen, Discrete Mathematics and its Applications, McGraw Hill, 6th Edition, 2007.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. D. F. Stanat and D. F. McAllister, Discrete Mathematics in Computer Science, Prentice Hall, 1977.
2. R. L. Graham, D. E. Knuth, and O. Patashnik, Concrete Mathematics, Second Edition, Addison Wesley, 1994.
3. Busby, Kolman, and Ross, Discrete Mathematical Structures, PHI, 6th Edition, 2008.
4. C. L. Liu, Elements of Discrete Mathematics, Second Edition, Tata McGraw Hill, 1995.</td></tr>
</table>

ANNEXURE E-I

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Computer Science and Engineering

Course Title	**Data Structures and Algorithms Practice**	Course No	**CS1006**
Department/ Specialization	Computer Science & Engineering	Credits	L: 0, T: 0, P: 4, C: 2
Faculty proposing the course	Faculty, Department of CSE	Status	Core ■ Elective □
Offered for	B.Tech CSE	Type	New ■ Revision □
To take effect from	March 2021	Submitted for approval	44th Senate
Prerequisite	Nil		
Learning Objectives	Given a computational problem, the focus is on design of algorithms, implementation of algorithms using a suitable data structures. The notion time and space complexity and design of efficient algorithms and data structures shall also be explored.		
Learning Outcomes	Students are expected to design efficient algorithms and data structures for computational problems		
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Implementation of case studies involving algorithms and data structures in C programming. • Binary Trees – Traversal – Computation of Structural parameters • Hashing – implementation of hash functions – computing collisions – Open vs closed hashing • Sorting and Searching Algorithms • Priority Queues and Heaps and its applications • Graph Traversals – BFS, DFS and its applications		
Essential Reading	1. M. A. Weiss, Data Structures and Algorithm Analysis in C, Pearson, 2nd edition, 2002.		
Supplementary Reading	1. Cormen T.H, Leiserson C.E and Rivest R.L, Introduction to Algorithms, Prentice Hall India, 2nd Edition, 2001. 2. Aho, Hopcroft and Ullmann, Data Structures and Algorithms, Addison Wesley, 1983. 3. Adam Drozdek, Data structures and Algorithms in C, 1994. 4. R G Dromey, How to solve it by Computer, Prentice Hall India, 1982. 5. Horowitz, Sahni and Anderson-Freed, Fundamentals of Data Structures in C, Silicon Press, 2007.		

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Computer Science and Engineering

<table>
<tr><td>Course Title</td><td>Earth, Environment and Design</td><td>Course No</td><td colspan="4">HS1002</td></tr>
<tr><td rowspan="2">Department / Specialization</td><td rowspan="2">Interdisciplinary</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>P/F</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of SIDI</td><td>Status</td><td colspan="2">Core</td><td colspan="2">Elective</td></tr>
<tr><td>Offered for</td><td>UG & DD</td><td>Type</td><td colspan="2">New</td><td colspan="2">Modification</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td></td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The course aims to provide an understanding of systems and processes in aquatic and terrestrial environments, and to explore changes in the atmosphere, lithosphere, hydrosphere, biosphere, and the evolution of organisms, since the origin of life on earth.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Introduction to environment and ecology – Ecosystems
Impacts of natural and human activities on ecosystems
Environmental policies, acts and standards, Environmental Impact Assessment
Prediction and assessment of the impacts on air, water, land, and biological environments
Assessment of impacts of the cultural, socioeconomic and ecosensitive environments</td></tr>
<tr><td>Textbook</td><td colspan="6">1. Rubin. E. S, Introduction to Engineering and the Environment, McGraw Hill, 2000.
2. Masters. G. M., Introduction to Environmental Engineering & Science, Prentice Hall, 1997.</td></tr>
<tr><td>References</td><td colspan="6">1. Henry. J. G, and Heike, G. W, Environmental Science & Engineering, Prentice Hall International, 1996.
2. Dhameja. S. K, Environmental Engineering and Management, S. K. Kataria and Sons, 1999.
3. Shyam Divan and Armin Rosancranz, Environmental Law and Policy in India, Cases, Materials and Statutes, Oxford University Press, 2001.</td></tr>
</table>

Revised Curriculum for second semester

B.Tech. Mechanical Engineering 2020 Batch

Semester 2					
Category	Course Name	L	T	P	C
BSC	Differential Equations	3	1	0	4
SEC	Science Elective 1	3	1	0	4
BEC	Engineering Graphics	2	0	4	4
ITC	Elementary Data Structures and Logical Thinking	3	0	0	3
DSC	Sociology of Design	1	2	0	3
ITC	Design and Manufacturing Lab	0	0	2	1
PCC	Engineering Mechanics	3	0	0	3
ITC	Elementary Data Structures and Logical Thinking Practice	0	0	4	2
PCC	Mechanics and Materials Practice	0	0	2	1
HMC	NSO/NCC/SSG/NSS	0	0	2	P/F
HMC	Earth, Environment and Design	1	0	0	P/F
					25.0

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Mechanical Engineering

<table>
<tr><td>Course Title</td><td>Differential Equations</td><td>Course No</td><td colspan="4">MA1001</td></tr>
<tr><td rowspan="2">Specialization</td><td rowspan="2">Mathematics</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Offered for</td><td>UG & DD</td><td>Status</td><td colspan="2">Core</td><td colspan="2">Elective</td></tr>
<tr><td>Faculty</td><td></td><td>Type</td><td colspan="2">New</td><td colspan="2">Modification</td></tr>
<tr><td>Pre-requisite</td><td></td><td rowspan="2">Date of approval by Senate</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>To take effect from</td><td>March 2021</td></tr>
<tr><td>Objectives</td><td colspan="6">To provide an exposure to the theory of ODEs & PDEs and the solution techniques.</td></tr>
<tr><td>Contents of the course</td><td colspan="6">Linear ordinary differential equations with constant coefficients, method of variation of parameters – Linear systems of ordinary differential equations (10L, 3T)
Power series solution of ordinary differential equations and Singular points
Bessel and Legendre differential equations; properties of Bessel functions and Legendre Polynomials (12L,3T)
Fourier series (6L,2T)
Laplace transforms elementary properties of Laplace transforms, inversion by partial fractions, convolution theorem and its applications to ordinary differential equations (6L,2T)
Introduction to partial differential equations, wave equation, heat equation, diffusion equation (8L,2T)</td></tr>
<tr><td>Textbooks</td><td colspan="6">1. Simmons. G.F, Differential Equations, Tata McGraw Hill, 2003.
2. Kreyszig. E, Advanced Engineering Mathematics, Wiley, 2007.</td></tr>
<tr><td>References</td><td colspan="6">1. William. E. Boyce and R. C. Diprima, Elementary Differential Equations and Boundary Value Problems, John Wiley, 8 Edn, 2004.
2. Sneddon. I, Elements of Partial Differential Equations, Tata McGraw Hill, 1972.
3. Ross. L.S, Differential Equations, Wiley, 2007.
4. Trench, W, Elementary Differential Equations, http://digitalcommons.trinity.edu/mono</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Mechanical Engineering

<table>
<tr><td>Course Title</td><td>Engineering Optics</td><td>Course No</td><td colspan="4">PH2000</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Physics</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Dr. Vivek Kumar</td><td>Status</td><td colspan="2">Core □</td><td colspan="2">Elective ■</td></tr>
<tr><td>Offered for</td><td>UG</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce the principles of physical optics and application of the physical concepts to topical engineering domains.
• Understand basic lasing action, study various types of lasers and to have basic idea of fiber optics.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• Interpret the intensity variation of light due to Polarization, interference and diffraction.
• Learn the concept and operating principles of optical instruments.
• State the working principle of lasers and describe its applications.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Module 1: Wave Optics (L17+T8)
• Interference- Introduction to waves, Coherence (Spatial and Temporal), Principle of Superposition, Young's double slit experiment, Interference by wave front division and by amplitude division and examples.
• Diffraction- Fresnel and Fraunhofer diffraction, Fraunhofer diffraction due to double slit. Diffraction grating and its applications.
• Polarization- Introduction, Malus' law, Polarization by reflection and Brewster's law and applications.
Module 2: Laser Basics (L8+T3)
• Laser operation, Absorption, Spontaneous Emission and Stimulated Emission, Population & Inversion, Three- and FourLevel Laser Systems, Laser Characteristics- Types of Lasers: Solid-State Lasers, Gas Lasers, Semiconductor Lasers.
Module 3: Applications (L16+T3)
• Interferometers: Michelson interferometer, Fabry-Perot interferometer, Mach-Zehnder interferometer, Sagnac interferometer.
• Fiber optics: Fermat's principle and Snell's law, optical fiber: principle and construction, acceptance cone, numerical aperture, types of fibers, Applications.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Eugene Hecht, Optics (5th edition), Pearson (2019).
2. A. Ghatak, Optics (4th edition), Tata Mcgraw Hill (2009).</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. William T. Silfvast, Laser Fundamentals, Cambridge University Press (2004).
2. John Crisp and Barry Elliott, Introduction to Fiber Optics, Elsevier (2005).
3. Warren J. Smith, Modern Optical Engineering, McGraw-Hill (2007).</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Mechanical Engineering

<table>
<tr><td>Course Title</td><td>Waves and Vibrations</td><td>Course No</td><td colspan="4">PH2001</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Physics</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Dr. Naveen Kumar</td><td>Status</td><td colspan="2">Core □</td><td colspan="2">Elective ■</td></tr>
<tr><td>Offered for</td><td>UG</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To improve the conceptual, physical and mathematical comprehension of the phenomenon of waves and vibrations
• To Implement the understanding of waves and vibrations in real-time applications/devices design</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students would be able to conceptualize the physical phenomenon of waves/and vibrations for varieties of interdisciplinary product design applications</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Module 1: Sources (electrical/mechanical/oceanic/optical) of waves and vibrations; Importance and applications of vibrations and waves in life; Free, damped, forced oscillations (Mathematical models) (L8+T3)
• Module 2: Wave equations, Classifications of Waves: transverse, longitudinal, plane, cylindrical, spherical, periodic, aperiodic, sinusoidal, square, triangular, saw tooth waves, polarization, circularly, plane, elliptically polarized waves with mathematical representation and examples/case studies from nature and real-time applications (L10 + T4)
• Module 3: Superposition of waves, beats, wave packet, phase velocity, group velocity, dispersion, modulation, wave plates, stationary and traveling waves, energy density (L8+T2)
• Module 4: Energy harvesting techniques along with basic electronic circuitry for product design applications (L8+ T3)
• Module 5: Wave guiding and fiber Interferometers for smart sensing and measurement applications (L8 +T2)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Frank S Crawford Jr., Waves: Berkeley Physics Course Volume 3, McGraw Hill, 2008</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. E. Hecht, Optics, Pearson, 5th edition, 2016
2. Shashank Priya and Daniel J Inman, Energy Harvesting Technologies, Springer, 2009
3. Daniele Tosi and Guido Perrone, Fiber-Optic Sensors for Biomedical Applications, Artech House, 2018</td></tr>
</table>

ANNEXURE E-I

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2^{nd} Semester Curriculum 2020 B Tech

Mechanical Engineering

<table>
<tr><td>Course Title</td><td>Physics of Materials</td><td>Course No</td><td colspan="4">PH2002</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Physics</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Dr. Y Ashok Kumar Reddy</td><td>Status</td><td colspan="2">Core □</td><td colspan="2">Elective ■</td></tr>
<tr><td>Offered for</td><td>UG</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The objective of the course is to provide the insights of various states of material and their properties, nanotechnology, existing energy resources and their applications for next generation Engineers.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Upon successful completion, students can gain the knowledge to:
Applied Physics concepts towards materials and their applications;
Evaluation and selection of suitable materials for different energy, medical and industrial applications.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Physics of Matter: Atoms in crystals, Atomic bonding, Free electron theory, Band theory, Fermi Level, Energy bands, Conductors, Insulators, Semiconductors, Superconductors, Dielectrics, Magnetic and Plasmonic materials (L12+T3)
Physics of Nano: Introduction to nanomaterials, Properties of nanomaterials, Types of nanomaterials, Synthesis of Nanomaterials-Top-down and Bottom-up approaches, Quantum confinement, Quantum well, Wire and Dot, Carbon Nano-tubes (CNTs), Nanotechnology for medical and industrial applications (L14+T4)
Physics of Energy: Introduction to energy sources, Solar energy- Solar production and Radiation, Photovoltaic solar cells; Nuclear energy- Nuclear energy processes, Fission and Fusion; Electrochemical energy- Storage and Conversion; Thermal Energy- Conduction, Convection and Radiation; Wind Energy- Turbines and Utility scale wind; Bio energy- Sources and Biomass (L16+T5)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, 7th Edition, 2017.
2. Charles P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology, A John Wiley-Interscience publication, 2003.
3. M.N. Avadhanulu, P.G. Kshirsagar, T.V.S. Arun Murthy, A Textbook of Engineering Physics, S. Chand Publishing, 11th Edition, 2018.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Charles Kittel, Introduction to Solid State Physics, 8th Edition, 2004.
2. A.P. Zambare, R.B. Bhise, A.B. Bhise, V.D. Kulkarni, H.R. Kulkarni, Physics of Nanomaterials, Nirali Prakashan, 2019.
3. Robert L. Jaffe, Washington Taylor, The Physics of Energy, Cambridge University Press, 2018.</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Mechanical Engineering

<table>
<tr><td>Course Title</td><td>Engineering Graphics</td><td>Course No</td><td colspan="4">ME2000</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>4</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech EC/CS/ME/MSM</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">____ Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce the basic concepts and techniques of technical drawing.
• 2D and 3D representation of various shapes/objects and its engineering applications.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students will acquire visualization skills and will be able to prepare technical drawings and 3D models using computer aided tools.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Role of technical drawing in product development process, Basics of technical drawing, Standards, Dimensioning principles. (L2+P4 hrs)
• Computer aided drafting. (L2+P8 hrs)
• Engineering curves and its applications. (L4+P8 hrs)
• Principles of orthographic projection. Orthographic projection of points, lines, planes and regular solids, Exercises related to engineering applications. (L7+P8 hrs)
• Principles of isometric projections. Orthographic to isometric and isometric to orthographic transformation of objects. (L3+P8 hrs)
• Section and intersection of regular solids and their lateral developments. (L6+P12 hrs)
• Introduction to 3D modelling of shapes and objects; electrical CAD. (L2+P4 hrs)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">2. K. Venugopal and V Prabhu Raja, Engineering Drawing + AutoCAD, New Age International (P) Limited. 5th Edition Reprint: July, 2016
3. Narayana. K.L, and Kannaiah. P, Engineering Drawing, Scitech Pub. Pvt. Ltd, 3rd Edition.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">4. PI Varghese, Engineering Graphics, McGraw Hill Education, 2013.
5. Bhatt. N.D, Engineering Drawing – Plane and Solid Geometry, Charotar Publishing House Pvt. Ltd., 53 Edition 2014.</td></tr>
</table>

ANNEXURE E-I

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Mechanical Engineering

<table>
<tr><td>Course Title</td><td>Elementary Data Structures and Logical Thinking</td><td>Course No</td><td colspan="4">CS1002</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">ECE/ME</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech ECE/ME</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The focus is to discuss how data is organized and retrieved in computers. Elementary data structures with supporting operations shall be discussed. Students will be exposed to art of logical thinking through algorithmic puzzles.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, given a computational problem, students are expected to come up with an algorithm and a suitable data structure, and implement the same using a programming language.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• History of Computing and Computers – the need for data organization – introduction to abstract data types and data structures (3L)
• Introduction to logical thinking (algorithmic thinking) through simple examples. Introduction to Elementary data structures - Discussion on Stacks and Queues with supporting operations – implementation using arrays and lists – implementation of stack using queues and vice-versa – variants of stacks and queues – algorithmic puzzles (10L)
• Arrays and applications - algorithmic puzzles involving arrays- sorting and searching. (8L)
• Discussion on linked lists with various supporting operations- algorithmic puzzles involving lists. Types of Lists – double, circular – the need for double and circular linked lists – puzzles involving lists (10L)
• Introduction to trees, binary trees, search trees (7L)
• Applications of elementary data structures in computer science and engineering. (7L)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. M. A. Weiss, Data Structures and Algorithm Analysis in C, 2nd ed., Pearson, 2002.
2. Anany Levitin and Maria Levitin, Algorithmic Puzzles, Oxford University Press, 2011</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Narasimha Karumanchi, Data Structure and Algorithmic Thinking with Python, Careermonk Publications, 2017</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Mechanical Engineering

<table>
<tr><td>Course Title</td><td>Sociology of Design</td><td>Course No</td><td colspan="4">DS1001</td></tr>
<tr><td rowspan="2">Specializ ation</td><td rowspan="2">Design Spine (Semester 2)</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>1</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>B.Tech & DD All streams</td><td rowspan="2">Status</td><td rowspan="2" colspan="2">Core</td><td rowspan="2" colspan="2">Elective</td></tr>
<tr><td>Prepared by (Faculty Name)</td><td></td></tr>
<tr><td>Prerequi site</td><td>Foundation Program</td><td>To take effect from</td><td colspan="4">2020 Batch</td></tr>
<tr><td>Course Objectiv es</td><td colspan="6">The objective of the course is to introduce engineering students to the importance of understanding the social context of technology and product design:
1. Observing the problem context and surfacing unstated user/customer needs / new product concepts,
2. Understanding people, team dynamics and working in multicultural / cross-functional / distributed teams.</td></tr>
<tr><td>Contents of the course (With approxi mate break up of hours)</td><td colspan="6">Module 1: Technology, Design and Society - [9 hrs]
● Observe the way people interact with objects
● Understanding the relationship between people and a variety of objects
● Actor Network Theory; History of Technology and Design; 2-3 Case studies
● Discover your passion and domain of interest & network to identify partners
Module 2: Understanding user/customer contexts [21 hrs]
● Ethnography - immersion in a problem context
● Learning to observe - see and listen;
● Developing rich pictures; Gigamapping
● Introduction to signs and semiotic analysis
Module 3: Understanding groups (multicultural/cross-functional teams) [12 hrs]
● Learning team formation and dynamics through a movie;
● Introduction to sociological imagination - Functionalism, Conflict Theory, Symbolic Interactionism; Interaction Ritual Chains
● Values, culture, methods of engineers and designers and how they shape the quality of our lives;
● Group dynamics within organizations and across organizations and implications for innovation and change
Evaluation: Continuous assessment (40%); Final ethnography report (20%); End Semester (40%)</td></tr>
<tr><td>Text and References</td><td colspan="6">1. Trevor Pinch (Editors) (2012), The Social Construction of Technological Systems: New directions in the sociology and history of technology, MIT Press, Anniversary Edition
2. Wendy Gunn, Ton Otto and Rachel Smith (2013), Design Anthropology: Theory and practice, Bloomsbury
3. Adrian Forty (2014), Objects of desire: Design and society since 1750s, Thames & Hudson
4. Bernhard E Burdek(2015), History, theory and practice of product design, second revised edition
5. Keri Smith (2008), How to be an Explorer of the World: Portable Life Museum, Penguin Group</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">At the end of the course, the students should be in a position to:
● Understand the need and the process of doing an ethnographic study
● Surface unstated needs and articulate the high level product requirements
● Connect with people, form teams and collaborate towards a common goal</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Mechanical Engineering

<table>
<tr><td>Course Title</td><td>Design and Manufacturing Lab.</td><td>Course No</td><td colspan="4">ID1000</td></tr>
<tr><td>Specialization</td><td>Interdisciplinary</td><td>Structure (LTPC)</td><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td>Offered for</td><td>UG & DD</td><td>Status</td><td colspan="2">Core</td><td colspan="2">Elective</td></tr>
<tr><td>Faculty</td><td>Dr. Avinash Kumar/ Dr. Karthik S.</td><td>Type</td><td colspan="2">New</td><td colspan="2">Modification</td></tr>
<tr><td>Pre-requisite</td><td>----</td><td>To take effect from</td><td colspan="4">December 2020</td></tr>
<tr><td>Submission date</td><td>December, 2020</td><td>Date of approval by Senate</td><td colspan="4">NA</td></tr>
<tr><td>Objectives</td><td colspan="6">The objective of this course is to give an exposure on the basic practices followed in the domain of mechanical, electrical, electronics and communication engineering. The exercises will train the students to acquire skills which are very essential for the engineers through hands-on sessions.</td></tr>
<tr><td>Contents of the course</td><td colspan="6">Experiments will be framed to train the students in following common engineering practices:

Basic manufacturing processes: Fitting, Drilling & tapping, Material joining processes, Carpentry, Sheet-metal work, Adhesive bonding and plastic welding, Arc Welding, 3D Printing. (10 hours)

Familiarization of electronic components by Nomenclature, meters, power supplies, function generators and Oscilloscope – Bread board assembling of simple circuits: IR transmitter and receiver – LED emergency lamp – Communication study: amplitude modulation and demodulation. (6 hours)

Domestic wiring practice: Fluorescent lamp connection, Staircase wiring – Estimation and costing of domestic and industrial wiring – power consumption by Incandescent, CFL and LED lamps. (2 Hours)

Dismantle and assembly of PC. Installing OS and disk management. (4 hours)</td></tr>
<tr><td>Textbook</td><td colspan="6">1. Uppal S. L., “Electrical Wiring & Estimating”, 5Edn, Khanna Publishers, 2003.
2. Chapman. W. A. J., Workshop Technology, Part 1 & 2, Taylor & Francis.</td></tr>
<tr><td>References</td><td colspan="6">1. Clyde F. Coombs, “Printed circuits hand book”, 6Edn, McGraw Hill, 2007.
2. John H. Watt, Terrell Croft, “American Electricians' Handbook: A Reference Book for the Practical Electrical Man”, Tata McGraw Hill, 2002.</td></tr>
</table>

ANNEXURE E-I

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Mechanical Engineering

Course Title	**Engineering Mechanics**	Course No	**ME1004**
Department/ Specialization	Mechanical Engineering	Credits	L: 3, T: 0, P: 0, C: 3
Faculty proposing the course	Faculty, Department of Mechanical Engineering	Status	Core ■ Elective □
Offered for	B.Tech. ME	Type	New ■ Revision □
To take effect from	March 2021	Submitted for approval	____ Senate
Prerequisite	Nil		
Learning Objectives	• To analyze the components and systems of engineering structures under static and dynamic conditions in terms of forces and moments.		
Learning Outcomes	At the end of the course, a student will be able to: • determine various forces acting on a component and structure, and calculate the resultant forces and moments • apply governing equations of equilibrium, work-energy and impulse-momentum principles to solve engineering problems • analyse the characteristics of single degree of freedom vibration systems		
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Equivalent force systems; free-body diagrams; degrees of freedom; equilibrium of particles and rigid bodies; analysis of determinate structures. (9 hrs) Properties of surfaces and volumes. Friction and applications. Principle of virtual work. (9 hrs) Particle Dynamics: equations of motion; work-energy and impulse-momentum principles; System of particles. (9 hrs) Rigid body dynamics: plane kinematics and kinetics of rigid bodies; Coriolis acceleration; work-energy and impulse-momentum principles. (9 hrs) Introduction to vibrations; single degree of freedom systems. (6 hrs)		
Essential Reading	4. F. Beer. R. Johnston, P.J. Cornwell, S. Sanghi, Vector mechanics for engineers: statics and dynamics, McGraw Hill Education; Eleventh edition, 2017.		
Supplementary Reading	1. J. L Meriam, L.G. Kraige, J.N. Bolton, Engineering Mechanics, Vol. I – Statics, Vol 2: Dynamics, SI version, Wiley, 2018. 2. Irving H Shames, Engineering mechanics: statics and dynamics, Pearson Education India, Fourth Edition, 2005. 3. R.C. Hibbeler, Engineering Mechanics: Statics & Dynamics, Pearson, Fourteenth Edition, 2016.		

ANNEXURE E-I

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2^{nd} Semester Curriculum 2020 B Tech

Mechanical Engineering

<table>
<tr><td>Course Title</td><td>Elementary Data Structures and Logical Thinking Practice</td><td>Course No</td><td colspan="4">CS1003</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">ECE/ME</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech ECE/ME</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The focus is to discuss how data is organized and retrieved in computers. Elementary data structures with supporting operations shall be discussed. Students will be exposed to art of logical thinking through algorithmic puzzles.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, given a computational problem, students are expected to come up with an algorithm and a suitable data structure, and implement the same using a programming language.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Case studies that motivates logical thinking (algorithmic thinking) – implementation using C programming
• Case studies involving arrays and implementation - Arrays with various supporting operations- algorithmic puzzles involving arrays – sorting and searching
• Examples on linked lists with various supporting operations- algorithmic puzzles involving singly, doubly and circular linked lists. – puzzles involving lists
• Case studies on Stacks and Queues with supporting operations – implementation using arrays and lists – implementation of stack using queues and vice-versa – variants of stacks and queues – algorithmic puzzles
• Applications of elementary data structures in computer science and engineering and implementation</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. M. A. Weiss, Data Structures and Algorithm Analysis in C, 2nd ed., Pearson, 2002.
2. Anany Levitin and Maria Levitin, Algorithmic Puzzles, Oxford University Press, 2011</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Narasimha Karumanchi, Data Structure and Algorithmic Thinking with Python, Careermonk Publications, 2017</td></tr>
</table>

ANNEXURE E-I

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Mechanical Engineering

<table>
<tr><td>Course Title</td><td>Mechanics and Materials Practice</td><td>Course No</td><td colspan="4">ME1005</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. ME</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">____ Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To assess a few important geometric and material properties of given objects relevant for engineering applications</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, a student will be able:
1. To measure friction coefficients, radius of gyration, rigidity modulus, strength and elastic modulus of materials.
2. To determine the hardness and examine the microstructure of materials
3. To analyze the stiffness and damping characteristics of single degree of freedom systems</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Experiments to measure rigidity modulus and radius of gyration
Experiments to measure strength and elastic modulus of materials
Experiments to study the hardness of materials and their microstructure
Experiments on small oscillations and friction</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. IIITD&M Laboratory manual for Mechanics and Materials Practice</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. F. Beer. R. Johnston, P.J. Cornwell, S. Sanghi, Vector mechanics for engineers: statics and dynamics, McGraw Hill Education, Eleventh edition, 2017.
2. F.P. Beer, E.R. Johnston, J.T. DeWolf, D. Mazurek, Mechanics of Materials, McGraw-Hill Education, Seventh edition, 2014.
3. Callister's Materials Science and Engineering, Adapted by R. Balasubramaniam, Wiley, Second edition, 2010.</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Mechanical Engineering

<table>
<tr><td>Course Title</td><td>Earth, Environment and Design</td><td>Course No</td><td colspan="4">HS1002</td></tr>
<tr><td rowspan="2">Department / Specialization</td><td rowspan="2">Interdisciplinary</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>P/F</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of SIDI</td><td>Status</td><td colspan="2">Core</td><td colspan="2">Elective</td></tr>
<tr><td>Offered for</td><td>UG & DD</td><td>Type</td><td colspan="2">New</td><td colspan="2">Modification</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td></td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The course aims to provide an understanding of systems and processes in aquatic and terrestrial environments, and to explore changes in the atmosphere, lithosphere, hydrosphere, biosphere, and the evolution of organisms, since the origin of life on earth.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Introduction to environment and ecology – Ecosystems
Impacts of natural and human activities on ecosystems
Environmental policies, acts and standards, Environmental Impact Assessment
Prediction and assessment of the impacts on air, water, land, and biological environments
Assessment of impacts of the cultural, socioeconomic and ecosensitive environments</td></tr>
<tr><td>Textbook</td><td colspan="6">1. Rubin. E. S, Introduction to Engineering and the Environment, McGraw Hill, 2000.
2. Masters. G. M., Introduction to Environmental Engineering & Science, Prentice Hall, 1997.</td></tr>
<tr><td>References</td><td colspan="6">1. Henry. J. G, and Heike, G. W, Environmental Science & Engineering, Prentice Hall International, 1996.
2. Dhameja. S. K, Environmental Engineering and Management, S. K. Kataria and Sons, 1999.
3. Shyam Divan and Armin Rosancranz, Environmental Law and Policy in India, Cases, Materials and Statutes, Oxford University Press, 2001.</td></tr>
</table>

Revised Curriculum for second semester

B.Tech. Smart Manufacturing 2020 Batch

Semester 2					
Category	Course Name	L	T	P	C
BSC	Differential Equations	3	1	0	4
SEC	Science Elective 1	3	1	0	4
BEC	Engineering Graphics	2	0	4	4
ITC	Elementary Data Structures and Logical Thinking	3	0	0	3
DSC	Sociology of Design	1	2	0	3
ITC	Design and Manufacturing Lab	0	0	2	1
PCC	Applied Mechanics	3	0	0	3
ITC	Elementary Data Structures and Logical Thinking Practice	0	0	4	2
PCC	Applied Mechanics Practice	0	0	2	1
HMC	NSO/NCC/SSG/NSS	0	0	2	P/F
HMC	Earth, Environment and Design	1	0	0	P/F
					25.0

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Smart Manufacturing

<table>
<tr><td>Course Title</td><td>Differential Equations</td><td>Course No</td><td colspan="4">MA1001</td></tr>
<tr><td rowspan="2">Specialization</td><td rowspan="2">Mathematics</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Offered for</td><td>UG & DD</td><td>Status</td><td colspan="2">Core</td><td colspan="2">Elective</td></tr>
<tr><td>Faculty</td><td></td><td>Type</td><td colspan="2">New</td><td colspan="2">Modification</td></tr>
<tr><td>Pre-requisite</td><td></td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>To take effect from</td><td>March 2021</td></tr>
<tr><td>Objectives</td><td colspan="6">To provide an exposure to the theory of ODEs & PDEs and the solution techniques.</td></tr>
<tr><td>Contents of the course</td><td colspan="6">Linear ordinary differential equations with constant coefficients, method of variation of parameters – Linear systems of ordinary differential equations (10L, 3T)
Power series solution of ordinary differential equations and Singular points
Bessel and Legendre differential equations; properties of Bessel functions and Legendre Polynomials (12L,3T)
Fourier series (6L,2T)
Laplace transforms elementary properties of Laplace transforms, inversion by partial fractions, convolution theorem and its applications to ordinary differential equations (6L,2T)
Introduction to partial differential equations, wave equation, heat equation, diffusion equation (8L,2T)</td></tr>
<tr><td>Textbooks</td><td colspan="6">1. Simmons. G.F, Differential Equations, Tata McGraw Hill, 2003.
2. Kreyszig. E, Advanced Engineering Mathematics, Wiley, 2007.</td></tr>
<tr><td>References</td><td colspan="6">1. William. E. Boyce and R. C. Diprima, Elementary Differential Equations and Boundary Value Problems, John Wiley, 8 Edn, 2004.
2. Sneddon. I, Elements of Partial Differential Equations, Tata McGraw Hill, 1972.
3. Ross. L.S, Differential Equations, Wiley, 2007.
4. Trench, W, Elementary Differential Equations, http://digitalcommons.trinity.edu/mono</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Smart Manufacturing

Course Title	**Engineering Optics**	Course No	**PH2000**			
Department/ Specialization	Physics	Credits	L	T	P	C
			3	1	0	4
Faculty proposing the course	Dr. Vivek Kumar	Status	Core □		Elective ■	
Offered for	UG	Type	New ■		Revision □	
To take effect from	March 2021	Submitted for approval	44^{th} Senate			
Prerequisite	Nil					
Learning Objectives	• To introduce the principles of physical optics and application of the physical concepts to topical engineering domains. • Understand basic lasing action, study various types of lasers and to have basic idea of fiber optics.					
Learning Outcomes	• Interpret the intensity variation of light due to Polarization, interference and diffraction. • Learn the concept and operating principles of optical instruments. • State the working principle of lasers and describe its applications.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	**Module 1:** Wave Optics (L17+T8) • Interference- Introduction to waves, Coherence (Spatial and Temporal), Principle of Superposition, Young's double slit experiment, Interference by wave front division and by amplitude division and examples. • Diffraction- Fresnel and Fraunhofer diffraction, Fraunhofer diffraction due to double slit. Diffraction grating and its applications. • Polarization- Introduction, Malus' law, Polarization by reflection and Brewster's law and applications. **Module 2:** Laser Basics (L8+T3) • Laser operation, Absorption, Spontaneous Emission and Stimulated Emission, Population & Inversion, Three- and FourLevel Laser Systems, Laser Characteristics- Types of Lasers: Solid-State Lasers, Gas Lasers, Semiconductor Lasers. **Module 3:** Applications (L16+T3) • Interferometers: Michelson interferometer, Fabry-Perot interferometer, Mach-Zehnder interferometer, Sagnac interferometer. • Fiber optics: Fermat's principle and Snell's law, optical fiber: principle and construction, acceptance cone, numerical aperture, types of fibers, Applications.					
Essential Reading	1. Eugene Hecht, Optics (5th edition), Pearson (2019). 2. A. Ghatak, Optics (4th edition), Tata Mcgraw Hill (2009).					
Supplementary Reading	1. William T. Silfvast, Laser Fundamentals, Cambridge University Press (2004). 2. John Crisp and Barry Elliott, Introduction to Fiber Optics, Elsevier (2005). 3. Warren J. Smith, Modern Optical Engineering, McGraw-Hill (2007).					

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Smart Manufacturing

<table>
<tr><td>Course Title</td><td>Waves and Vibrations</td><td>Course No</td><td colspan="4">PH2001</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Physics</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Dr. Naveen Kumar</td><td>Status</td><td colspan="2">Core ☐</td><td colspan="2">Elective ■</td></tr>
<tr><td>Offered for</td><td>UG</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision ☐</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To improve the conceptual, physical and mathematical comprehension of the phenomenon of waves and vibrations
• To Implement the understanding of waves and vibrations in real-time applications/devices design</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students would be able to conceptualize the physical phenomenon of waves/and vibrations for varieties of interdisciplinary product design applications</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Module 1: Sources (electrical/mechanical/oceanic/optical) of waves and vibrations; Importance and applications of vibrations and waves in life; Free, damped, forced oscillations (Mathematical models) (L8+T3)
• Module 2: Wave equations, Classifications of Waves: transverse, longitudinal, plane, cylindrical, spherical, periodic, aperiodic, sinusoidal, square, triangular, saw tooth waves, polarization, circularly, plane, elliptically polarized waves with mathematical representation and examples/case studies from nature and real-time applications (L10 + T4)
• Module 3: Superposition of waves, beats, wave packet, phase velocity, group velocity, dispersion, modulation, wave plates, stationary and traveling waves, energy density (L8+T2)
• Module 4: Energy harvesting techniques along with basic electronic circuitry for product design applications (L8+ T3)
• Module 5: Wave guiding and fiber Interferometers for smart sensing and measurement applications (L8 +T2)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Frank S Crawford Jr., Waves: Berkeley Physics Course Volume 3, McGraw Hill, 2008</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. E. Hecht, Optics, Pearson, 5th edition, 2016
2. Shashank Priya and Daniel J Inman, Energy Harvesting Technologies, Springer, 2009
3. Daniele Tosi and Guido Perrone, Fiber-Optic Sensors for Biomedical Applications, Artech House, 2018</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Smart Manufacturing

Course Title	**Physics of Materials**	Course No	**PH2002**			
Department/ Specialization	Physics	Credits	L	T	P	C
			3	1	0	4
Faculty proposing the course	Dr. Y Ashok Kumar Reddy	Status	Core □		Elective ■	
Offered for	UG	Type	New ■		Revision □	
To take effect from	March 2021	Submitted for approval	44th Senate			
Prerequisite	Nil					
Learning Objectives	• The objective of the course is to provide the insights of various states of material and their properties, nanotechnology, existing energy resources and their applications for next generation Engineers.					
Learning Outcomes	Upon successful completion, students can gain the knowledge to: • Applied Physics concepts towards materials and their applications; • Evaluation and selection of suitable materials for different energy, medical and industrial applications.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• **Physics of Matter:** Atoms in crystals, Atomic bonding, Free electron theory, Band theory, Fermi Level, Energy bands, Conductors, Insulators, Semiconductors, Superconductors, Dielectrics, Magnetic and Plasmonic materials (L12+T3) • **Physics of Nano:** Introduction to nanomaterials, Properties of nanomaterials, Types of nanomaterials, Synthesis of Nanomaterials-Top-down and Bottom-up approaches, Quantum confinement, Quantum well, Wire and Dot, Carbon Nano-tubes (CNTs), Nanotechnology for medical and industrial applications (L14+T4) • Physics of Energy: Introduction to energy sources, Solar energy- Solar production and Radiation, Photovoltaic solar cells; Nuclear energy- Nuclear energy processes, Fission and Fusion; Electrochemical energy- Storage and Conversion; Thermal Energy- Conduction, Convection and Radiation; Wind Energy- Turbines and Utility scale wind; Bio energy- Sources and Biomass (L16+T5)					
Essential Reading	1. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, 7th Edition, 2017. 2. Charles P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology, A John Wiley-Interscience publication, 2003. 3. M.N. Avadhanulu, P.G. Kshirsagar, T.V.S. Arun Murthy, A Textbook of Engineering Physics, S. Chand Publishing, 11th Edition, 2018.					
Supplementary Reading	1. Charles Kittel, Introduction to Solid State Physics, 8th Edition, 2004. 2. A.P. Zambare, R.B. Bhise, A.B. Bhise, V.D. Kulkarni, H.R. Kulkarni, Physics of Nanomaterials, Nirali Prakashan, 2019. 3. Robert L. Jaffe, Washington Taylor, The Physics of Energy, Cambridge University Press, 2018.					

ANNEXURE E-I

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech Smart Manufacturing

<table>
<tr><td>Course Title</td><td>Engineering Graphics</td><td>Course No</td><td colspan="4">ME2000</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>4</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech EC/CS/ME/MSM</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">_____ Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce the basic concepts and techniques of technical drawing.
• 2D and 3D representation of various shapes/objects and its engineering applications.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students will acquire visualization skills and will be able to prepare technical drawings and 3D models using computer aided tools.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Role of technical drawing in product development process, Basics of technical drawing, Standards, Dimensioning principles. (L2+P4 hrs)
• Computer aided drafting. (L2+P8 hrs)
• Engineering curves and its applications. (L4+P8 hrs)
• Principles of orthographic projection. Orthographic projection of points, lines, planes and regular solids, Exercises related to engineering applications. (L7+P8 hrs)
• Principles of isometric projections. Orthographic to isometric and isometric to orthographic transformation of objects. (L3+P8 hrs)
• Section and intersection of regular solids and their lateral developments. (L6+P12 hrs)
• Introduction to 3D modelling of shapes and objects; electrical CAD. (L2+P4 hrs)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">2. K. Venugopal and V Prabhu Raja, Engineering Drawing + AutoCAD, New Age International (P) Limited. 5th Edition Reprint: July, 2016
3. Narayana. K.L, and Kannaiah. P, Engineering Drawing, Scitech Pub. Pvt. Ltd, 3rd Edition.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">4. PI Varghese, Engineering Graphics, McGraw Hill Education, 2013.
5. Bhatt. N.D, Engineering Drawing – Plane and Solid Geometry, Charotar Publishing House Pvt. Ltd., 53 Edition 2014.</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech Smart Manufacturing

<table>
<tr><td>Course Title</td><td>Elementary Data Structures and Logical Thinking</td><td>Course No</td><td colspan="4">CS1002</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">ECE/ME</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech ECE/ME</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The focus is to discuss how data is organized and retrieved in computers. Elementary data structures with supporting operations shall be discussed. Students will be exposed to art of logical thinking through algorithmic puzzles.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, given a computational problem, students are expected to come up with an algorithm and a suitable data structure, and implement the same using a programming language.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">History of Computing and Computers – the need for data organization – introduction to abstract data types and data structures (3L)
Introduction to logical thinking (algorithmic thinking) through simple examples. Introduction to Elementary data structures - Discussion on Stacks and Queues with supporting operations – implementation using arrays and lists – implementation of stack using queues and vice-versa – variants of stacks and queues – algorithmic puzzles (10L)
Arrays and applications - algorithmic puzzles involving arrays- sorting and searching. (8L)
Discussion on linked lists with various supporting operations- algorithmic puzzles involving lists. Types of Lists – double, circular – the need for double and circular linked lists – puzzles involving lists (10L)
Introduction to trees, binary trees, search trees (7L)
Applications of elementary data structures in computer science and engineering. (7L)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. M. A. Weiss, Data Structures and Algorithm Analysis in C, 2nd ed., Pearson, 2002.
2. Anany Levitin and Maria Levitin, Algorithmic Puzzles, Oxford University Press, 2011</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Narasimha Karumanchi, Data Structure and Algorithmic Thinking with Python, Careermonk Publications, 2017</td></tr>
</table>

ANNEXURE E-I

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Smart Manufacturing

<table>
<tr><td>Course Title</td><td>Sociology of Design</td><td>Course No</td><td colspan="4">DS1001</td></tr>
<tr><td rowspan="2">Specializ ation</td><td rowspan="2">Design Spine (Semester 2)</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>1</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>B.Tech & DD All streams</td><td rowspan="2">Status</td><td colspan="2" rowspan="2">Core</td><td colspan="2" rowspan="2">Elective</td></tr>
<tr><td>Prepared by (Faculty Name)</td><td></td></tr>
<tr><td>Prerequi site</td><td>Foundation Program</td><td>To take effect from</td><td colspan="4">2020 Batch</td></tr>
<tr><td>Course Objectiv es</td><td colspan="6">The objective of the course is to introduce engineering students to the importance of understanding the social context of technology and product design:
1. Observing the problem context and surfacing unstated user/customer needs / new product concepts,
2. Understanding people, team dynamics and working in multicultural / cross-functional / distributed teams.</td></tr>
<tr><td>Contents of the course (With approxi mate break up of hours)</td><td colspan="6">Module 1: Technology, Design and Society - [9 hrs]
● Observe the way people interact with objects
● Understanding the relationship between people and a variety of objects
● Actor Network Theory; History of Technology and Design; 2-3 Case studies
● Discover your passion and domain of interest & network to identify partners
Module 2: Understanding user/customer contexts [21 hrs]
● Ethnography - immersion in a problem context
● Learning to observe - see and listen;
● Developing rich pictures; Gigamapping
● Introduction to signs and semiotic analysis
Module 3: Understanding groups (multicultural/cross-functional teams) [12 hrs]
● Learning team formation and dynamics through a movie;
● Introduction to sociological imagination - Functionalism, Conflict Theory, Symbolic Interactionism; Interaction Ritual Chains
● Values, culture, methods of engineers and designers and how they shape the quality of our lives;
● Group dynamics within organizations and across organizations and implications for innovation and change
Evaluation: Continuous assessment (40%); Final ethnography report (20%); End Semester (40%)</td></tr>
<tr><td>Text and References</td><td colspan="6">1. Trevor Pinch (Editors) (2012), The Social Construction of Technological Systems: New directions in the sociology and history of technology, MIT Press, Anniversary Edition
2. Wendy Gunn, Ton Otto and Rachel Smith (2013), Design Anthropology: Theory and practice, Bloomsbury
3. Adrian Forty (2014), Objects of desire: Design and society since 1750s, Thames & Hudson
4. Bernhard E Burdek(2015), History, theory and practice of product design, second revised edition
5. Keri Smith (2008), How to be an Explorer of the World: Portable Life Museum, Penguin Group</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">At the end of the course, the students should be in a position to:
● Understand the need and the process of doing an ethnographic study
● Surface unstated needs and articulate the high level product requirements
● Connect with people, form teams and collaborate towards a common goal</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Smart Manufacturing

Course Title	**Design and Manufacturing Lab.**	Course No	**ID1000**				
Specialization	Interdisciplinary	Structure (LTPC)	0	0	2	1
Offered for	UG & DD	Status	Core		Elective	
Faculty	Dr. Avinash Kumar/ Dr. Karthik S.	Type	New		Modification	
Pre-requisite	----	To take effect from	December 2020			
Submission date	December, 2020	Date of approval by Senate	NA			
Objectives	The objective of this course is to give an exposure on the basic practices followed in the domain of mechanical, electrical, electronics and communication engineering. The exercises will train the students to acquire skills which are very essential for the engineers through hands-on sessions.					
Contents of the course	Experiments will be framed to train the students in following common engineering practices: Basic manufacturing processes: Fitting, Drilling & tapping, Material joining processes, Carpentry, Sheet-metal work, Adhesive bonding and plastic welding, Arc Welding, 3D Printing. (10 hours) Familiarization of electronic components by Nomenclature, meters, power supplies, function generators and Oscilloscope – Bread board assembling of simple circuits: IR transmitter and receiver – LED emergency lamp – Communication study: amplitude modulation and demodulation. (6 hours) Domestic wiring practice: Fluorescent lamp connection, Staircase wiring – Estimation and costing of domestic and industrial wiring – power consumption by Incandescent, CFL and LED lamps. (2 Hours) Dismantle and assembly of PC. Installing OS and disk management. (4 hours)					
Textbook	1. Uppal S. L., "Electrical Wiring & Estimating", 5Edn, Khanna Publishers, 2003. 2. Chapman. W. A. J., Workshop Technology, Part 1 & 2, Taylor & Francis.					
References	1. Clyde F. Coombs, "Printed circuits hand book", 6Edn, McGraw Hill, 2007. 2. John H. Watt, Terrell Croft, "American Electricians' Handbook: A Reference Book for the Practical Electrical Man", Tata McGraw Hill, 2002.					

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Smart Manufacturing

<table>
<tr><td>Course Title</td><td>Applied Mechanics</td><td>Course No</td><td colspan="4">ME1002</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. MSM</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Materials for engineers</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course is intended to give an understanding of
• the force and moment systems on mechanical structures
• the equations governing rigid body systems
• the behaviour of solid bodies subjected to various types of loads.
• the connection between the properties of materials and the behaviour of physical systems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the completion of the course, the student will be able to
• analyze the interactions of various structural elements
• apply the principles to practical structural analysis
• carry out design and failure analyses of basic mechanical structures.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Engineering mechanics:
• Equivalent force systems, free body concepts, equations of equilibrium; Trusses (12L)
Strength of materials:
• stress, strain and their relation for simple tension, compression and shear; Axial load; Torsion (9L)
• Bending – Shear force and Bending moment, Stresses, Deflection; Euler’s theory of columns (9L)
• Analysis of stress and strain – Transformations, Principal stresses and strains, Plane stress, Mohr’s circle; Thin cylinders; Theories of failure. (12L)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. B. J. Goodno and J. M. Gere, Statics and Mechanics of Materials, CL Engineering, SI edition, 2018. ISBN-13: 978-133364412.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. F. P. Beer, E. R. Johnston, J. T. Dewolf, and D. F. Mazurek, Statics and Mechanics of Materials, Mc Graw Hill, 3rd edition, 2021, ISBN-13: 978-0073398167.
2. R. C. Hibbeler, Statics and Mechanics of Materials, 5th edition, Pearson education, 2016, ISBN-13: 978-0134382593.
3. W. F. Riley, L. D. Sturges and D. H. Morris, Statics and Mechanics of Materials: An integrated approach, Willey, 2nd edition, 2018, ISBN-13: 978-0471013341.
4. A. Bedford, K.Liechti and W. Fowler, Statics and Mechanics of Materials, 5th edition, Pearson education, 2002, ISBN-13: 978-0130285935.</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Smart Manufacturing

<table>
<tr><td>Course Title</td><td>Elementary Data Structures and Logical Thinking Practice</td><td>Course No</td><td colspan="4">CS1003</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">ECE/ME</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech ECE/ME</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The focus is to discuss how data is organized and retrieved in computers. Elementary data structures with supporting operations shall be discussed. Students will be exposed to art of logical thinking through algorithmic puzzles.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, given a computational problem, students are expected to come up with an algorithm and a suitable data structure, and implement the same using a programming language.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Case studies that motivates logical thinking (algorithmic thinking) – implementation using C programming
• Case studies involving arrays and implementation - Arrays with various supporting operations- algorithmic puzzles involving arrays – sorting and searching
• Examples on linked lists with various supporting operations- algorithmic puzzles involving singly, doubly and circular linked lists. – puzzles involving lists
• Case studies on Stacks and Queues with supporting operations – implementation using arrays and lists – implementation of stack using queues and vice-versa – variants of stacks and queues – algorithmic puzzles
• Applications of elementary data structures in computer science and engineering and implementation</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. M. A. Weiss, Data Structures and Algorithm Analysis in C, 2nd ed., Pearson, 2002.
2. Anany Levitin and Maria Levitin, Algorithmic Puzzles, Oxford University Press, 2011</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Narasimha Karumanchi, Data Structure and Algorithmic Thinking with Python, Careermonk Publications, 2017</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Smart Manufacturing

Course Title	**Applied Mechanics Practice**	Course No	**ME1003**		
Specialization	Smart Manufacturing	Structure (IPC)	0	3	1.5
Offered for	UG	Status (Core / Elective)	Core		
Prerequisite	Materials for engineers	To take effect from			
Course Objectives	This course is intended to give a hands-on experience to • relate theoretical principles of rigid body mechanics to various practical systems • find the properties of materials by applying various experimental methods. • apply the equations and see the real time behavior of deformable bodies and various structural elements • handle the instruments and present the results				
Course Outcomes	At the completion of the course, the student will be able to • analyze the interactions of various structural elements experimentally • do mechanical characterization of the materials • apply standard methods of testing materials.				
Contents of the course	• Experiments on concepts of linear elasticity - stress, strain and strength of material. (9P) • Experiments to measure various properties such as rigidity modulus, Young's modulus, radius of gyration, flexural modulus, poisons ratio, etc. (12P) • Experiments to study the influence of microstructure on Young's modulus, hardness, tensile strength, creep, etc. (9P) • Experiments to study the influence of geometry and the strength of materials on structural elements like beam and column. (6P)				
Textbooks	2. C. Suryanarayana, Experimental techniques in materials and mechanics, CRC Press, 1st edition, 2011, ISBN: 9781439819043. 3. B. J. Goodno and J. M. Gere, Statics and Mechanics of Materials, CL Engineering, SI edition, 2018. ISBN-13: 978-133364412.				
References	5. D. R. Askeland and W. J. Wright, The science and engineering of materials, 7th edition, Cengage Learning, 2016, ISBN-13: 978-1-205-07710-2. 6. F. P. Beer, E. R. Johnston, J. T. Dewolf, and D. F. Mazurek, Statics and Mechanics of Materials, Mc Graw Hill, 3rd edition, 2021, ISBN-13: 978-0073398167. 7. R. C. Hibbeler, Statics and Mechanics of Materials, 5th edition, Pearson education, 2016, ISBN-13: 978-0134382593.				

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

2nd Semester Curriculum 2020 B Tech

Smart Manufacturing

<table>
<tr><td>Course Title</td><td>Earth, Environment and Design</td><td>Course No</td><td colspan="4">HS1002</td></tr>
<tr><td rowspan="2">Department / Specialization</td><td rowspan="2">Interdisciplinary</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>P/F</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of SIDI</td><td>Status</td><td colspan="2">Core</td><td colspan="2">Elective</td></tr>
<tr><td>Offered for</td><td>UG & DD</td><td>Type</td><td colspan="2">New</td><td colspan="2">Modification</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td></td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The course aims to provide an understanding of systems and processes in aquatic and terrestrial environments, and to explore changes in the atmosphere, lithosphere, hydrosphere, biosphere, and the evolution of organisms, since the origin of life on earth.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Introduction to environment and ecology – Ecosystems
Impacts of natural and human activities on ecosystems
Environmental policies, acts and standards, Environmental Impact Assessment
Prediction and assessment of the impacts on air, water, land, and biological environments
Assessment of impacts of the cultural, socioeconomic and ecosensitive environments</td></tr>
<tr><td>Textbook</td><td colspan="6">1. Rubin. E. S, Introduction to Engineering and the Environment, McGraw Hill, 2000.
2. Masters. G. M., Introduction to Environmental Engineering & Science, Prentice Hall, 1997.</td></tr>
<tr><td>References</td><td colspan="6">1. Henry. J. G, and Heike, G. W, Environmental Science & Engineering, Prentice Hall International, 1996.
2. Dhameja. S. K, Environmental Engineering and Management, S. K. Kataria and Sons, 1999.
3. Shyam Divan and Armin Rosancranz, Environmental Law and Policy in India, Cases, Materials and Statutes, Oxford University Press, 2001.</td></tr>
</table>

ANNEXURE E-II-A

Curriculum for B.Tech. Computer Science and Engineering 2020 Batch

Category	Course Name	L	T	P	C
	Semester 1				
Category	Course Name	L	T	P	C
BSC	Calculus	3	1	0	4
BSC	Engineering Electromagnetics	3	0	0	3
BEC	Electrical Circuits for Engineers	3	1	0	4
BEC	Problem Solving and Programming	3	0	0	3
BEC	Materials for Engineers	3	0	0	3
DSC	Foundation for Engineering and Product Design	1	2	0	3
BSC	Engineering Electromagnetics Practice	0	0	3	1.5
BEC	Problem Solving and Programming Practice	0	0	3	1.5
HSC	Effective Language and Communication Skills	1	0	2	2
HSC	NSO/NCC/SSG/NSS	0	0	2	P/F
					25.0
	Semester 2				
Category	Course Name	L	T	P	C
BSC	Differential Equations	3	1	0	4
SEC	Science Elective 1	3	1	0	4
BEC	Engineering Graphics	2	0	4	4
ITC	Data Structures and Algorithms	3	0	0	3
DSC	Sociology of Design	1	2	0	3
ITC	Design and Manufacturing Lab	0	0	2	1
PCC	Discrete Structures for Computer Science	3	1	0	4
ITC	Data Structures and Algorithms Practice	0	0	4	2
HSC	NSO/NCC/SSG/NSS	0	0	2	P/F
HSC	Earth, Environment and Design	1	0	0	P/F
					25.0
	Semester 3				
Category	Course Name	L	T	P	C
SEC	Science Elective 2	3	1	0	4
DSC	Systems Thinking for Design	1	2	0	3
PCC	Object Oriented Programming	2	0	4	4
PCC	Digital System Design	3	1	0	4
PCC	Design and Analysis of Algorithms	3	1	0	4
PCC	Digital System Design practice	0	0	4	2
PCC	Design and Analysis of Algorithms practice	0	0	4	2
HSC	Indian Constitution, Essence of Indian Traditional Knowledge	1	0	0	P/F
					23.0
	Semester 4				
Category	Course Name	L	T	P	C
SEC	Science Elective 3	3	1	0	4
DSC	Smart Product Design	1	2	0	3
PCC	Computer Organization and Architecture	3	1	0	4
PCC	Database Systems	3	1	0	4
PCC	Theory of Computation	3	1	0	4
PCC	Computer Organization and Architecture practice	0	0	4	2
PCC	Database Systems practice	0	0	4	2
HSC	Human Values and Stress Management	1	0	0	P / F
					23.0
	Semester 5				
Category	Course Name	L	T	P	C
ITC	Data Science: An Applied Perspective	3	0	2	4
DSC	Entrepreneurship and Management Functions	1	2	0	3
PCC	Operating Systems	3	1	0	4
PCC	Computer Networks	3	1	0	4
PCC	Compiler Design	3	1	0	4
PCC	Operating Systems practice	0	0	4	2
PCC	Computers Networks practice	0	0	4	2
PCC	Compiler Design Practice	0	0	4	2
HSC	Professional Ethics and Organizational Behaviour	1	0	0	P/F

ANNEXURE E-II-A

Curriculum for B.Tech. Computer Science and Engineering 2020 Batch

					25.0
Semester 6					
Category	Course Name	L	T	P	C
DSC	Prototyping and Testing	1	2	0	3
PEC	Professional Elective 1	3	1	0	4
PEC	Professional Elective 2	3	1	0	4
PEC	Professional Elective 3	3	1	0	4
ELC	Elective 1	3	1	0	4
ELC	Elective 2	3	1	0	4
HSC	Professional Communication	1	0	2	2
HSC	Intellectual Property Rights	1	0	0	P/F
					25.0
Summer					
PCD	Internship				P/F
Semester 7					
Category	Course Name	L	T	P	C
ELC	Elective 3	3	1	0	4
ELC	Elective 4	3	1	0	4
ELC	Elective 5	3	1	0	4
					12.0
Semester 8					
Category	Course Name	L	T	P	C
ELC	Elective 6	3	1	0	4
PCD	Project/Course work	0	0	16	8
					12.0

Semester wise Credit Distribution	Credits									
Category	S1	S2	S3	S4	S5	S6	S7	S8	Total	%
Basic Science Course (BSC)	8.5	4	0	0	0	0	0	0	12.5	7.4
Science Elective Course (SEC)	0	4	4	4	0	0	0	0	12	7.1
Basic Engineering Course (BEC)	11.5	4	0	0	0	0	0	0	15.5	9.1
Design Course (DSC)	3	3	3	3	3	3	0	0	18	10.6
IT Skill Course (ITC)	0	6	0	0	4	0	0	0	10	5.9
Professional Core Course (PCC)	0	4	16	16	18	0	0	0	54	31.8
Professional Elective Course (PEC)	0	0	0	0	0	12	0	0	12	7.1
Elective Course (ELC)	0	0	0	0	0	8	12	4	24	14.1
Humanities and Social Science Course (HSC)	2	0	0	0	0	2	0	0	4	2.4
Professional Career Development (PCD)	0	0	0	0	0	0	0	8	8	4.7
Total	25.0	25.0	23.0	23.0	25.0	25.0	12.0	12.0	170.0	100.0
	25.0	50.0	73.0	96.0	121.0	146.0	158.0	170.0	**170.0**	

<table>
<tr><td>Course Title</td><td>Object Oriented Programming</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>4</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The course introduces students to the object oriented programming paradigm and its benefits in application development. Both C++ and Java would be used as implementation platforms for the various object oriented features.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">● To understand Object Oriented Concepts for Software Design
● To analyze various aspects of Software Design in a reusable and secure fashion
● To create applications supporting a command line & graphical user interface in Object Oriented fashion.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Object oriented programming - Encapsulation – Constructors – Destructors - Composition – Friend functions/classes – this pointer – Dynamic memory management (8L)
• Operator overloading Reusability – Inheritance – Base & derived classes – Protected members – Constructors –Destructors in derived classes – public/private/protected inheritance – Polymorphism (9L)
• Virtual functions - Templates – Function & Class templates – Streams – Stream input Output Stream format states – Manipulators – Exception handling – Re–throwing exceptions –specifications–and exception handling – Inheritance – STL (9L)
• Event Handling, Applets, – Frames, Buttons, Menu – Visual design layout, Multithreading, Networking, Database connectivity support (10L)

• Practice component will test drive the concepts covered in theory using C++/Java approximately for 14 sessions in the semester [Overall 36 Hours Theory + 28 Hours for lab]</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Deitel P J and Deitel H M, C : How To Program, Prentice Hall, 10th Edn, 2016, ISBN 9780131596825
2. Deitel P J and Deitel H M, Java: How To Program, Prentice Hall, 9th Edn, 2016, ISBN 978-0132575669</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. David Flanagan, Java in a Nutshell, 5th Edition, O'Rielly, 2005, ISBN 9780596007737
2. Herbert Schildt, Java: A Beginners Guide, 9th Edition, McGraw Hill, 2014, ISBN 9781260440218
3. Herbet Schildt, Teach Yourself C++, 4th Edition, Tata McGraw Hill, 2003, ISBN 978-0070532465</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Digital System Design</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core ■</td><td colspan="3">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New ■</td><td colspan="3">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To introduce the basic understanding of digital representation, Boolean algebra and the operation of the logic components, combinational and sequential circuits, and to introduce the analog device concepts like diode, FET and op-amp.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• To understand Digital Number systems, fixed and floating point representation and arithmetic operations.
• To use Boolean Algebra and Switching theory for Logic minimization.
• To implement Combinational Circuits using Primitive gates and logic functions.
• To implement sequential circuit elements and finite state machines.
• To design various circuits using Op-Amp 741 such as summing, difference, average, logarithmic amplifiers etc.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Digital Circuits: Number Representation: Fixed point and floating point, 1’s and 2’s complement. Switching Theory: Boolean algebra, Switching functions, Truth Tables and Algebraic forms, Simplification of Boolean expressions – Algebraic methods, canonical forms and Minimization of functions using K-Maps. (5L,1T)
• Binary Codes: BCD, Gray, Excess 3, Alpha Numeric codes and conversion circuits. (3L,1T)
• Arithmetic circuits: Binary adders and subtractors, multipliers and division, ALU. (5L,2T)
• Synthesis of combinational logic functions using MSIs: mux/demux, decoders/encoders, Priority encoders, Comparators. (2L,2T)
• Sequential Circuits: Latches and Flip-Flops: SR, JK, D, T; Excitation tables. (2L,1T)
• Shift Registers, Counters, Random Access Memory. (3L,1T)
• Synchronous sequential circuits: Finite State Machines- Mealy & Moore types- Basic design steps- Design of counters, sequence generators, and sequence detectors - Design of simple synchronous machines – state minimization. (8L,3T)
• Analog Circuits: Diodes – Basics and Circuits – Clippers, Clampers, rectifiers. (3L,1T)
• Operational amplifiers (op-amp) – Basics and op-amp circuits – non inverting and inverting amplifiers – Signal offset. (4L,1T)
• Analog to Digital and Digital to Analog Conversion and circuits, Applications of Digital ICS: 555 Timer, V to F converters, Introduction to Logic Families, Noise in Digital System. (7L,1T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. M. Mano and C. Kime, “Logic and Computer Design Fundamentals,” Prentice Hall, Upper Saddle River, NJ, 4 th Edition, ISBN-13 : 978-9332518728, 2008.
2. B. Razavi, “Fundamentals of Microelectronics,” Wiley Student Edition, ISBN: 978-1-118-15632-2, 2010.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Sedra and Smith, Microelectronic Circuits, 7 th Edition, ISBN-13 : 978-0198089131, Oxford University Press, 2013.
2. J. F. Wakerly, “Digital Design - Principles and Practices,” 3 rd Edition, Pearson, ISBN-13 : 978-9332508125, 2008.
3. M. M. Mano, “Digital Design,” PHI, ISBN-13: 978-0-13-277420-8, 1979.
4. S. Franco, “Design with Operational Amplifiers and Analog Integrated Circuits,” McGraw-Hill Series in Electrical and Computer Engineering, 4th Edition, ISBN-13 : 978-0072320848, 2015.
5. R. J. Tocci, N. S. Widmer, and G. L. Moss, “Digital Systems Principles and applications,” Pearson Prentice Hall,10 th Edition, ISBN-13 : 978-0135103821, 2010.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Design and Analysis of Algorithms</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To design time or space efficient algorithms using well known paradigms.
• To understand the limitations of computing machines.
• To explore tractable vs intractable problems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• To design efficient algorithms using paradigms such as divide and conquer, dynamic programming, greedy method etc.
• To differentiate easy vs hard problems.
• To design polynomial-time algorithms with proof of correctness.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Review of time/space complexity – recurrence relations – recurrence tree method – masters theorem (5L,2T)
• Incremental and decremental strategies – divide and conquer – case studies – lower bounds for sorting (5L,3T)
• Greedy Method – Container loading – knapsack – scheduling – coin change – proof of correctness (8L,2T)
• Dynamic programming – matrix chain, optimal binary search tree, travelling salesman, LCS, knapsack , greedy vs dynamic programming – Principle of optimality, overlapping subproblems – Dynamic programming vs Divide and Conquer (8L,2T)
• Graph algorithms – Topological sort – Shortest path algorithms – Dijskstra's Algorithm, – Bellman-Ford's Algorithm – minimum spanning tree – Principle of optimality (8L,2T)
• Tractability - Introduction to NP-completeness – NP, NP-hardness , polynomial-time reductions (6L,1T)
• Coping with intractable problems - Branch and bound – Back tracking – case studies (5L,1T)
• Solvable vs Unsolvable problems – Halting problem, Reducibility to Halting problem (3L)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. T. H. Cormen, C. E. Leiserson, and R. L. Rivest, "Introduction to Algorithms," Prentice Hall India, 2 nd Edition, 2001. ISBN 978-0-262-53305-8
2. E. Horowitz, S. Sahni, and S. Rajasekaran, "Computer Algorithms," 2 nd Edition, Galgotia Publications, 2007. ISBN 0-7167-8316-9</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Aho, Hopcroft, and Ullmann, "Data Structures & Algorithms," Addison Wesley, 1983. ISBN13: 9780201000238
2. Algorithm Design , Eva Tardos and Kleinberg, Pearson, 2006, ISBN-13 : 978-0321295354</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Digital System Design Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To provide hands on design and implementation of analog and digital circuits. Students will build simple digital systems on general purpose PCBs.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• To implement and verify logic circuits
• To implement and verify arithmetic circuits using discrete components
• To implement and verify digital systems using Combinational/ Sequential elements
• To implement and verify analog circuits</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Design and implementation of logic functions, combinational circuits (code converters, half & full adders, comparator, ripple carry adder, priority encoder, Decoders, Seven segment display, multiplexer)
• Design of sequential Circuits.
• Design of 4-bit ALU (Adder, subtractor, logic and shift operations).
• Design project
• Static characteristics of rectifiers and filters, clipping and clamping circuits, Op-Amp based amplifier circuits.
• Design and implementation of a digital system.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. S. Franco, “Design with Operational Amplifiers and Analog Integrated Circuits,” McGraw-Hill Series in Electrical and Computer Engineering, 4th Edition, ISBN-13 : 978-0072320848, 2015.
2. S. Brown and Z. Vranesic, “Fundamentals of Digital Logic with VHDL Design,”TMH, 3 rd Edition, ISBN-13 : 978-0077221430, 2008.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. R.J. Tocci, N. S.Widmer, and G. L. Moss, “Digital Systems Principles and applications,” Pearson Prentice Hall, 10 th Edition, ISBN-13 : 978-0135103821, 2010.
2. D. A. Neaman, “Electronic Circuits,” TMH, 4 th Edition,ISBN-13 : 978-0070634336, 2006.</td></tr>
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<table>
<tr><td>Course Title</td><td>Design and Analysis of Algorithms Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To design time or space efficient algorithms using well known paradigms.
• To understand the limitations of computing machines.
• To explore tractable vs intractable problems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• To design efficient algorithms using paradigms such as divide and conquer, dynamic programming, greedy method etc.
• To differentiate easy vs hard problems.
• To design polynomial-time algorithms with proof of correctness.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• The laboratory component will require the student to write computer programs using a careful choice of data structures and algorithmic paradigms (in C++/Java language) from scratch, based on the concepts learnt in the theory course.

• Case studies in respect of different paradigms discussed in theory shall be implemented in C++/Java

• Paradigms – Divide and conquer, dynamic programming, greedy, backtracking.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. T. H. Cormen, C. E. Leiserson, and R. L. Rivest, “Introduction to Algorithms,” Prentice Hall India, 2 nd Edition, 2001. ISBN 978-0-262-53305-8
2. E. Horowitz, S. Sahni, and S. Rajasekaran, “Computer Algorithms,” 2 nd Edition, Galgotia Publications, 2007. ISBN 0-7167-8316-9</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Aho, Hopcroft, and Ullmann, “Data Structures & Algorithms,” Addison Wesley, 1983. ISBN13: 9780201000238
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<table>
<tr><td rowspan="2">Course Title</td><td rowspan="2">Computer Organization and Architecture</td><td rowspan="2">Course No</td><td colspan="6" rowspan="2"></td></tr>
<tr></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td><td>C</td></tr>
<tr><td>3</td><td colspan="2">1</td><td colspan="2">0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core</td><td colspan="2">■</td><td colspan="2">Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td colspan="2">■</td><td colspan="2">Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="6" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="8">The course aims to introduce various aspects of computer organization such as Instruction format, Instruction codes, Addressing Modes, processor design and hierarchical memory design, Input and Output Interface design using Programmed Controlled and Interrupt Control way</td></tr>
<tr><td>Learning Outcomes</td><td colspan="8">● Understand the organization of a Computer system and ISAs
● Apply the knowledge of combinational and sequential logical circuits to design computer architecture.
● Understand the input / output and Memory related concepts.
● Analyze the performance of different scalar Computers
● Develop the Pipelining Concept for a given set of Instructions
● Distinguish the performance of pipelining and non pipelining environment in a processor</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="8">• Introduction: function and structure of a computer, functional components of a computer, performance of a computer system. Instruction set architectures – CISC and RISC architectures.(5L,1T)
• Instructions: Language of the Computer, Operations of the Computer Hardware, Operands of the Computer Hardware, Representing Instructions in the Computer, Logical Operations Instructions for Making Decisions, addressing Modes, Parallelism & Instructions. (5L,1T)
• Arithmetic Design: – Carry look ahead adder, Wallace tree multiplier, Floating–point adder/subtractor, Division. (5L,2T)
• The Processor: Logic Design Conventions, Building a Datapath, A Simple Implementation Scheme (3L,1T)
• An Overview of Pipelining, Pipelined Data path and Control, Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions and Parallelism via Instructions. (7L,2T)
• Memory Hierarchy: Introduction, Memory Technologies (SRAM, DRAM), The Basics of Caches, Measuring and Improving Cache Performance, Dependable Memory, Virtual Machines, Virtual Memory, A Common Framework for Memory Hierarchy, Using a Finite State Machine to Control a Simple Cache, Parallelism and Memory Hierarchies: Cache Coherence, Parallelism and Memory Hierarchy: Redundant Arrays of Inexpensive Disks and
• Implementing Cache Controllers. (9L,2T)
• Input/Output Unit: access of I/O devices, I/O ports, I/O control mechanisms – Program Controlled I/O. Interrupt controlled I/O and DMA controlled I/O; I/O interfaces – Serial port, parallel port, USB port, SCSI bus, PCI bus; I/O peripherals – Keyboard, display, secondary storage devices. (8L,2T)</td></tr>
<tr><td>Essential Reading</td><td colspan="8">1. Patterson and Hennessy, “Computer Organization and Design,” Morgan Kaufmann, 5 th Edition, ISBN-13 : 978-8131222744, 2013.
2. C. Hamacher, Z. Vranesic, and S. Zaky, “Computer Organization,” Tata McGraw Hill, 5 th Edition, ISBN-9789339212131, 2002.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="8">1. J. P. Hayes, “Computer Architecture and Organization,” Tata McGraw Hill, ISBN-13 : 978-1259028564, 2017.
2. M. J. Murdocca, V. P. Heuring, “Computer Architecture and Organization - An Integrated Approach,” John Wiley & Sons Inc., ISBN-13:978-0471733881, 2007.
3. A. S. Tanenbaum, “Structured Computer Organization,” Prentice Hall, 5th Edition, ISBN-13 : 978-0132916523, 2006.</td></tr>
</table>

ANNEXURE E-II-A

Curriculum for B.Tech. Computer Science and Engineering 2020 Batch

<table>
<tr><td>Course Title</td><td>Database Systems</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/
Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">Objective of the course is to equip students with skillsets required for database design and implementation. Various concepts such as ER modeling, Schema Mapping, Normalization, Lossless Join etc. would be explored to help in efficient an and effective databases.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• To appreciate the systematic design and principles involved in any database development.
• To understand the Importance of canonical normal forms and its design in large scale database systems
• To design and implement Database with formal analysis and design thinking</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Introduction to Database Systems, Database System Architecture, Schema, Database Models, Relational Model, ER Modelling and case studies. (7L,2T)
Expressive power of relational databases, Relational Algebra (5L,2T)
Database Languages, DDL, DML, Structured Query Language (SQL), SQL views, case studies (8L,3T)
Database Design, Normal Forms (First to third normal form), Boyce codd Normal Form, Database decomposition, Functional Dependencies, Loss-less Join decomposition (8L,2T)
Transaction Processing and Concurrency control (4L,1T)
Internal schema Design, Indexing, B-trees, B+ trees (5L,2T)
Introduction to advanced concepts like Data mining, Data warehousing, XML(5L)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. R. Elmasri and S. B. Navathe, “Fundamentals of Database Systems,” Pearson, 7th Edition, 2016, ISBN 9789332582705</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. A. Silberschatz, H. F. Korth, and S. Sudharsan, “Database System Concepts,” Tata McGraw Hill, 6th Edition, 2011, ISBN 9332901384.
2. C. J. Date, A. Kannan, and S. Swamynathan, “An Introduction to Database Systems,” Pearson, 8th Edition, 2006, ISBN 978-0321197849</td></tr>
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<table>
<tr><td>Course Title</td><td>Theory of Computation</td><td>Course No</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Department/
Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td><td>C</td></tr>
<tr><td>3</td><td colspan="2">1</td><td colspan="2">0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core</td><td>■</td><td colspan="2">Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td colspan="2">Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="6">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="8">This course aims to provide fundamentals of computing models such as finite state automata, push down automata, linear bounded automata and Turing machine. Powers and limitations of the models will also be discussed. Solvability and Tractability will be introduced through Turing machine</td></tr>
<tr><td>Learning Outcomes</td><td colspan="8">• To design various computational models useful for solving problems
• To understand the relationship among digital computer, algorithm and Turing machine.
• To verify whether a given problem is solvable or tractable.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="8">Finite Automata & Regular Languages - (10L,3T)
Languages vs Problems. Finite State Automata, Regular Languages. Closure properties, Limitations, Pumping Lemma, Myhill-Nerode relations, Quotient Construction. Minimization Algorithm.
Non-determinism, Regular Grammar & Regular Expressions - (10L,3T)
Notion of non-determinism. Acceptance condition. Equivalence of NFA and DFA. Regular Grammar and NFA, Pattern matching and regular expressions. Regular Expressions and Regular languages. More closure properties of regular languages.
Push Down Automata & Context-free Languages (CFLs) - (12L,4T)
Grammars and Chomsky Hierarchy, CFLs, Chomsky Normal Form, Pumping Lemma for CFLs, Inherent Ambiguity of Context-Free Languages, Cock-Younger-Kasami Algorithm, Applications to Parsing. Pushdown Automata (PDA), PDA vs CFLs. Non-equivalence of Deterministic and non- deterministic versions of PDA. Deterministic CFLs.
Linear Bounded Automata, Turing Machines & Computability - (12L,4 T)
Introduction to Linear Bounded Automata (LBA), Turing Machines. Context Sensitive Language Vs LBA. Turing Machine vs Phrase Structure Language. Multi-tape Turing machines. Recursive and Recursively enumerable languages. Undecidability of Halting Problem. Reductions. Introduction to Theory of NP-completeness.</td></tr>
<tr><td>Essential Reading</td><td colspan="8">1. Introduction to Automata Theory, Languages and Computation, Hopcroft, Motwani, and Ullman, Pearson Publishers, Third Edition, ISBN: 9780321455369, 2006.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="8">1. Elements of the Theory of Computation, H. R. Lewis and C.H. Papadimitriou, Prentice Hall Publishers, ISBN. 0-13-2624 78-8, 1981
2. Introduction to Languages and the Theory of Computation, John. C. Martin, Tata McGraw-Hill, ISBN 978-00731914612003.</td></tr>
</table>

Course Title	**Computer Organization and Architecture Practice**	Course No					
Department/ Specialization	Computer Science and Engineering	Credits	L	T	P	C	
			0	0	4	2	
Faculty proposing the course	Faculty, Department of CSE	Status	Core	■	Elective	□	
Offered for	B.Tech	Type	New	■	Revision	□	
To take effect from	July 2021	Submitted for approval	44th Senate				
Prerequisite	Nil						
Learning Objectives	Exposure to assembly language programming, instruction set design, and processor design for a given instruction set are given. Assembler macros, interrupt service routines, and simple device driver programs would also be introduced. Computer system design concepts are introduced.						
Learning Outcomes	• Assembly Language Instructions and programming • Machine code based program execution • Input and output device interfacing and programming • Programming Interrupt service routines • Writing device driver program to control and monitor the peripheral device						
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Exercises will mainly involve writing the assembly language programs - Execution of assembly language programs: Single–step, break points, Accessing the contents of registers, accessing the contents of memory locations - Implementation of higher level language assignment statements with arithmetic expressions and logical expressions - Implementation of control transfer statements. Macros - Software interrupts - Operating system function calls - Interrupt service routines - Simple device drivers - Assembly language programming in C language. I/O interfacing and programming. Computer System Design.						
Essential Reading	1. Patterson and Hennessy, "Computer Organization and Design," Morgan Kaufmann, 5 th Edition, ISBN-13 : 978-8131222744, 2013.						
Supplementary Reading	1. C. Hamacher, Z. Vranesic, and S. Zaky, "Computer Organization," Tata McGraw Hill, ISBN-9789339212131, 2002.						

<table>
<tr><td>Course Title</td><td>Database Systems Practice</td><td>Course No</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td colspan="2">T</td><td>P</td><td colspan="2">C</td></tr>
<tr><td>0</td><td colspan="2">0</td><td>4</td><td colspan="2">2</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core</td><td>■</td><td colspan="2">Elective</td><td colspan="2">□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td colspan="2">Revision</td><td colspan="2">□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="6" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="8">The focus of this course is on database design, architecture, and relational models. Normal forms, internal schema design would also be explored. This course introduces SQL programming. Database design preserving functional dependencies and loss-less decomposition properties would be addressed.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="8">• Conceptual design using ER diagrams, programming using structured query language, Ability to Design and Implement Database based on formal guidelines
• Students would also be equipped with skills required for basic application development involving database connectivity.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="8">Introduction to SQL. Schema, table creation using SQL, Data definition and data manipulation using SQL. Implementation of set theoretic operations on databases. Views using SQL. Implementation of algorithms related to functional dependencies and loss-less decomposition. Indexing using B-trees and B+ trees (creation, insertion, deletion).
Assignment/Mini project-based application design and development involving database</td></tr>
<tr><td>Essential Reading</td><td colspan="8">1. R. Elmasri and S. B. Navathe, “Fundamentals of Database Systems,” Pearson, 7th Edition, 2016, ISBN 9789332582705</td></tr>
<tr><td>Supplementary Reading</td><td colspan="8">1. A. Silberschatz, H. F. Korth, and S. Sudharsan, “Database System Concepts,” Tata McGraw Hill, 6th Edition, 2011, 978-0321197849
2. C. J. Date, A. Kannan, and S. Swamynathan, “An Introduction to Database Systems,” Pearson, 8th Edition, 2006, ISBN 978-0321197849</td></tr>
</table>

<table>
<tr><td>Course Title</td><td colspan="1">Data Science –An Applied Perspective</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Dept. of CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course covers the basic concepts of Data Science to help the student to learn, understand and practice data analytics encompassing concepts from descriptive, inferential statistics and predictive techniques and big data concepts.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Ability to identify the characteristics of datasets ; Ability to select and implement machine learning techniques suitable for the respective application ;
Ability to solve problems associated with big data characteristics such as high dimensionality;
Ability to integrate machine learning libraries and mathematical and statistical tools</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Introduction to relevant industry applications and analytics – Descriptive Statistics – Data Visualization & Interpretation -Measures of Central Tendency & Dispersion - Basic and advanced plots such as Stem-Leaf Plots, Histograms, Pie charts, Box Plots, Violin Plots etc. – Merits of Demerits & Interpretation (10)
Inferential Statistics – Hypothesis Testing - Tests of Significance – Analysis of Variance - Regression – Linear and Logistic (8)
Predictive Analytics – Supervised and Unsupervised – Association Rules, Classification, Clustering, Outlier Analysis, Time Series Modeling (14)
Big Data Characteristics – Map Reduce – Deduplication, Distributed Storage, Implementation using Hadoop / Pyspark platforms (8)
Practice Component: Concepts from Descriptive Statistics, Inferential and Predictive Analytics would be test driven using platforms such as Python, R etc. ML support in these platforms for rule mining and application, classification & clustering algorithms etc. would also be test driven as part of the practice exercises. Modern technologies for big data handling such as Pyspark – support for Map reduce would also be test driven. Applications relevant to the students stream of specialization would be explored for exercises / course project as case studies. (14 sessions – weekly exercises)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. J Han, M Kamber, Data Mining Concepts & Techniques, Elsevier, 3rd Edition, 2007, ISBN 9780123814791</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Joel Grus, Data Science from Scratch, Orielly, 2nd Edn, 2019, ISBN 9781492041139
2. Leskovec, Anand Rajaraman,, Ullmann, Mining of Massive Data Sets, Cambridge University Press, Open Source free version , ISBN 9781107015357
3. P Bruce, Practical Statistics for Data Scientists, O'Reilly, 2017, iSBN 9789352135653</td></tr>
</table>

Course Title	**Operating Systems**	Course No	
Department/ Specialization	Computer Science and Engineering	Credits	L: 3, T: 1, P: 0, C: 4
Faculty proposing the course	Faculty, Department of CSE	Status	Core ■ Elective □
Offered for	B.Tech	Type	New ■ Revision □
To take effect from	July 2021	Submitted for approval	44th Senate
Prerequisite	Nil		
Learning Objectives	This first level course focuses on exposing students to the purpose, structure and functions of an operating system. Operating systems abstraction, mechanisms and their implementation support for concurrency (threads) and synchronization, resource management, scheduling strategies, etc. are explored.		
Learning Outcomes	• Sound understanding of basic concepts relating to the design and implementation of an operating system. • Specifics relating to scheduling, multithreading, synchronization, etc. to understand the structure of the operating system (Linux), at the concept and the source code level. • Ability to use Kernel API support to implement various features to be supported by an OS		
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Functionalities & Services of an Operating System – System Calls & Types - Process Concept – Process Control Block – Linux System calls for Process creation, Inter Process Communication using Shared memory / Message passing. (10L,2T) Concurrency – Multithreaded programming – benefits, challenges, models, Pthreads library in Linux – thread creation, cancellation, thread specific data, Thread pools, Signal handling , Scheduling – Preemptive, Non preemptive algorithms FCFS, SJF, SRT, RR – Thread scheduling – contention scope, pthread support for scheduling. (11L,3T) Synchronization – Race condition – Critical Section Problem, Solution, Mutex Locks and Semaphores – Priority Inversion, Pthreads synchronization - Producer Consumer problem (multi threaded) example Deadlock characterization – Resource graph – Avoidance & Prevention – Safe state – Bankers algorithm – recovery schemes. (10L,3T) Memory management – logical v/s physical address space – Segmentation, Paging, Page table structures , Virtual memory, Page replacement strategies, File Systems – file operations, types, access methods, Directory structure, Mounting file systems. (11L,3T) Introduction to operating systems for hand held devices - RTOS, Free RTOS		
Essential Reading	1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts, John Wiley, 9 th Edn, 2015, ISBN 978-0471694663		
Supplementary Reading	1. Andrew S Tanenbaum, Modern Operating Systems, Prentice Hall, 2009, ISBN 9788120339040 2. Stallings. W, Operating System: Internals and Design Principles, Prentice Hall, 2011, ISBN 9332518807 3. Gary Nut, Operating Systems: A Modern Perspective, Addison Wesley, 2003, ISBN 978-0201773446		

<table>
<tr><td>Course Title</td><td>Computer Networking</td><td>Course No</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td><td>C</td></tr>
<tr><td>3</td><td colspan="2">1</td><td colspan="2">0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core</td><td>■</td><td colspan="2">Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td colspan="2">Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="6" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="8">To introduce the basics of computer networking, error detection and correction techniques, and flow control techniques. Also an exposure to IP addressing and routing and its associated protocols would be given. A highlight of various application layer protocols and its relevance in modern networking world would be discussed.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="8">• To design a local area network and analyze the network using performance metrics.
• To appreciate the importance of subnetting, masking, and nuances involved in setting up a campus network.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="8">Evolution of computer networks, creating a small network, Data transfer between nodes, encoding of bits in physical layer, NRZ, Manchester, Differential Manchester, Performance evaluation of a network: propagation delay, transmission delay, RTT, effective bandwidth. (10L,3T)
Error detection techniques in Data link layer (LRC, CRC, Two dimensional parity check), Hamming Error correcting codes. Data transfer between nodes using stop and wait protocol, sliding window protocol (Go-back-n and selective reject), performance analysis of stop and wait and sliding window protocols. Flow control at data link layer. Introduction to layer-2 devices (switches, bridges) and addressing scheme at Layer-2 (MAC addresses). (10L,3T)
Creating a small network using Ethernet (IEEE 802.3) Token Ring (IEEE 802.5), Performance evaluation of IEEE 802.3 and 802.5 networks. Introduction to Layer-3 devices, IP addresses, IPv4,IPv6, Error detection at layer-3 using Checksum. IP addressing schemes, subnetting, CIDR (10L,3T)
Introduction to TCP/IP, IP routing, RIP, OSPF, Circuit and Packet switching, ICMP, Introduction to networking commands: Ping, Traceroute, IPconfig, UDP, congestion control and avoidance. (10L,3T)
Introduction to DHCP, FTP, HTTP(s) and other application layer protocols, Introduction to Network security. (5L)</td></tr>
<tr><td>Essential Reading</td><td colspan="8">1. Larry L.Peterson and Bruce S Davie, Computer Networks: A systems Approach,Morgan, 5th Edn, 2011. ISBN: 9780123850591
2. William Stallings, Data and Computer Communications, 10th Edn, Pearson, 2017. ISBN: 9780133506488</td></tr>
<tr><td>Supplementary Reading</td><td colspan="8">1. Andrew S. Tanenbaum, Computer Networks, 5th Edn, 2014. ISBN: 9788131770221
2. Behrouz Forouzan, TCP/IP protocol suite, Tata McGraw Hill, 4th Edn, 2010. ISBN: 9780070706521</td></tr>
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<table>
<tr><td>Course Title</td><td>Compiler Design</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The objective of this course is to train students to design various phases of compiler such as Lexical analyzer, syntax analyzer, semantic analyzer, intermediate code generator, code optimizer and code generator. Students are also exposed to design compiler construction tools such as Lexical Analyzer generator and parser generator. Applications of finite state machine and pushdown automation in compiler design are also taught in this course.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• At the end of the course, students will be able to design a programming language and compiler for the same.
• Students will also be able to write large programs.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Need of compiler-cross compiler-Introduction to phases of compiler –Lexical Analyzer Design using DFAs —regular expression and its application to give syntax of word –Automatic design of Lexical Analyzer from regular expression, Construction of NFA without epsilon moves from regular expression- Efficient Lexical analyzer using Minimization of automata- limitation of recognition capability of Lexical analyzer using Pumping lemma (12L,3T)
Context free grammar & its application to give syntax of program statement – Types of parsing – Top down & bottom up–Recursive descent– Predictive–Shift reduce–Operator precedence–SLR (10L,3T)
Semantic analysis - Intermediate code generation: Declaration – Assignment statements – Boolean expressions– looping and branching statements (7L,2T)
Back patching and procedure calls code generator design issues – Runtime storage management – Code Optimization: Basic blocks – Flow graphs – Next use information – Code generator case study – Directed acyclic graph representation of basic blocks – Peephole optimization technique Introduction to code optimization (10L,3T)
Storage optimization & allocation strategies).Assembly Code Generation: from syntax tree and Directed acyclic graph - from three address code. (5L,1T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Alfred Aho, Ravi Sethi and Jeffrey D Ullman, Compilers Principles, Techniques and Tools, Pearson Education, 2003. ISBN: 9780321491695</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Levine J.R, Mason T, Brown D, Lex & Yacc, OReilly Associates, 1992 ISBN: 9781565920002.
2. Allen I. Holub, Compiler Design in C, Prentice Hall, 2003. ISBN: 9780131550452</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Operating System Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core ■</td><td colspan="3">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New ■</td><td colspan="3">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The course aims to equip the student with implementation level constructs / support in Linux for various concepts such as process management, concurrency, scheduling, deadlock avoidance, etc.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• To relate the operating system concepts listed above to the Linux operating system and support for the same available through various system calls.
• To use LINUX Kernel Support for various features such as multiprocessing multithreading etc.
• To Test Drive various Features of an OS relating to application scenario</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Linux System Calls for process creation, management – Applications such as command prompt simulator using fork – Interprocess Communication using Shared Memory and Pipes – Producer Consumer – Applications using pipes / shm – Concurrency – Multithreading –Pthread support – Applications such as merge sort, min-max-average, etc. in a multi threaded fashion – Scheduling –pthread interfaces setschedpolicy – getschedpolicy based applications – Synchronization – threaded solution for classical problems like dining philosophers, readers writers, etc. using mutex locks and semaphores - Deadlock detection / avoidance algorithms.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts, John Wiley, 9 th Edn, 2015, ISBN 9788120339040</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Robert Love, Linux Systems Programming, O Reilly Media, 2 nd Edition, 2013, ISBN 9781449339531
2. D Butlar, J Farrell, B Nichols, Pthreads Programming, O Reilly Media, 1996, ISBN 9781565921153</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Computer Networking Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core ■</td><td colspan="3">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New ■</td><td colspan="3">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To understand basic networking commands, MAC/IP addressing, file transfer between two systems, etc. Simulation of error control techniques and flow control techniques using well known protocols would be addressed as part of this course.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• To design, test and troubleshoot aspects associated with local area networking.
• To appreciate the importance of error detecting codes and flow control techniques.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Connecting two nodes using Ethernet cable and study the performance evaluation parameters such as delay, effective bandwidth - Basic Networking commands – Ping, IPConfig, Traceroute, NSlookup - Introduction to Socket Programming. File transfer using TCP. Echo, Chat between two or more clients using socket programming - Simulation of Stop and Wait Protocol - Simulation of Stop and Wait protocol with NACK, Modelling of ACK, NACK drops, etc., -Modelling and simulation of Sliding window protocol - Sliding window protocol with ACK/NACK drops, frame drops etc., - Performance evaluation through simulation of IEEE 802.3/802.5 networks - Implementation of OSPF. Introduction to NS2/OPNET simulator, Case studies.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Larry L.Peterson and Bruce S Davie, Computer Networks: A systems Approach,Morgan, 5th Edn, 2011.ISBN: 9780123850591
2. William Stallings, Data and Computer Communications, 10th Edn, Pearson, 2017.ISBN: 9780133506488</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Andrew S. Tanenbaum, Computer Networks, 5th Edn, 2014. ISBN: 9788131770221
2. Behrouz Forouzan, TCP/IP protocol suite, Tata McGraw Hill, 4th Edn, 2010. ISBN: 9780070706521</td></tr>
</table>

Course Title	**Compiler Design Practice**	Course No					
Department/ Specialization	Computer Science and Engineering	Credits	L	T	P	C	
			0	0	4	2	
Faculty proposing the course	Faculty, Department of CSE	Status	Core	■	Elective	□	
Offered for	B.Tech	Type	New	■	Revision	□	
To take effect from	July 2021	Submitted for approval	44th Senate				
Prerequisite	Nil						
Learning Objectives	The objective of this course is to train students to design various phases of compiler such as Lexical analyzer, syntax analyzer, semantic analyzer, intermediate code generator, code optimizer and code generator. Students are also exposed to design compiler construction tools such as Lexical Analyzer generator and parser generator. Applications of finite state machine and pushdown automation in compiler design are also taught in this course.						
Learning Outcomes	• At the end of the course, students will be able to design a programming language and compiler for the same. • Students will also be able to write large programs.						
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Lexical analyzer implementation in C - Lexical analyser implementation using LEX tool Recursive descent parser implementation in C for an expression grammar - YACC and LEX based implementation for an expressions grammar - YACC implementation of a calculator that takes an expression with digits, + and * and computes and prints its value - Front end implementation of a compiler that generates the three address code for a simple language- Back end implementation of a compiler which takes the three address code (output of previous exercise) and results in assembly language instructions - Implementation of peephole optimization in C.						
Essential Reading	1. Alfred Aho, Ravi Sethi and Jeffrey D Ullman, Compilers Principles, Techniques and Tools, Pearson Education, 2003. ISBN: 9780321491695						
Supplementary Reading	1. Levine J.R, Mason T, Brown D, Lex & Yacc, OReilly Associates, 1992 ISBN: 9781565920002. 2. Allen I. Holub, Compiler Design in C, Prentice Hall, 2003. ISBN: 9780131550452						

<table>
<tr><td>9.5</td><td>Professional Communication</td><td>Course No</td><td colspan="4">HS3001</td></tr>
<tr><td rowspan="2">Department/
Specialization</td><td rowspan="2">English</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>1</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Faculty proposing the course</td><td>Dr. Parvathy Das
Faculty, Dept. of SH</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech.</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• Develop the capability to apply for a job and participate in selection process
• Acquire interview skills
• Gain proficiency in language skills indispensable for a successful professional
• Develop emotional intelligence</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• Prepare résumé and cover letter
• Ready to perform at different levels of the interview process
• Able to use interpersonal skills in challenging situations
• Competent to draft various documents for specific purposes</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Preparing cover letter, résumé, digital profile; video profile; Email etiquette (L2,P4)
• Interview skills, Group discussion and impromptu speech (L2,P6)
• Social communication skills (L4,P6)
  ○ Conversational English appropriateness, context based speaking in general situations, discussion and associated vocabulary in professional situations)
  ○ Non-verbal communication – relevance and effective use of paralinguistic features – body language, chronemics, haptics, proxemics
  ○ Emotional intelligence (EI) and social intelligence at workplace – theoretical perspectives and their application in relevant workplace situations – EI and leadership skills – assessments and best practices in organizations
• Conflict management and communication at workplace (L4,P6)
  ○ Cross-cultural communication, Argumentation, negotiation, persuasion, decision making, case study of challenging situations
  ○ Organizing a meeting, working as part of a team, briefing
  ○ Business presentations – Preparing effective presentations, delivering presentaions and handling questions
• Writing proposals, statement of purpose, research article, agreements, summary Proofreading (L1,P4)
• Training for proficiency assessment (L1,P2)</td></tr>
<tr><td>References</td><td colspan="6">1. Tebeaux, Elizabeth, and Sam Dragga. The Essentials of Technical Communication. OUP, 2018.
2. Sabin, William A. The Gregg Reference Manual: A Manual of Style, Grammar, Usage, and Formatting. McGraw-Hill, 2011, pp 408-421.
3. Raman, Meenakshi and Sangeeta Sharma. Technical Communication: Principles and Practice. OUP, 2015.
4. Caruso, David R. and Peter Salovey. The Emotionally Intelligent Manager: How to Develop and Use the Four Key Emotional Skills of Leadership. John Wiley and Sons, 2004.
5. https://learnenglish.britishcouncil.org/business-english/youre-hired/episode-01
6. https://www.youtube.com/watch?v=HAnw168huqA
7. https://www.youtube.com/watch?v=azrqlQ_SLW8
8. https://owl.purdue.edu/owl/purdue_owl.html
9. Turabian,Kate L. Student's Guide to Writing College Papers. University of Chicago Press, 2010.</td></tr>
<tr><td>Methodology for content delivery</td><td colspan="6">Since students have been introduced to the basics of technical and professional communication in the first semester, this course is designed with the purpose of giving them intense training in professional and academic communication with global competence. Once the concept is introduced, adequate time should be devoted to practice and review.</td></tr>
</table>

ANNEXURE E-II-B

Curriculum for B.Tech. CSE-AI 2021 Batch

Semester 1					
Category	Course Name	L	T	P	C
BSC	Calculus	3	1	0	4
BSC	Engineering Electromagnetics	3	0	0	3
BEC	Electrical Circuits for Engineers	3	1	0	4
BEC	Problem Solving and Programming	3	0	0	3
BEC	Materials for Engineers	3	0	0	3
DSC	Foundation for Engineering and Product Design	1	2	0	3
BSC	Engineering Electromagnetics Practice	0	0	3	1.5
BEC	Problem Solving and Programming Practice	0	0	3	1.5
HSC	Effective Language and Communication Skills	1	0	2	2
HSC	NSO/NCC/SSG/NSS	0	0	2	P/F
					25.0

Semester 2					
Category	Course Name	L	T	P	C
BSC	Differential Equations	3	1	0	4
BSC	Linear Algebra	3	1	0	4
BEC	Engineering Graphics	2	0	4	4
ITC	Data Structures and Algorithms	3	0	0	3
DSC	Sociology of Design	1	2	0	3
ITC	Design and Manufacturing Lab	0	0	2	1
PCC	Discrete Structures for Computer Science	3	1	0	4
ITC	Data Structures and Algorithms practice	0	0	4	2
HSC	NSO/NCC/SSG/NSS	0	0	2	P/F
HSC	Earth, Environment and Design	1	0	0	P/F
					25.0

Semester 3					
Category	Course Name	L	T	P	C
BSC	Optimization Techniques for Machine Learning	3	1	0	4
PMC	Data Science: An Applied Perspective	3	0	2	4
PCC	Object Oriented Programming	2	0	4	4
PCC	Digital System Design	3	1	0	4
PCC	Design and Analysis of Algorithms	3	1	0	4
PCC	Digital System Design practice	0	0	4	2
PCC	Design and Analysis of Algorithms practice	0	0	4	2
HSC	Indian Constitution, Essence of Indian Traditional Knowledge	1	0	0	P/F
					24.0

ANNEXURE E-II-B

Curriculum for B.Tech. CSE-AI 2021 Batch

Semester 4					
Category	Course Name	L	T	P	C
BSC	Probability and Statisitcs	3	1	0	4
PMC	Artificial Intelligence	3	0	2	4
PCC	Computer Organization and Architecture	3	1	0	4
PCC	Database Systems	3	1	0	4
PCC	Theory of Computation	3	1	0	4
PCC	Computer Organization and Architecture practice	0	0	4	2
PCC	Database Systems practice	0	0	4	2
HSC	Human Values and Stress Management	1	0	0	P/F
					24.0
Semester 5					
Category	Course Name	L	T	P	C
PMC	Pattern Recognition and Machine Learning	3	0	2	4
DSC	Entrepreneurship and Management Functions	1	2	0	3
PCC	Operating Systems	3	1	0	4
PCC	Computer Networks	3	1	0	4
PCC	Compiler Design	3	1	0	4
PCC	Operating Systems practice	0	0	4	2
PCC	Computers Networks practice	0	0	4	2
PCC	Compiler Design Practice	0	0	4	2
HSC	Professional Ethics and Organizational Behaviour	1	0	0	P/F
					25.0
Semester 6					
Category	Course Name	L	T	P	C
PMC	Deep Learning	3	0	2	4
PMC	Reinforcement Learning	3	0	2	4
PME	Professional Major Elective 1	3	1	0	4
PME	Professional Major Elective 2	3	1	0	4
ELC	Elective 1	3	1	0	4
HSC	Professional Communication	1	0	2	2
HSC	Intellectual Property Rights	1	0	0	P/F
					22.0

ANNEXURE E-II-B

Curriculum for B.Tech. CSE-AI 2021 Batch

Summer					
PCD	Internship				P/F
Semester 7					
Category	Course Name	L	T	P	C
PME	Professional Major Elective 3	3	1	0	4
PME	Professional Major Elective 4	3	1	0	4
ELC	Elective 2	3	1	0	4
					12.0
Semester 8					
Category	Course Name	L	T	P	C
ELC	Elective 3	3	1	0	4
PCD	Project in AI	0	0	16	8
					12.0

Semester wise Credit Distribution	Credits									
Category	S1	S2	S3	S4	S5	S6	S7	S8	Total	%
Basic Science Course (BSC)	8.5	8	4	4	0	0	0	0	24.5	14.5
Basic Engineering Course (BEC)	11.5	4	0	0	0	0	0	0	15.5	9.2
Design Course (DSC)	3	3	0	0	3	0	0	0	9	5.3
IT Skill Course (ITC)	0	6	0	0	0	0	0	0	6	3.6
Professional Core Course (PCC)	0	4	16	16	18	0	0	0	54	32.0
Professional Major Course (PMC)	0	0	4	4	4	8	0	0	20	11.8
Professional Major Elective (PME)	0	0	0	0	0	8	8	0	16	9.5
Elective Course (ELC)	0	0	0	0	0	4	4	4	12	7.1
Humanities and Social Science Course (HSC)	2	0	0	0	0	2	0	0	4	2.4
Professional Career Development (PCD)	0	0	0	0	0	0	0	8	8	4.7
Total	25	25	24	24	25	22	12	12	169	100
	25	50	74	98	123	145	157	169	**169**	

ANNEXURE E-II-B

Curriculum for B.Tech. CSE-AI 2021 Batch

<table>
<tr><td rowspan="2">Course Title</td><td rowspan="2">Optimization Techniques for Machine Learning</td><td rowspan="2">Course No</td><td colspan="6" rowspan="2"></td></tr>
<tr></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mathematics</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td colspan="2">P</td><td colspan="2">C</td></tr>
<tr><td>3</td><td>0</td><td colspan="2">0</td><td colspan="2">3</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Dept. of SH</td><td>Status</td><td>Core</td><td>■</td><td colspan="2">Elective</td><td colspan="2">□</td></tr>
<tr><td>Offered for</td><td>B.Tech CSE</td><td>Type</td><td>New</td><td>■</td><td colspan="2">Revision</td><td colspan="2">□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="6" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="8">The objective of this course is to teach mathematics of optimization that can be applied to Machine Learning. The focus will be on deriving solutions to various optimization problems .</td></tr>
<tr><td>Learning Outcomes</td><td colspan="8">● Students will be familiar with probabilistic models for optimization
● Will be familiar with algorithms to solve constraint and unconstrained versions of optimization problems
● Will be able to solve combinatorial optimization problems</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="8">• Categorization and characteristics of optimization problem(1)
• UnConstrained Optimization: Fibonacci and Golden-Section Search (3)
• Constrained Optimization: Lagrange Multiplier, Karush Kuhn Tucker(KKT) Conditions, First order and Second-order necessary conditions for minima and maxima; convex sets and functions, convex optimization; Duality, IRLS (12)
• Derivatives and Gradients- First-Order Methods -Gradient descent -batch gradient descent - stochastic gradient descent -Adam (6)
• Second-Order Methods –Conjugate gradient method- Quasi Newton method- Newton method (4)
• Stochastic Methods –-simulated annealing -monte-carlo methods for stochastic optimization(6)
• Combinatorial Optimization –Mincut-Maxflow-normalized cut (4)</td></tr>
<tr><td>Essential Reading</td><td colspan="8">1. Sra, Suvrit, Sebastian Nowozin, and Stephen J. Wright, eds. Optimization for machine learning. Mit Press, 2012. (ISBN: 9780262016469):
2. Roberto Battiti, Mauro Brunato. The LION Way: Machine Learning plus Intelligent Optimization. Lionsolver, Inc. 2013.(ISBN: 9781496034021)</td></tr>
<tr><td>Supplementary Reading</td><td colspan="8">1. Bubeck, Sebastien. "Theory of Convex Optimization for Machine Learning." arXiv preprint arXiv:1405.4980, 2014.
2. Algorithms for Optimization, Mykel J. Kochenderfer (Author), Tim A. Wheeler (Author), 2019, ISBN-13: 978-0262039420; ISBN-10: 0262039427 (ebook)</td></tr>
</table>

ANNEXURE E-II-B

Curriculum for B.Tech. CSE-AI 2021 Batch

<table>
<tr><td>Course Title</td><td>Data Science –An Applied Perspective</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Dept. of CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course covers the basic concepts of Data Science to help the student to learn, understand and practice data analytics encompassing concepts from descriptive, inferential statistics and predictive techniques and big data concepts.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Ability to identify the characteristics of datasets ; Ability to select and implement machine learning techniques suitable for the respective application ;
Ability to solve problems associated with big data characteristics such as high dimensionality;
Ability to integrate machine learning libraries and mathematical and statistical tools</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Introduction to relevant industry applications and analytics – Descriptive Statistics – Data Visualization & Interpretation -Measures of Central Tendency & Dispersion - Basic and advanced plots such as Stem-Leaf Plots, Histograms, Pie charts, Box Plots, Violin Plots etc. – Merits of Demerits & Interpretation (10)
Inferential Statistics – Hypothesis Testing - Tests of Significance – Analysis of Variance - Regression – Linear and Logistic (8)
Predictive Analytics – Supervised and Unsupervised – Association Rules, Classification, Clustering, Outlier Analysis, Time Series Modeling (14)
Big Data Characteristics – Map Reduce – Deduplication, Distributed Storage, Implementation using Hadoop / Pyspark platforms (8)
Practice Component: Concepts from Descriptive Statistics, Inferential and Predictive Analytics would be test driven using platforms such as Python, R etc. ML support in these platforms for rule mining and application, classification & clustering algorithms etc. would also be test driven as part of the practice exercises. Modern technologies for big data handling such as Pyspark – support for Map reduce would also be test driven. Applications relevant to the students stream of specialization would be explored for exercises / course project as case studies. (14 sessions – weekly exercises)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">J Han, M Kamber, Data Mining Concepts & Techniques, Elsevier, 3rd Edition, 2007, ISBN 9780123814791</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">Joel Grus, Data Science from Scratch, Orielly, 2nd Edn, 2019, ISBN 9781492041139
Leskovec, Anand Rajaraman,, Ullmann, Mining of Massive Data Sets, Cambridge University Press, Open Source free version , ISBN 9781107015357
P Bruce, Practical Statistics for Data Scientists, O'Reilly, 2017, iSBN 9789352135653</td></tr>
</table>

ANNEXURE E-II-B

Curriculum for B.Tech. CSE-AI 2021 Batch

<table>
<tr><td>Course Title</td><td>Object Oriented Programming</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>4</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The course introduces students to the object oriented programming paradigm and its benefits in application development. Both C++ and Java would be used as implementation platforms for the various object oriented features.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• To understand Object Oriented Concepts for Software Design
• To analyze various aspects of Software Design in a reusable and secure fashion
• To create applications supporting a command line & graphical user interface in Object Oriented fashion.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Object oriented programming - Encapsulation – Constructors – Destructors - Composition – Friend functions/classes – this pointer – Dynamic memory management (8L)
• Operator overloading Reusability – Inheritance – Base & derived classes – Protected members – Constructors –Destructors in derived classes – public/private/protected inheritance – Polymorphism (9L)
• Virtual functions - Templates – Function & Class templates – Streams – Stream input Output Stream format states – Manipulators – Exception handling – Re–throwing exceptions –specifications–and exception handling – Inheritance – STL (9L)
• Event Handling, Applets, – Frames, Buttons, Menu – Visual design layout, Multithreading, Networking, Database connectivity support (10L)

• Practice component will test drive the concepts covered in theory using C++/Java approximately for 14 sessions in the semester [Overall 36 Hours Theory + 28 Hours for lab]</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Deitel P J and Deitel H M, C : How To Program, Prentice Hall, 10th Edn, 2016, ISBN 9780131596825
2. Deitel P J and Deitel H M, Java: How To Program, Prentice Hall, 9th Edn, 2016, ISBN 978-0132575669</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. David Flanagan, Java in a Nutshell, 5th Edition, O'Rielly, 2005, ISBN 9780596007737
2. Herbert Schildt, Java: A Beginners Guide, 9th Edition, McGraw Hill, 2014, ISBN 9781260440218
3. Herbet Schildt, Teach Yourself C++, 4th Edition, Tata McGraw Hill, 2003, ISBN 978-0070532465</td></tr>
</table>

ANNEXURE E-II-B

Curriculum for B.Tech. CSE-AI 2021 Batch

Course Title	**Digital System Design**	Course No				
Department/ Specialization	Computer Science and Engineering	Credits	L	T	P	C
			3	1	0	4
Faculty proposing the course	Faculty, Department of CSE	Status	Core	■	Elective	□
Offered for	B.Tech	Type	New	■	Revision	□
To take effect from	July 2021	Submitted for approval	44th Senate			
Prerequisite	Nil					
Learning Objectives	To introduce the basic understanding of digital representation, Boolean algebra and the operation of the logic components, combinational and sequential circuits, and to introduce the analog device concepts like diode, FET and op-amp.					
Learning Outcomes	• To understand Digital Number systems, fixed and floating point representation and arithmetic operations. • To use Boolean Algebra and Switching theory for Logic minimization. • To implement Combinational Circuits using Primitive gates and logic functions. • To implement sequential circuit elements and finite state machines. • To design various circuits using Op-Amp 741 such as summing, difference, average, logarithmic amplifiers etc.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Digital Circuits: Number Representation: Fixed point and floating point, 1's and 2's complement. Switching Theory: Boolean algebra, Switching functions, Truth Tables and Algebraic forms, Simplification of Boolean expressions – Algebraic methods, canonical forms and Minimization of functions using K-Maps. (5L,1T) • Binary Codes: BCD, Gray, Excess 3, Alpha Numeric codes and conversion circuits. (3L,1T) • Arithmetic circuits: Binary adders and subtractors, multipliers and division, ALU. (5L,2T) • Synthesis of combinational logic functions using MSIs: mux/demux, decoders/encoders, Priority encoders, Comparators. (2L,2T) • Sequential Circuits: Latches and Flip-Flops: SR, JK, D, T; Excitation tables. (2L,1T) • Shift Registers, Counters, Random Access Memory. (3L,1T) • Synchronous sequential circuits: Finite State Machines- Mealy & Moore types- Basic design steps- Design of counters, sequence generators, and sequence detectors - Design of simple synchronous machines – state minimization. (8L,3T) • Analog Circuits: Diodes – Basics and Circuits – Clippers, Clampers, rectifiers. (3L,1T) • Operational amplifiers (op-amp) – Basics and op-amp circuits – non inverting and inverting amplifiers – Signal offset. (4L,1T) • Analog to Digital and Digital to Analog Conversion and circuits, Applications of Digital ICS: 555 Timer, V to F converters, Introduction to Logic Families, Noise in Digital System. (7L,1T)					
Essential Reading	1. M. Mano and C. Kime, "Logic and Computer Design Fundamentals," Prentice Hall, Upper Saddle River, NJ, 4 th Edition, ISBN-13 : 978-9332518728, 2008. 2. B. Razavi, "Fundamentals of Microelectronics," Wiley Student Edition, ISBN: 978-1-118-15632-2, 2010.					
Supplementary Reading	1. Sedra and Smith, Microelectronic Circuits, 7 th Edition, ISBN-13 : 978-0198089131, Oxford University Press, 2013. 2. J. F. Wakerly, "Digital Design - Principles and Practices," 3 rd Edition, Pearson, ISBN-13 : 978-9332508125, 2008. 3. M. M. Mano, "Digital Design," PHI, ISBN-13: 978-0-13-277420-8, 1979. 4. S. Franco, "Design with Operational Amplifiers and Analog Integrated Circuits," McGraw-Hill Series in Electrical and Computer Engineering, 4th Edition, ISBN-13 : 978-0072320848, 2015. 5. R. J. Tocci, N. S. Widmer, and G. L. Moss, "Digital Systems Principles and applications," Pearson Prentice Hall,10 th Edition, ISBN-13 : 978-0135103821, 2010.					

ANNEXURE E-II-B

Curriculum for B.Tech. CSE-AI 2021 Batch

<table>
<tr><td>Course Title</td><td>Design and Analysis of Algorithms</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To design time or space efficient algorithms using well known paradigms.
• To understand the limitations of computing machines.
• To explore tractable vs intractable problems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• To design efficient algorithms using paradigms such as divide and conquer, dynamic programming, greedy method etc.
• To differentiate easy vs hard problems.
• To design polynomial-time algorithms with proof of correctness.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Review of time/space complexity – recurrence relations – recurrence tree method – masters theorem (5L,2T)
• Incremental and decremental strategies – divide and conquer – case studies – lower bounds for sorting (5L,3T)
• Greedy Method – Container loading – knapsack – scheduling – coin change – proof of correctness (8L,2T)
• Dynamic programming – matrix chain, optimal binary search tree, travelling salesman, LCS, knapsack , greedy vs dynamic programming – Principle of optimality, overlapping subproblems – Dynamic programming vs Divide and Conquer (8L,2T)
• Graph algorithms – Topological sort – Shortest path algorithms – Dijskstra's Algorithm, – Bellman-Ford's Algorithm – minimum spanning tree – Principle of optimality (8L,2T)
• Tractability - Introduction to NP-completeness – NP, NP-hardness , polynomial-time reductions (6L,1T)
• Coping with intractable problems - Branch and bound – Back tracking – case studies (5L,1T)
• Solvable vs Unsolvable problems – Halting problem, Reducibility to Halting problem (3L)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. T. H. Cormen, C. E. Leiserson, and R. L. Rivest, "Introduction to Algorithms," Prentice Hall India, 2 nd Edition, 2001. ISBN 978-0-262-53305-8
2. E. Horowitz, S. Sahni, and S. Rajasekaran, "Computer Algorithms," 2 nd Edition, Galgotia Publications, 2007. ISBN 0-7167-8316-9</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Aho, Hopcroft, and Ullmann, "Data Structures & Algorithms," Addison Wesley, 1983. ISBN13: 9780201000238
2. Algorithm Design , Eva Tardos and Kleinberg, Pearson, 2006, ISBN-13 : 978-0321295354</td></tr>
</table>

Course Title	**Digital System Design Practice**	Course No				
Department/ Specialization	Computer Science and Engineering	Credits	L	T	P	C
			0	0	4	2
Faculty proposing the course	Faculty, Department of CSE	Status	Core	■	Elective	□
Offered for	B.Tech	Type	New	■	Revision	□
To take effect from	July 2021	Submitted for approval	44th Senate			
Prerequisite	Nil					
Learning Objectives	To provide hands on design and implementation of analog and digital circuits. Students will build simple digital systems on general purpose PCBs.					
Learning Outcomes	• To implement and verify logic circuits • To implement and verify arithmetic circuits using discrete components • To implement and verify digital systems using Combinational/ Sequential elements • To implement and verify analog circuits					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Design and implementation of logic functions, combinational circuits (code converters, half & full adders, comparator, ripple carry adder, priority encoder, Decoders, Seven segment display, multiplexer) • Design of sequential Circuits. • Design of 4-bit ALU (Adder, subtractor, logic and shift operations). • Design project • Static characteristics of rectifiers and filters, clipping and clamping circuits, Op-Amp based amplifier circuits. • Design and implementation of a digital system.					
Essential Reading	1. S. Franco, "Design with Operational Amplifiers and Analog Integrated Circuits," McGraw-Hill Series in Electrical and Computer Engineering, 4th Edition, ISBN-13 : 978-0072320848, 2015. 2. S. Brown and Z. Vranesic, "Fundamentals of Digital Logic with VHDL Design,"TMH, 3 rd Edition, ISBN-13 : 978-0077221430, 2008.					
Supplementary Reading	1. R.J. Tocci, N. S.Widmer, and G. L. Moss, "Digital Systems Principles and applications," Pearson Prentice Hall, 10 th Edition, ISBN-13 : 978-0135103821, 2010. 2. D. A. Neaman, "Electronic Circuits," TMH, 4 th Edition,ISBN-13 : 978-0070634336, 2006.					

ANNEXURE E-II-B

Curriculum for B.Tech. CSE-AI 2021 Batch

<table>
<tr><td>Course Title</td><td>Design and Analysis of Algorithms Practice</td><td>Course No</td><td colspan="5"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td colspan="2">T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td colspan="2">0</td><td>4</td><td>2</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core</td><td>■</td><td colspan="2">Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td colspan="2">Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="5">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="7">• To design time or space efficient algorithms using well known paradigms.
• To understand the limitations of computing machines.
• To explore tractable vs intractable problems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="7">• To design efficient algorithms using paradigms such as divide and conquer, dynamic programming, greedy method etc.
• To differentiate easy vs hard problems.
• To design polynomial-time algorithms with proof of correctness.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="7">• The laboratory component will require the student to write computer programs using a careful choice of data structures and algorithmic paradigms (in C++/Java language) from scratch, based on the concepts learnt in the theory course.

• Case studies in respect of different paradigms discussed in theory shall be implemented in C++/Java

• Paradigms – Divide and conquer, dynamic programming, greedy, backtracking.</td></tr>
<tr><td>Essential Reading</td><td colspan="7">1. T. H. Cormen, C. E. Leiserson, and R. L. Rivest, “Introduction to Algorithms,” Prentice Hall India, 2 nd Edition, 2001. ISBN 978-0-262-53305-8
2. E. Horowitz, S. Sahni, and S. Rajasekaran, “Computer Algorithms,” 2 nd Edition, Galgotia Publications, 2007. ISBN 0-7167-8316-9</td></tr>
<tr><td>Supplementary Reading</td><td colspan="7">1. Aho, Hopcroft, and Ullmann, “Data Structures & Algorithms,” Addison Wesley, 1983. ISBN13: 9780201000238
2. Algorithm Design , Eva Tardos and Kleinberg, Pearson, 2006, ISBN-13 : 978-0321295354</td></tr>
</table>

Course Title	**Probability and Statistics**	Course No					
Department/ Specialization	Mathematics	Credits	L	T	P		C
			3	0	0		3
Faculty proposing the course	Faculty, Dept. of SH	Status	Core	■	Elective		□
Offered for	B.Tech	Type	New	■	Revision		□
To take effect from	July 2021	Submitted for approval	44th Senate				
Prerequisite	Nil						
Learning Objectives	The objective of this course is to impart knowledge related to the essentials for probability and statistics to students so that students they can understand probabilistic machine learning models and also validate the models using statistical inference						
Learning Outcomes	• Will be familiar with fundamentals of probability and statistics • Students are expected to apply probability and statistics concepts in machine learning algorithm design • Expected to validate the algorithms						
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Probability : Classical probability-Axioms of probability-Random variables –continuous and discrete (4) Probability density function-Binomial-Bernoulli, poison-Gaussian-logistic (5) Cumulative distribution function-quantile function-joint probability –Marginal Probability distribution(4) independence of random variables-conditional probability-Bayes theorem-base rate fallacy (4) Gaussian Mixture model- Hidden Markov Model-Random Markov Field-central limit theorem and application (8) Statistics: Summarizing data using descriptive statistics-expectation – variance – covariance-correlation (4) Hypothesis testing, introduction to ANOVA (analysis of variance), regression analysis. (5) Estimation Statistics- Nonparametric Statistics (4)						
Essential Reading	1. Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences, by J. Susan Milton, Jesse Arnold, 2002, 4th Edision, Published by McGraw-Hill. (ISBN: 9780070636941)						
Supplementary Reading	1. Introduction to Probability Theory and Statistical Inference by H.J. Larson, 3rd Edition, published by Wiley.(ISBN: 9780471059097) 2. Introduction to Probability and Statistics for Engineers and Scientists by S.M. Ross, 5th Edision, published by Elsevier(ISBN: 9780123948113)						

ANNEXURE E-II-B

Curriculum for B.Tech. CSE-AI 2021 Batch

Course Title	**Artificial Intelligence**	Course No	
Department/ Specialization	Computer Science and Engineering	Credits	L: 3, T: 0, P: 2, C: 4
Faculty proposing the course	Faculty, Dept. of CSE	Status	Core ■ Elective □
Offered for	B.Tech	Type	New ■ Revision □
To take effect from	July 2021	Submitted for approval	44th Senate
Prerequisite	Nil		
Learning Objectives	The course focuses on understanding, thinking and intelligence such that computer systems are able to reason in uncertain environment. The course shall primarily focus on a variety of representation formalisms and associated algorithms for reasoning.		
Learning Outcomes	● Thorough understanding of the core areas of AI such as Representation, Search, Uncertainty, interconnections amongst them; & with other areas such as robotics, NLP, expert systems, etc; ● Ability to decide on the apt representation for a domain model ● Ability to choose appropriate algorithms for AI reasoning in that domain, implement and debug core AI algorithms.		
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Introduction to Artificial Intelligence – Philosophy of AI and Definitions, Problem Solving Methods - Formalism - Modeling a Problem as Search Problem - Uniformed Search - Examples - Basic Search Strategies – Iterative Deepening DFS , Bidirectional Search - Informed Search – Best First , A* Search, Iterative Deepening A*, Depth First Branch Bound - Heuristic Search, Domain Relaxations [12] Local Search – Satisfaction, Optimization,N Queens Example, Hill Climbing – Limitations, Random walk / Restart, Simulated Annealing, Genetic Algorithms, Adversarial Search –Min Max algorithm Game Playing, Alpha Beta pruning [10] Constraint Satisfaction Problems – Representation, Examples – Backtracking search – Variable Value Ordering – Inferences - Logic in AI – Representation Systems – Syntax & Semantics – Forward Chaining –Resolution, Reduction to Satisfiability Problems[10] Uncertainty in AI – Conditional Independence, Bayesian Networks, Inferences, Expectation Maximization, Decision Theory – MDPs – Applications of AI in NLP, Speech Recognition etc. [10] Practice component shall involve programming exercises to supplement material covered in theory.		
Essential Reading	1. S Russell & P Norvig, Artificial Intelligence – A Modern Approach, Pearson, 3rd Edition, 2010, ISBN 9789332543515		
Supplementary Reading	1. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill, 2013,ISBN9783827370891 2. Nils J Nilsson, Artificial Intelligence – A New Synthesis, Morgan Kauffmann, 1998,ISBN 9781558604674 3. P Norvig, Paradigms of AI Programming, Morgan Kauffmann,1991, ISBN 9781558601918 4. Dean, Allen & Aloimonos , AI Theory & Practice, Addison Wesley, 1995, ISBN 978-0805325478		

<table>
<tr><td>Course Title</td><td colspan="2">Computer Organization and Architecture</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td colspan="2" rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td colspan="2">Faculty, Department of CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td colspan="2">B.Tech</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td colspan="2">July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td colspan="2">Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="7">The course aims to introduce various aspects of computer organization such as Instruction format, Instruction codes, Addressing Modes, processor design and hierarchical memory design, Input and Output Interface design using Programmed Controlled and Interrupt Control way</td></tr>
<tr><td>Learning Outcomes</td><td colspan="7">● Understand the organization of a Computer system and ISAs
● Apply the knowledge of combinational and sequential logical circuits to design computer architecture.
● Understand the input / output and Memory related concepts.
● Analyze the performance of different scalar Computers
● Develop the Pipelining Concept for a given set of Instructions
● Distinguish the performance of pipelining and non pipelining environment in a processor</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="7">• Introduction: function and structure of a computer, functional components of a computer, performance of a computer system. Instruction set architectures – CISC and RISC architectures.(5L,1T)
• Instructions: Language of the Computer, Operations of the Computer Hardware, Operands of the Computer Hardware, Representing Instructions in the Computer, Logical Operations Instructions for Making Decisions, addressing Modes, Parallelism & Instructions. (5L,1T)
• Arithmetic Design: – Carry look ahead adder, Wallace tree multiplier, Floating–point adder/subtractor, Division. (5L,2T)
• The Processor: Logic Design Conventions, Building a Datapath, A Simple Implementation Scheme (3L,1T)
• An Overview of Pipelining, Pipelined Data path and Control, Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions and Parallelism via Instructions. (7L,2T)
• Memory Hierarchy: Introduction, Memory Technologies (SRAM, DRAM), The Basics of Caches, Measuring and Improving Cache Performance, Dependable Memory, Virtual Machines, Virtual Memory, A Common Framework for Memory Hierarchy, Using a Finite State Machine to Control a Simple Cache, Parallelism and Memory Hierarchies: Cache Coherence, Parallelism and Memory Hierarchy: Redundant Arrays of Inexpensive Disks and
• Implementing Cache Controllers. (9L,2T)
• Input/Output Unit: access of I/O devices, I/O ports, I/O control mechanisms – Program Controlled I/O. Interrupt controlled I/O and DMA controlled I/O; I/O interfaces – Serial port, parallel port, USB port, SCSI bus, PCI bus; I/O peripherals – Keyboard, display, secondary storage devices. (8L,2T)</td></tr>
<tr><td>Essential Reading</td><td colspan="7">1. Patterson and Hennessy, “Computer Organization and Design,” Morgan Kaufmann, 5 th Edition, ISBN-13 : 978-8131222744, 2013.
2. C. Hamacher, Z. Vranesic, and S. Zaky, “Computer Organization,” Tata McGraw Hill, 5 th Edition, ISBN-9789339212131, 2002.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="7">1. J. P. Hayes, “Computer Architecture and Organization,” Tata McGraw Hill, ISBN-13 : 978-1259028564, 2017.
2. M. J. Murdocca, V. P. Heuring, “Computer Architecture and Organization - An Integrated Approach,” John Wiley & Sons Inc., ISBN-13:978-0471733881, 2007.</td></tr>
</table>

<table>
<tr><td></td><td>3. A. S. Tanenbaum, “Structured Computer Organization,” Prentice Hall, 5th Edition, ISBN-13 : 978-0132916523, 2006.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Database Systems</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">Objective of the course is to equip students with skillsets required for database design and implementation. Various concepts such as ER modeling, Schema Mapping, Normalization, Lossless Join etc. would be explored to help in efficient an and effective databases.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• To appreciate the systematic design and principles involved in any database development.
• To understand the Importance of canonical normal forms and its design in large scale database systems
• To design and implement Database with formal analysis and design thinking</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Introduction to Database Systems, Database System Architecture, Schema, Database Models, Relational Model, ER Modelling and case studies. (7L,2T)
Expressive power of relational databases, Relational Algebra (5L,2T)
Database Languages, DDL, DML, Structured Query Language (SQL), SQL views, case studies (8L,3T)
Database Design, Normal Forms (First to third normal form), Boyce codd Normal Form, Database decomposition, Functional Dependencies, Loss-less Join decomposition (8L,2T)
Transaction Processing and Concurrency control (4L,1T)
Internal schema Design, Indexing, B-trees, B+ trees (5L,2T)
Introduction to advanced concepts like Data mining, Data warehousing, XML(5L)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. R. Elmasri and S. B. Navathe, “Fundamentals of Database Systems,” Pearson, 7th Edition, 2016, ISBN 9789332582705</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. A. Silberschatz, H. F. Korth, and S. Sudharsan, “Database System Concepts,” Tata McGraw Hill, 6th Edition, 2011, ISBN 9332901384.
2. C. J. Date, A. Kannan, and S. Swamynathan, “An Introduction to Database Systems,” Pearson, 8th Edition, 2006, ISBN 978-0321197849</td></tr>
</table>

ANNEXURE E-II-B

Curriculum for B.Tech. CSE-AI 2021 Batch

<table>
<tr><td>Course Title</td><td>Theory of Computation</td><td>Course No</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td><td>C</td></tr>
<tr><td>3</td><td colspan="2">1</td><td colspan="2">0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core</td><td>■</td><td colspan="2">Elective</td><td colspan="2">□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td colspan="2">Revision</td><td colspan="2">□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="6">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="8">This course aims to provide fundamentals of computing models such as finite state automata, push down automata, linear bounded automata and Turing machine. Powers and limitations of the models will also be discussed. Solvability and Tractability will be introduced through Turing machine</td></tr>
<tr><td>Learning Outcomes</td><td colspan="8">• To design various computational models useful for solving problems
• To understand the relationship among digital computer, algorithm and Turing machine.
• To verify whether a given problem is solvable or tractable.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="8">Finite Automata & Regular Languages - (10L,3T)
Languages vs Problems. Finite State Automata, Regular Languages. Closure properties, Limitations, Pumping Lemma, Myhill-Nerode relations, Quotient Construction. Minimization Algorithm.
Non-determinism, Regular Grammar & Regular Expressions - (10L,3T)
Notion of non-determinism. Acceptance condition. Equivalence of NFA and DFA. Regular Grammar and NFA, Pattern matching and regular expressions. Regular Expressions and Regular languages. More closure properties of regular languages.
Push Down Automata & Context-free Languages (CFLs) - (12L,4T)
Grammars and Chomsky Hierarchy, CFLs, Chomsky Normal Form, Pumping Lemma for CFLs, Inherent Ambiguity of Context-Free Languages, Cock-Younger-Kasami Algorithm, Applications to Parsing. Pushdown Automata (PDA), PDA vs CFLs. Non-equivalence of Deterministic and non- deterministic versions of PDA. Deterministic CFLs.
Linear Bounded Automata, Turing Machines & Computability - (12L,4 T)
Introduction to Linear Bounded Automata (LBA), Turing Machines. Context Sensitive Language Vs LBA. Turing Machine vs Phrase Structure Language. Multi-tape Turing machines. Recursive and Recursively enumerable languages. Undecidability of Halting Problem. Reductions. Introduction to Theory of NP-completeness.</td></tr>
<tr><td>Essential Reading</td><td colspan="8">1. Introduction to Automata Theory, Languages and Computation, Hopcroft, Motwani, and Ullman, Pearson Publishers, Third Edition, ISBN: 9780321455369, 2006.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="8">1. Elements of the Theory of Computation, H. R. Lewis and C.H. Papadimitriou, Prentice Hall Publishers, ISBN. 0-13-2624 78-8, 1981
2. Introduction to Languages and the Theory of Computation, John. C. Martin, Tata McGraw-Hill, ISBN 978-00731914612003.</td></tr>
</table>

ANNEXURE E-II-B

Curriculum for B.Tech. CSE-AI 2021 Batch

<table>
<tr><td>Course Title</td><td>Computer Organization and Architecture Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">Exposure to assembly language programming, instruction set design, and processor design for a given instruction set are given. Assembler macros, interrupt service routines, and simple device driver programs would also be introduced. Computer system design concepts are introduced.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">● Assembly Language Instructions and programming
● Machine code based program execution
● Input and output device interfacing and programming
● Programming Interrupt service routines
● Writing device driver program to control and monitor the peripheral device</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Exercises will mainly involve writing the assembly language programs - Execution of assembly language programs: Single–step, break points, Accessing the contents of registers, accessing the contents of memory locations - Implementation of higher level language assignment statements with arithmetic expressions and logical expressions - Implementation of control transfer statements. Macros - Software interrupts - Operating system function calls - Interrupt service routines - Simple device drivers - Assembly language programming in C language. I/O interfacing and programming. Computer System Design.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Patterson and Hennessy, “Computer Organization and Design,” Morgan Kaufmann, 5 th Edition, ISBN-13 : 978-8131222744, 2013.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. C. Hamacher, Z. Vranesic, and S. Zaky, “Computer Organization,” Tata McGraw Hill, ISBN-9789339212131, 2002.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Database Systems Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/
Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The focus of this course is on database design, architecture, and relational models. Normal forms, internal schema design would also be explored. This course introduces SQL programming. Database design preserving functional dependencies and loss-less decomposition properties would be addressed.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• Conceptual design using ER diagrams, programming using structured query language, Ability to Design and Implement Database based on formal guidelines
• Students would also be equipped with skills required for basic application development involving database connectivity.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Introduction to SQL. Schema, table creation using SQL, Data definition and data manipulation using SQL. Implementation of set theoretic operations on databases. Views using SQL. Implementation of algorithms related to functional dependencies and loss-less decomposition. Indexing using B-trees and B+ trees (creation, insertion, deletion).
Assignment/Mini project-based application design and development involving database</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. R. Elmasri and S. B. Navathe, “Fundamentals of Database Systems,” Pearson, 7th Edition, 2016, ISBN 9789332582705</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. A. Silberschatz, H. F. Korth, and S. Sudharsan, “Database System Concepts,” Tata McGraw Hill, 6th Edition, 2011, 978-0321197849
2. C. J. Date, A. Kannan, and S. Swamynathan, “An Introduction to Database Systems,” Pearson, 8th Edition, 2006, ISBN 978-0321197849</td></tr>
</table>

ANNEXURE E-II-B

Curriculum for B.Tech. CSE-AI 2021 Batch

Course Title	**Machine Learning and Pattern Recognition**	Course No					
Department/ Specialization	Computer Science and Engineering	Credits	L	T	P	C	
			3	0	2	4	
Faculty proposing the course	Faculty, Dept. of CSE	Status	Core	■	Elective	□	
Offered for	B.Tech	Type	New	■	Revision	□	
To take effect from	July 2021	Submitted for approval	44th Senate				
Prerequisite	CoT						
Learning Objectives	Students will understand the concepts, theory and computational algorithms needed for several real world recognition tasks such as text, speech, characters, objects etc. Simulate and understand how machine will have power to accomplish these tasks and can aim at developing several examples based learning tasks in several domains ranging from medical, economical, engineering to industrial needs.						
Learning Outcomes	• Identify the ML&PR algorithms which are more appropriate for domain specific such as computer vision, NLP, etc • Implement ML&PR algorithms and solve real-world problems • To know the cutting-edge research in this field.						
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• PR overview-Feature extraction-Statistical Pattern Recognition-Supervised & Unsupervised Learning; Bayes decision Theory, Linear discriminant functions (8 hours). • Parametric methods, ML and MAP estimation-Bayes estimation. Non parametric methods; Parzen windows & k NN approaches (8 hours). • Dimensionality reduction (PCA) & Fishers linear discriminant. Linear perceptron and Neural Networks. Introduction to Deep Neural nets. Kernel methods and Support vector machine (10 hours). • Unsupervised learning and Clustering. K-means and Hierarchical clustering. Linear & Logistic Regression (8 hours). • Decision trees for classification. Ensemble/ Adaboost classifier. Expectation Maximization (EM). Applications to document analysis and recognition (8 hours).						
Essential Reading	1. Christopher M B, Pattern Recognition and Machine Learning, Springer, 2006. ISBN: 9780387310732 2. Duda R O, Hart P E, and Stork D G, Pattern classification, John Wiley and Sons, 2001. ISBN: 9788126511167						
Supplementary Reading	1. Sergios T and Konstantinos K, Pattern Recognition, 4 th edition, Academic Press, 2008. ISBN: 9781597492720						

<table>
<tr><td>Course Title</td><td>Operating Systems</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This first level course focuses on exposing students to the purpose, structure and functions of an operating system. Operating systems abstraction, mechanisms and their implementation support for concurrency (threads) and synchronization, resource management, scheduling strategies, etc. are explored.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">● Sound understanding of basic concepts relating to the design and implementation of an operating system.
● Specifics relating to scheduling, multithreading, synchronization, etc. to understand the structure of the operating system (Linux), at the concept and the source code level.
● Ability to use Kernel API support to implement various features to be supported by an OS</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Functionalities & Services of an Operating System – System Calls & Types - Process Concept – Process Control Block – Linux System calls for Process creation, Inter Process Communication using Shared memory / Message passing. (10L,2T) Concurrency – Multithreaded programming – benefits, challenges, models, Pthreads library in Linux – thread creation, cancellation, thread specific data, Thread pools, Signal handling , Scheduling – Preemptive, Non preemptive algorithms FCFS, SJF, SRT, RR – Thread scheduling – contention scope, pthread support for scheduling. (11L,3T) Synchronization – Race condition – Critical Section Problem, Solution, Mutex Locks and Semaphores – Priority Inversion, Pthreads synchronization - Producer Consumer problem (multi threaded) example Deadlock characterization – Resource graph – Avoidance & Prevention – Safe state – Bankers algorithm – recovery schemes. (10L,3T)
Memory management – logical v/s physical address space – Segmentation, Paging, Page table structures , Virtual memory, Page replacement strategies, File Systems – file operations, types, access methods, Directory structure, Mounting file systems. (11L,3T) Introduction to operating systems for hand held devices - RTOS, Free RTOS</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts, John Wiley, 9 th Edn, 2015, ISBN 978-0471694663</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Andrew S Tanenbaum, Modern Operating Systems, Prentice Hall, 2009, ISBN 9788120339040
2. Stallings. W, Operating System: Internals and Design Principles, Prentice Hall, 2011, ISBN 9332518807
3. Gary Nut, Operating Systems: A Modern Perspective, Addison Wesley, 2003, ISBN 978-0201773446</td></tr>
</table>

Course Title	**Computer Networking**	Course No	
Department/ Specialization	Computer Science and Engineering	Credits	L: 3, T: 1, P: 0, C: 4
Faculty proposing the course	Faculty, Department of CSE	Status	Core ■ Elective □
Offered for	B.Tech	Type	New ■ Revision □
To take effect from	July 2021	Submitted for approval	44th Senate
Prerequisite	Nil		
Learning Objectives	To introduce the basics of computer networking, error detection and correction techniques, and flow control techniques. Also an exposure to IP addressing and routing and its associated protocols would be given. A highlight of various application layer protocols and its relevance in modern networking world would be discussed.		
Learning Outcomes	• To design a local area network and analyze the network using performance metrics. • To appreciate the importance of subnetting, masking, and nuances involved in setting up a campus network.		
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Evolution of computer networks, creating a small network, Data transfer between nodes, encoding of bits in physical layer, NRZ, Manchester, Differential Manchester, Performance evaluation of a network: propagation delay, transmission delay, RTT, effective bandwidth. (10L,3T) Error detection techniques in Data link layer (LRC, CRC, Two dimensional parity check), Hamming Error correcting codes. Data transfer between nodes using stop and wait protocol, sliding window protocol (Go-back-n and selective reject), performance analysis of stop and wait and sliding window protocols. Flow control at data link layer. Introduction to layer-2 devices (switches, bridges) and addressing scheme at Layer-2 (MAC addresses). (10L,3T) Creating a small network using Ethernet (IEEE 802.3) Token Ring (IEEE 802.5), Performance evaluation of IEEE 802.3 and 802.5 networks. Introduction to Layer-3 devices, IP addresses, IPv4,IPv6, Error detection at layer-3 using Checksum. IP addressing schemes, subnetting, CIDR (10L,3T) Introduction to TCP/IP, IP routing, RIP, OSPF, Circuit and Packet switching, ICMP, Introduction to networking commands: Ping, Traceroute, IPconfig, UDP, congestion control and avoidance. (10L,3T) Introduction to DHCP, FTP, HTTP(s) and other application layer protocols, Introduction to Network security. (5L)		
Essential Reading	1. Larry L.Peterson and Bruce S Davie, Computer Networks: A systems Approach,Morgan, 5th Edn, 2011. ISBN: 9780123850591 2. William Stallings, Data and Computer Communications, 10th Edn, Pearson, 2017. ISBN: 9780133506488		
Supplementary Reading	1. Andrew S. Tanenbaum, Computer Networks, 5th Edn, 2014. ISBN: 9788131770221 2. Behrouz Forouzan, TCP/IP protocol suite, Tata McGraw Hill, 4th Edn, 2010. ISBN: 9780070706521		

ANNEXURE E-II-B

Curriculum for B.Tech. CSE-AI 2021 Batch

Course Title	**Compiler Design**	Course No	
Department/ Specialization	Computer Science and Engineering	Credits	L T P C 3 1 0 4
Faculty proposing the course	Faculty, Department of CSE	Status	Core ■ Elective □
Offered for	B.Tech	Type	New ■ Revision □
To take effect from	July 2021	Submitted for approval	44th Senate
Prerequisite	Nil		
Learning Objectives	The objective of this course is to train students to design various phases of compiler such as Lexical analyzer, syntax analyzer, semantic analyzer, intermediate code generator, code optimizer and code generator. Students are also exposed to design compiler construction tools such as Lexical Analyzer generator and parser generator. Applications of finite state machine and pushdown automation in compiler design are also taught in this course.		
Learning Outcomes	• At the end of the course, students will be able to design a programming language and compiler for the same. • Students will also be able to write large programs.		
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Need of compiler-cross compiler-Introduction to phases of compiler –Lexical Analyzer Design using DFAs —regular expression and its application to give syntax of word –Automatic design of Lexical Analyzer from regular expression, Construction of NFA without epsilon moves from regular expression- Efficient Lexical analyzer using Minimization of automata- limitation of recognition capability of Lexical analyzer using Pumping lemma (12L,3T) Context free grammar & its application to give syntax of program statement – Types of parsing – Top down & bottom up–Recursive descent– Predictive–Shift reduce–Operator precedence–SLR (10L,3T) Semantic analysis - Intermediate code generation: Declaration – Assignment statements – Boolean expressions– looping and branching statements (7L,2T) Back patching and procedure calls code generator design issues – Runtime storage management – Code Optimization: Basic blocks – Flow graphs – Next use information – Code generator case study – Directed acyclic graph representation of basic blocks – Peephole optimization technique Introduction to code optimization (10L,3T) Storage optimization & allocation strategies).Assembly Code Generation: from syntax tree and Directed acyclic graph - from three address code. (5L,1T)		
Essential Reading	1. Alfred Aho, Ravi Sethi and Jeffrey D Ullman, Compilers Principles, Techniques and Tools, Pearson Education, 2003. ISBN: 9780321491695		
Supplementary Reading	1. Levine J.R, Mason T, Brown D, Lex & Yacc, OReilly Associates, 1992 ISBN: 9781565920002. 2. Allen I. Holub, Compiler Design in C, Prentice Hall, 2003. ISBN: 9780131550452		

ANNEXURE E-II-B

Curriculum for B.Tech. CSE-AI 2021 Batch

<table>
<tr><td>Course Title</td><td>Operating System Practice</td><td>Course No</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td colspan="2">T</td><td>P</td><td colspan="2">C</td></tr>
<tr><td>0</td><td colspan="2">0</td><td>4</td><td colspan="2">2</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of CSE</td><td>Status</td><td>Core</td><td>■</td><td colspan="3">Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td colspan="3">Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="6" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="8">The course aims to equip the student with implementation level constructs / support in Linux for various concepts such as process management, concurrency, scheduling, deadlock avoidance, etc.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="8">• To relate the operating system concepts listed above to the Linux operating system and support for the same available through various system calls.
• To use LINUX Kernel Support for various features such as multiprocessing multithreading etc.
• To Test Drive various Features of an OS relating to application scenario</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="8">Linux System Calls for process creation, management – Applications such as command prompt simulator using fork – Interprocess Communication using Shared Memory and Pipes – Producer Consumer – Applications using pipes / shm – Concurrency – Multithreading –Pthread support – Applications such as merge sort, min-max-average, etc. in a multi threaded fashion – Scheduling –pthread interfaces setschedpolicy – getschedpolicy based applications – Synchronization – threaded solution for classical problems like dining philosophers, readers writers, etc. using mutex locks and semaphores - Deadlock detection / avoidance algorithms.</td></tr>
<tr><td>Essential Reading</td><td colspan="8">1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts, John Wiley, 9 th Edn, 2015, ISBN 9788120339040</td></tr>
<tr><td>Supplementary Reading</td><td colspan="8">1. Robert Love, Linux Systems Programming, O Reilly Media, 2 nd Edition, 2013, ISBN 9781449339531
2. D Butlar, J Farrell, B Nichols, Pthreads Programming, O Reilly Media, 1996, ISBN 9781565921153</td></tr>
</table>

Course Title	**Computer Networking Practice**	Course No	
Department/ Specialization	Computer Science and Engineering	Credits	L: 0, T: 0, P: 4, C: 2
Faculty proposing the course	Faculty, Department of CSE	Status	Core ■ Elective □
Offered for	B.Tech	Type	New ■ Revision □
To take effect from	July 2021	Submitted for approval	44th Senate
Prerequisite	Nil		
Learning Objectives	To understand basic networking commands, MAC/IP addressing, file transfer between two systems, etc. Simulation of error control techniques and flow control techniques using well known protocols would be addressed as part of this course.		
Learning Outcomes	• To design, test and troubleshoot aspects associated with local area networking. • To appreciate the importance of error detecting codes and flow control techniques.		
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Connecting two nodes using Ethernet cable and study the performance evaluation parameters such as delay, effective bandwidth - Basic Networking commands – Ping, IPConfig, Traceroute, NSlookup - Introduction to Socket Programming. File transfer using TCP. Echo, Chat between two or more clients using socket programming - Simulation of Stop and Wait Protocol - Simulation of Stop and Wait protocol with NACK, Modelling of ACK, NACK drops, etc., -Modelling and simulation of Sliding window protocol - Sliding window protocol with ACK/NACK drops, frame drops etc., - Performance evaluation through simulation of IEEE 802.3/802.5 networks - Implementation of OSPF. Introduction to NS2/OPNET simulator, Case studies.		
Essential Reading	1. Larry L.Peterson and Bruce S Davie, Computer Networks: A systems Approach,Morgan, 5th Edn, 2011.ISBN: 9780123850591 2. William Stallings, Data and Computer Communications, 10th Edn, Pearson, 2017.ISBN: 9780133506488		
Supplementary Reading	1. Andrew S. Tanenbaum, Computer Networks, 5th Edn, 2014. ISBN: 9788131770221 2. Behrouz Forouzan, TCP/IP protocol suite, Tata McGraw Hill, 4th Edn, 2010. ISBN: 9780070706521		

ANNEXURE E-II-B

Curriculum for B.Tech. CSE-AI 2021 Batch

Course Title	**Compiler Design Practice**	Course No					
Department/ Specialization	Computer Science and Engineering	Credits	L	T	P	C	
			0	0	4	2	
Faculty proposing the course	Faculty, Department of CSE	Status	Core	■	Elective	□	
Offered for	B.Tech	Type	New	■	Revision	□	
To take effect from	July 2021	Submitted for approval	44th Senate				
Prerequisite	Nil						
Learning Objectives	The objective of this course is to train students to design various phases of compiler such as Lexical analyzer, syntax analyzer, semantic analyzer, intermediate code generator, code optimizer and code generator. Students are also exposed to design compiler construction tools such as Lexical Analyzer generator and parser generator. Applications of finite state machine and pushdown automation in compiler design are also taught in this course.						
Learning Outcomes	• At the end of the course, students will be able to design a programming language and compiler for the same. • Students will also be able to write large programs.						
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Lexical analyzer implementation in C - Lexical analyser implementation using LEX tool Recursive descent parser implementation in C for an expression grammar - YACC and LEX based implementation for an expressions grammar - YACC implementation of a calculator that takes an expression with digits, + and * and computes and prints its value - Front end implementation of a compiler that generates the three address code for a simple language- Back end implementation of a compiler which takes the three address code (output of previous exercise) and results in assembly language instructions - Implementation of peephole optimization in C.						
Essential Reading	1. Alfred Aho, Ravi Sethi and Jeffrey D Ullman, Compilers Principles, Techniques and Tools, Pearson Education, 2003. ISBN: 9780321491695						
Supplementary Reading	1. Levine J.R, Mason T, Brown D, Lex & Yacc, OReilly Associates, 1992 ISBN: 9781565920002. 2. Allen I. Holub, Compiler Design in C, Prentice Hall, 2003. ISBN: 9780131550452						

<table>
<tr><td>Course Title</td><td>Deep Learning</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Dept. of CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>□</td><td>Revision</td><td>■</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>CoT</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">Introduce major deep learning algorithms, the problem settings and their applications to solve real world problems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains
Implement deep learning algorithms and solve real-world problems
To know the cutting-edge research in this field.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">
Introduction- to Neural Network (Recap), Gradient Descent, Linear Classifiers- Perceptron, Multilayer Perceptron, Delta Rule [4]
Deep Artificial Neural Networks- Back Propagation Learning, Gradient Descent – Stochastic, Batch and Mini-Batch, Activation Functions- RelU, Leaky RelU, Loss Functions [4]
Optimization Techniques – Momentum, Nesterov, AdaGrad, RMSProp, AdaDelta, Adam, AdaMax, Nadam, AMSGrad, etc. Training tricks in Deep Models - Regularization, Early stopping, Dropout, Data Augmentation, Normalization- Batch, Layer, Instance, and Group [7]
Deep Convolutional Neural Network- Convolution, pooling, Popular CNN models- AlexNet, VGG16, GoogleNet, and Transfer Learning, Recent Trends in Deep Learning Architectures, Skip Connection Network, Residual Network (ResNet) [9]
Deep Sequential Modeling -Recurrent Neural Network (RNN), LSTM Networks, Applications [3]
Classical Supervised Tasks with Deep Learning: Image Denoising, Semantic segmentation, Instance Segmentation, Object Detection, and Classification –YOLO [4]
Unsupervised Learning with Deep Network: Auto encoders, Variational Autoencoder [4]
Deep Generative Modeling - Generative Adversarial Network, Applications of Deep Learning to Computer Vision, NLP and Medical Data Analysis [6]
Practice: Evaluation Metrics- Confusion Matrix, Sensitivity, Specificity, Dice Score, Precision, Recall, Hausdorff Distance and Other popular metrics, K-fold Cross Validation-Stratification [4]
</td></tr>
<tr><td>Essential Reading</td><td colspan="6">Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016. ISBN: 9780262035613
Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006. ISBN: 9780387310732</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">François Chollet, Deep Learning with Python, 1st Edition, Manning Publication ISBN: 9781617294433
http://www.deeplearningbook.org/lecture_slides.html
http://www.cse.iitm.ac.in/~miteshk/CS7015.html</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Reinforcement Learning</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Dept. of CSE</td><td>Status</td><td>Core ■</td><td colspan="3">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New ■</td><td colspan="3">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The goal of the course is to introduce the basic mathematical foundations of reinforcement learning, as well as highlight some of the recent directions of research.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">It aims to model the trial-and-error learning process that is needed in many problem situations where explicit instructive signals are not available.
Implement RL algorithms and solve real-world problems
To know the cutting-edge research in this field.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">The Reinforcement Learning problem : evaluative feedback, non-associative learning, Rewards and returns, Markov Decision Processes, Value functions, optimality and approximation [8].
Dynamic programming : value iteration, policy iteration, asynchronous DP, generalized policy iteration. Monte-Carlo methods : policy evaluation, roll outs, on policy and off policy learning, importance sampling [8].
Temporal Difference learning : TD prediction, Optimality of TD(0), SARSA, Q-learning, R-learning, Games and after states. Eligibility traces : n-step TD prediction, TD (lambda), forward and backward views, Q (lambda), SARSA (lambda), replacing traces and accumulating traces [10].
Function Approximation : Value prediction, gradient descent methods, linear function approximation, ANN based function approximation, lazy learning, instability issues [8]
Policy Gradient methods : non-associative learning – REINFORCE algorithm, exact gradient methods, estimating gradients, approximate policy gradient algorithms, actor-critic methods [8]</td></tr>
<tr><td>Essential Reading</td><td colspan="6">Richard S. Sutton and Andrew G. Barto. Introduction to Reinforcement Learning, 2nd Edition, MIT Press. 2017. ISBN: 9780262193986
Neuro Dynamic Programming. Dimitri Bertsikas and John G. Tsitsiklis. Athena Scientific. 1996. ISBN: 9781886529106</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">Reinforcement Learning Algorithms, Analysis and Real Evaluation Application, by Boris Belousov, Simone Parisi, Hany Abdulsamad, Jan Peters, Springer ISBN: 9783030411879</td></tr>
</table>

ANNEXURE E-II-B

Curriculum for B.Tech. CSE-AI 2021 Batch

<table>
<tr><td>Course Title</td><td>Professional Communication</td><td>Course No</td><td colspan="4">HS3001</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">English</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>1</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Faculty proposing the course</td><td>Dr. Parvathy Das
Faculty, Dept. of SH</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech.</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• Develop the capability to apply for a job and participate in selection process
• Acquire interview skills
• Gain proficiency in language skills indispensable for a successful professional
• Develop emotional intelligence</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• Prepare résumé and cover letter
• Ready to perform at different levels of the interview process
• Able to use interpersonal skills in challenging situations
• Competent to draft various documents for specific purposes</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Preparing cover letter, résumé, digital profile; video profile; Email etiquette (L2,P4)
• Interview skills, Group discussion and impromptu speech (L2,P6)
• Social communication skills (L4,P6)
○ Conversational English appropriateness, context based speaking in general situations, discussion and associated vocabulary in professional situations)
○ Non-verbal communication – relevance and effective use of paralinguistic features – body language, chronemics, haptics, proxemics
○ Emotional intelligence (EI) and social intelligence at workplace – theoretical perspectives and their application in relevant workplace situations – EI and leadership skills – assessments and best practices in organizations
• Conflict management and communication at workplace (L4,P6)
○ Cross-cultural communication, Argumentation, negotiation, persuasion, decision making, case study of challenging situations
○ Organizing a meeting, working as part of a team, briefing
○ Business presentations – Preparing effective presentations, delivering presentaions and handling questions
• Writing proposals, statement of purpose, research article, agreements, summary Proofreading (L1,P4)
• Training for proficiency assessment (L1,P2)</td></tr>
<tr><td>References</td><td colspan="6">1. Tebeaux, Elizabeth, and Sam Dragga. The Essentials of Technical Communication. OUP, 2018.
2. Sabin, William A. The Gregg Reference Manual: A Manual of Style, Grammar, Usage, and Formatting. McGraw-Hill, 2011, pp 408-421.
3. Raman, Meenakshi and Sangeeta Sharma. Technical Communication: Principles and Practice. OUP, 2015.
4. Caruso, David R. and Peter Salovey. The Emotionally Intelligent Manager: How to Develop and Use the Four Key Emotional Skills of Leadership. John Wiley and Sons, 2004.
5. https://learnenglish.britishcouncil.org/business-english/youre-hired/episode-01
6. https://www.youtube.com/watch?v=HAnw168huqA
7. https://www.youtube.com/watch?v=azrqlQ_SLW8
8. https://owl.purdue.edu/owl/purdue_owl.html
9. Turabian,Kate L. Student's Guide to Writing College Papers. University of Chicago Press, 2010.</td></tr>
<tr><td>Methodology for content delive</td><td colspan="6">Since students have been introduced to the basics of technical and professional communication in the first semester, this course is designed with the purpose of giving them intense training in professional and academic communication with global competence. Once the concept is introduced, adequate time should be devoted to practice and review.</td></tr>
</table>

ANNEXURE E-II-C

Curriculum for M.Tech. Computer Science and Engineering 2021 Batch

Semester 1					
Category	Course Name	L	T	P	C
PCC	Mathematical Foundations of Computer Science	3	1	0	4
PCC	Advanced Data Structures and Algorithms	3	1	0	4
PCC	Computer System Design (Dept Design course)	3	1	0	4
ELC	Elective 1	3	1	0	4
ELC	Elective 2	3	1	0	4
PCC	Computer System Design Practice	0	0	4	2
PCC	Advanced Data Structures and Algorithms Practice	0	0	4	2
					24.0
Semester 2					
Category	Course Name	L	T	P	C
ELC	Elective 2	3	1	0	4
ELC	Elective 3	3	1	0	4
ELC	Elective 4	3	1	0	4
ELC	Elective 5	3	1	0	4
ELC	Elective 6	3	1	0	4
					20.0
Summer					
Category	Course Name	L	T	P	C
PCD	Project I	0	0	20	10
					10.0
Semester 3					
Category	Course Name	L	T	P	C
PCD	Project II	0	0	32	16
					16.0
Semester 4					
Category	Course Name	L	T	P	C
PCD	Project III	0	0	32	16
					16.0

Semester wise Credit Distribution	Credits						
Category	S1	S2	Summer	S3	S4	Total	%
Professional Core Course (PCC)	16	0	0	0	0	16	18.6
Elective Course (ELC)	8	20	0	0	0	28	32.6
Professional Career Development (PCD)	0	0	10	16	16	42	48.8
Total	24.0	20.0	10.0	16.0	16.0	86.0	100.0
	24.0	44.0	54.0	70.0	86.0		

ANNEXURE E-II-C

Curriculum for M.Tech. Computer Science and Engineering 2021 Batch

<table>
<tr><td>Course Title</td><td>Mathematical Foundations of Computer Science</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>M.Tech CSE</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Discrete Mathematics</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To learn to reason out logical arguments, proving logical arguments and identifying inconsistencies in arguments. To introduce proof techniques and study mathematical/algebraic structures.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Ability to understand and appreciate the power of mathematics in computing.
The importance of mathematical abstraction in solving computational problems that arise in various domains.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Logic : Propositional Logic, Predicate and First order Logic, Second Order Logic, Monadic Second Order Logic. (7L, 2T)

Proof Techniques: Discussion on proof techniques for problems that arise in CS. Proof by contradiction, Mathematical Induction, Loop in-variants in proving correctness of algorithms, Pigeon hole principle and its applications in Ramsey theorem, design of fault-tolerant networks, Principle of inclusion and exclusion, derangements, counting onto functions. (10L, 3T)

Introduction to algebraic structures; groups, subgroups, posets, lattices, fields, vector spaces, eigen values/vectors, Orthogonality : Inner Product, Orthogonality, Gram-Schmidt Orthogonalization, Vector and Matrix Norms (12L, 3T)

Counting sets, countable and uncountable sets, the role of graph theory in computing; bipartite graphs, planar graphs, matching, coloring. Modelling CS case studies as graph theoretic problems (10L, 3T)

Introduction to Probability - Random variables, Distribution - Conditional, Joint probability distributions (6L, 2T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. D. F. Stanat and D. F. McAllister, “Discrete Mathematics in Computer Science,” Prentice Hall, 1977, ISBN 13: 9780132161503
2. Linear Algebra and Its Applications - Gilbert Strang- Fourth Edition- Cengage Learning, 2006, ISBN-10; 0030105676</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. K. H. Rosen, “Discrete Mathematics and its Applications,” McGraw Hill, 6 th Edition, 2007, ISBN: 9780070648241
2. R. L. Graham, D. E. Knuth, and O. Patashnik, “Concrete Mathematics,” Addison Wesley, 1994, ISBN o-201-14236-8
3. Busby, Kolman, and Ross, “Discrete Mathematical Structures,” PHI, 6 th Edition, 2008. ISBN 13: 9780132154185
4. C. L. Liu, “Elements of Discrete Mathematics,” Tata McGraw Hill, 1995. ISBN 81 – 7808 – 279 - 9</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Advanced Data Structures and Algorithms</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>M.Tech CSE</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Discrete Mathematics, Data structures and algorithms</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To introduce mathematical models, advanced data structures and algorithm design strategies. To introduce various analysis in the design of algorithms</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• The ability to design and analyze algorithms for computational problems that arise in CS.
• To understand and appreciate the notion of solvability and unsolvability.
• The ability to gauge easy vs hard instances of a computational problem.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Mathematical Models and Encoding: Mathematical models - Turing Machine, Random Access Machine along with their input encoding/representation. The notion input size/magnitude, time/space complexity analysis in terms of input size. Introduction to asymptotic analysis. (5L,2T)

Recursive vs Iterative Algorithms, Recurrence relations, solving recurrence relations - guess method, substitution method (review). The recurrence tree method, Proof of Master theorem, Solving recurrence relations using characteristic equation method. The number of binary search trees, Catalan number (5L,2T)

Advanced data structures; Min-Max Heap, Deap, leftist trees, Symmetric Heaps - design and analysis of algorithms for basic operations. Applications. (7L,2T)

Introduction to probabilistic analysis; Average Case analysis of search, sorting problems. Lower bound theory arguments for search and sorting problems. Order Statistics and its applications (5L,2T)

Introduction to amortized analysis; potential function method. Binomial-Heaps and Fibonacci Heaps, Splay trees, dynamic tables (7L,2T)

Algorithm design; Case studies following greedy algorithms and dynamic programming. Introduction to graph algorithms - application of BFS/DFS, topological sorting, strongly connected components. Proof of correctness of greedy algorithms (7L,2T)

Introduction to NP-completeness, NP, NP-Hardness result of well-known problems (6)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. T. H. Cormen, C. E. Leiserson, and R. L. Rivest, “Introduction to Algorithms,” Prentice Hall India, 2 nd Edition, 2001. ISBN 978-0-262-53305-8
2. E. Horowitz, S. Sahni, and S. Rajasekaran, “Computer Algorithms,” 2 nd Edition, Galgotia Publications, 2007. ISBN 0-7167-8316-9</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Aho, Hopcroft, and Ullmann, “Data Structures & Algorithms,” Addison Wesley, 1983. ISBN13: 9780201000238
2. Algorithm Design , Eva Tardos and Kleinberg, Pearson, 2006, ISBN-13 : 978-0321295354</td></tr>
</table>

ANNEXURE E-II-C

Curriculum for M.Tech. Computer Science and Engineering 2021 Batch

<table>
<tr><td>Course Title</td><td>Advanced Data Structures and Algorithms Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>M.Tech CSE</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To design time or space efficient algorithms using well known paradigms. To get practical exposure on design and analysis of algorithms</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students are expected to design efficient algorithms using paradigms such as divide and conquer, dynamic programming, greedy method etc.
To be able to implement advanced data structures and revisit classical algorithms using these data structures</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">The laboratory component will require the student to write computer programs using a careful choice of data structures and algorithmic paradigms (in C++/Java language) from scratch, based on the concepts learnt in the theory course.

Case studies in respect of different paradigms discussed in theory shall be implemented in C++/Java

Paradigms – Divide and conquer, dynamic programming, greedy, backtracking. Order Statistics, Probabilistic Algorithms</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. T. H. Cormen, C. E. Leiserson, and R. L. Rivest, “Introduction to Algorithms,” Prentice Hall India, 2 nd Edition, 2001. ISBN 978-0-262-53305-8
2. E. Horowitz, S. Sahni, and S. Rajasekaran, “Computer Algorithms,” 2 nd Edition, Galgotia Publications, 2007. ISBN 0-7167-8316-9</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Aho, Hopcroft, and Ullmann, “Data Structures & Algorithms,” Addison Wesley, 1983. ISBN13: 9780201000238
2. Algorithm Design , Eva Tardos and Kleinberg, Pearson, 2006, ISBN-13 : 978-0321295354</td></tr>
</table>

ANNEXURE E-II-C

Curriculum for M.Tech. Computer Science and Engineering 2021 Batch

<table>
<tr><td>Course Title</td><td>Computer System Design</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>M.Tech CSE</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The course aims to expose students to the concepts involved in the design of computer systems covering aspects such as instruction sets, pipelining, caches, physical memory, virtual memory, superscalar and out-of-order instruction execution, vector processor and multi-threading.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">● Hardware and software techniques to optimize the memory access time.
● Software and Hardware Optimization techniques at Instruction level Parallelism.
● Limitations of ILP and scope for Multi-thread computing at architectural level.
● Thread level parallelism and its synchronization in multi-core scenario.
● Advanced OS concepts like Virtualization, parallel and distributed computing..</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Memory Hierarchy Design: Optimizations of Cache Performance, Memory Technology and Optimizations, Virtual Memory and Virtual Machines. (7L, 2T)

Instruction-Level Parallelism and Its Exploitation: ILP Concepts and Challenges, Overcoming Data Hazards with Static and Dynamic Scheduling, Reducing Branch Costs with Advanced Branch Prediction, Static and Dynamic Scheduling, Hardware-Based Speculation, Studies of the Limitations of ILP. (12L, 3T) Multi-Threading: Exploiting Thread-Level Parallelism to Improve Uniprocessor Throughput (5) Data-Level Parallelism in Vector, SIMD, and GPU Architectures: Vector Architecture, Detecting and Enhancing Loop-Level Parallelism. (5L, 2T)

Thread-Level Parallelism: Centralized Shared-Memory Architectures, Performance of Symmetric Shared-Memory Multiprocessors, Distributed Shared-Memory and Directory-Based Coherence, Synchronization, Models of Memory Consistency, Multicore Processors and Their Performance. (7L, 2T)

Advanced Operating System Concepts: Overview OS Structures - SPIN, Exokernel, L3 microkernel approach, Virtualization: Memory Virtualization - CPU and Device virtualization. Parallel Systems: Shared memory machines - Synchronization – Communication- Lightweight RPC - Scheduling - Shared memory multiprocessor OS. Distributed Systems - Lamport Clock- Latency limits - Active networks - Systems from Components (12L, 3T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. John L. Hennessy and David A. Patterson, Computer Architecture, Fifth Edition: A Quantitative Approach, The Morgan Kaufmann, 6th Edn, ISBN-13 : 978-8178672663, 2017.

2. Mukesh Singhal and Niranjan G. Shivaratri, Advanced Concepts in Operating Systems" ISBN 0-07-057572-X, McGraw Hill.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. John P. Shen and Mikko H. Lipasti, Modern Processor Design: Fundamentals of Superscalar Processors, Waveland Press, 1 st Edn, ISBN-13 : 978-1478607830, 2005,</td></tr>
</table>

	2. D.M. Harris and S.L. Harris. Digital Design and Computer Architecture, 2 nd Edn. Morgan Kaufmann, ISBN-13 : 978-0123944245, 2012.

Course Title	**Computer System Design Practice**	Course No					
Department/ Specialization	Computer Science and Engineering	Credits	L	T	P	C	
			0	0	4	2	
Faculty proposing the course	Faculty, CSE	Status	Core	■	Elective	□	
Offered for	M.Tech CSE	Type	New	■	Revision	□	
To take effect from	March 2021	Submitted for approval	44th Senate				
Prerequisite	Nil						
Learning Objectives	The course aims to be a hands on supplementing theory course with exposure to issues related to computer systems design on instruction level and thread level parallelism.						
Learning Outcomes	• Hardware modelling and simulation of the high speed arithmetic functional units. • Hardware modelling and simulation of the Register file and Memory access unit • Pipelined processor implementation and demonstration. • Hardware/Software level stall handling mechanism implementation and demonstration. • Cache Coherence Implementation for multicore processor architectures.						
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Incrementally design, implement, test, and evaluate a complete multi-core system with an integrated collection of processors, memories. A processor includes – pipeline arithmetic operation, register file, branch predictors, hardware based instruction scheduling and commit, cache design, MESI. Exercises involving advanced OS concepts.						
Essential Reading	1. John L. Hennessy and David A. Patterson, Computer Architecture, Fifth Edition: A Quantitative Approach, The Morgan Kaufmann, 6th Edn, ISBN-13 : 978-8178672663, 2017. 2. Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Second Edition, Prentice Hall, ISBN-13 : 978-8177589184, 2003.						
Supplementary Reading	1. John P. Shen and Mikko H. Lipasti, Modern Processor Design: Fundamentals of Superscalar Processors, Waveland Press, 1 st Edn, ISBN-13 : 978-1478607830, 2005, 2. D.M. Harris and S.L. Harris. Digital Design and Computer Architecture, 2 nd Edn Morgan Kaufmann, ISBN-13 : 978-0123944245, 2012.						

ANNEXURE E-II-D

Curriculum for M.Tech. CSE in DS-AI 2021 Batch

Semester 1					
Category	Course Name	L	T	P	C
PCC	Mathematical Foundations of Computer Science	3	1	0	4
PCC	Advanced Data Structures and Algorithms	3	1	0	4
PCC	Analytics and Systems of Big Data	3	1	0	4
ELC	Elective 1	3	1	0	4
ELC	Elective 2	3	1	0	4
PCC	Analytics and Systems of Big Data Practice	0	0	4	2
PCC	Advanced Data Structures and Algorithms Practice	0	0	4	2
					24.0
Semester 2					
Category	Course Name	L	T	P	C
ELC	Elective 2	3	1	0	4
ELC	Elective 3	3	1	0	4
ELC	Elective 4	3	1	0	4
ELC	Elective 5	3	1	0	4
ELC	Elective 6	3	1	0	4
					20.0
Summer					
Category	Course Name	L	T	P	C
PCD	Project I	0	0	20	10
					10.0
Semester 3					
Category	Course Name	L	T	P	C
PCD	Project II	0	0	32	16
					16.0
Semester 4					
Category	Course Name	L	T	P	C
PCD	Project III	0	0	32	16
					16.0

Semester wise Credit Distribution	Credits						
Category	S1	S2	Summer	S3	S4	Total	%
Professional Core Course (PCC)	16	0	0	0	0	16	18.6
Elective Course (ELC)	8	20	0	0	0	28	32.6
Professional Career Development (PCD)	0	0	10	16	16	42	48.8
Total	24.0	20.0	10.0	16.0	16.0	86.0	100.0
	24.0	44.0	54.0	70.0	86.0		

ANNEXURE E-II-D

Curriculum for M.Tech. CSE in DS-AI 2021 Batch

<table>
<tr><td>Course Title</td><td>Mathematical Foundations of Computer Science</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>M.Tech CSE</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">____ Senate</td></tr>
<tr><td>Prerequisite</td><td>Discrete Mathematics</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To learn to reason out logical arguments, proving logical arguments and identifying inconsistencies in arguments. To introduce proof techniques and study mathematical/algebraic structures.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">● Ability to understand and appreciate the power of mathematics in computing.
● The importance of mathematical abstraction in solving computational problems that arise in various domains.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Logic : Propositional Logic, Predicate and First order Logic, Second Order Logic, Monadic Second Order Logic. (7L, 2T)

Proof Techniques: Discussion on proof techniques for problems that arise in CS. Proof by contradiction, Mathematical Induction, Loop in-variants in proving correctness of algorithms, Pigeon hole principle and its applications in Ramsey theorem, design of fault-tolerant networks, Principle of inclusion and exclusion, derangements, counting onto functions. (10L, 3T)

Introduction to algebraic structures; groups, subgroups, posets, lattices, fields, vector spaces, eigen values/vectors, Orthogonality : Inner Product, Orthogonality, Gram-Schmidt Orthogonalization, Vector and Matrix Norms (12L, 3T)

Counting sets, countable and uncountable sets, the role of graph theory in computing; bipartite graphs, planar graphs, matching, coloring. Modelling CS case studies as graph theoretic problems (10L, 3T)

Introduction to Probability - Random variables, Distribution - Conditional, Joint probability distributions (6L, 2T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. D. F. Stanat and D. F. McAllister, “Discrete Mathematics in Computer Science,” Prentice Hall, 1977, ISBN 13: 9780132161503
2. Linear Algebra and Its Applications - Gilbert Strang- Fourth Edition- Cengage Learning, 2006, ISBN-10; 0030105676</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. K. H. Rosen, “Discrete Mathematics and its Applications,” McGraw Hill, 6 th Edition, 2007, ISBN: 9780070648241
2. R. L. Graham, D. E. Knuth, and O. Patashnik, “Concrete Mathematics,” Addison Wesley, 1994, ISBN o-201-14236-8
3. Busby, Kolman, and Ross, “Discrete Mathematical Structures,” PHI, 6 th Edition, 2008. ISBN 13: 9780132154185
4. C. L. Liu, “Elements of Discrete Mathematics,” Tata McGraw Hill, 1995. ISBN 81 – 7808 – 279 - 9</td></tr>
</table>

Course Title	**Advanced Data Structures and Algorithms**	Course No					
Department/ Specialization	Computer Science and Engineering	Credits	L	T	P	C	
			3	1	0	4	
Faculty proposing the course	Faculty, CSE	Status	Core	■	Elective	□	
Offered for	M.Tech CSE	Type	New	■	Revision	□	
To take effect from	March 2021	Submitted for approval	____ Senate				
Prerequisite	Discrete Mathematics, Data structures and algorithms						
Learning Objectives	To introduce mathematical models, advanced data structures and algorithm design strategies. To introduce various analysis in the design of algorithms						
Learning Outcomes	• The ability to design and analyze algorithms for computational problems that arise in CS. • To understand and appreciate the notion of solvability and unsolvability. • The ability to gauge easy vs hard instances of a computational problem.						
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Mathematical Models and Encoding: Mathematical models - Turing Machine, Random Access Machine along with their input encoding/representation. The notion input size/magnitude, time/space complexity analysis in terms of input size. Introduction to asymptotic analysis. (5L,2T) Recursive vs Iterative Algorithms, Recurrence relations, solving recurrence relations - guess method, substitution method (review). The recurrence tree method, Proof of Master theorem, Solving recurrence relations using characteristic equation method. The number of binary search trees, Catalan number (5L,2T) Advanced data structures; Min-Max Heap, Deap, leftist trees, Symmetric Heaps - design and analysis of algorithms for basic operations. Applications. (7L,2T) Introduction to probabilistic analysis; Average Case analysis of search, sorting problems. Lower bound theory arguments for search and sorting problems. Order Statistics and its applications (5L,2T) Introduction to amortized analysis; potential function method. Binomial-Heaps and Fibonacci Heaps, Splay trees, dynamic tables (7L,2T) Algorithm design; Case studies following greedy algorithms and dynamic programming. Introduction to graph algorithms - application of BFS/DFS, topological sorting, strongly connected components. Proof of correctness of greedy algorithms (7L,2T) Introduction to NP-completeness, NP, NP-Hardness result of well-known problems (6)						
Essential Reading	1. T. H. Cormen, C. E. Leiserson, and R. L. Rivest, “Introduction to Algorithms,” Prentice Hall India, 2 nd Edition, 2001. **ISBN** 978-0-262-53305-8 2. E. Horowitz, S. Sahni, and S. Rajasekaran, “Computer Algorithms,” 2 nd Edition, Galgotia Publications, 2007. **ISBN** 0-7167-8316-9						
Supplementary Reading	1. Aho, Hopcroft, and Ullmann, “Data Structures & Algorithms,” Addison Wesley, 1983. ISBN13: 9780201000238 2. Algorithm Design , Eva Tardos and Kleinberg, Pearson, 2006, ISBN-13 : 978-0321295354						

<table>
<tr><td>Course Title</td><td>Advanced Data Structures and Algorithms Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>M.Tech CSE</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">_____ Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To design time or space efficient algorithms using well known paradigms. To get practical exposure on design and analysis of algorithms</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">● Students are expected to design efficient algorithms using paradigms such as divide and conquer, dynamic programming, greedy method etc.
● To be able to implement advanced data structures and revisit classical algorithms using these data structures</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">The laboratory component will require the student to write computer programs using a careful choice of data structures and algorithmic paradigms (in C++/Java language) from scratch, based on the concepts learnt in the theory course.

Case studies in respect of different paradigms discussed in theory shall be implemented in C++/Java

Paradigms – Divide and conquer, dynamic programming, greedy, backtracking. Order Statistics, Probabilistic Algorithms</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. T. H. Cormen, C. E. Leiserson, and R. L. Rivest, “Introduction to Algorithms,” Prentice Hall India, 2 nd Edition, 2001. ISBN 978-0-262-53305-8
2. E. Horowitz, S. Sahni, and S. Rajasekaran, “Computer Algorithms,” 2 nd Edition, Galgotia Publications, 2007. ISBN 0-7167-8316-9</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Aho, Hopcroft, and Ullmann, “Data Structures & Algorithms,” Addison Wesley, 1983. ISBN13: 9780201000238
2. Algorithm Design , Eva Tardos and Kleinberg, Pearson, 2006, ISBN-13 : 978-0321295354</td></tr>
</table>

ANNEXURE E-II-D

Curriculum for M.Tech. CSE in DS-AI 2021 Batch

Course Title	**Analytics & Systems of Big Data**	Course No				
Department/ Specialization	Computer Science and Engineering	Credits	L	T	P	C
			3	1	0	4
Faculty proposing the course	Faculty, CSE	Status	Core	■	Elective	□
Offered for	M.Tech CSE	Type	New	■	Revision	□
To take effect from	March 2021	Submitted for approval	____ Senate			
Prerequisite	Database Systems, DSA					
Learning Objectives	The course intends to expose computer engineering students to recent advances in storage and analytics involved with big data. Topics related to Mapreduce, globally distributed storage systems and analytics such as feature extraction, learning, similarity, etc. are dealt with to expose the students to current trends in data storage & analytics.					
Learning Outcomes	• The course shall equip students with required storage mechanisms / analytics algorithms for large distributed data intensive applications • Ability to understand, visualize and perform analytics of huge data • Ability to design and test drive big data and descriptive cum predictive analytics solutions for real life scenarios.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Descriptive Statistics – Data Visualization & Interpretation – Data Preprocessing Techniques – Dimensionality Reduction Techniques - Inferential Statistics [9L, 2T] Predictive Analytics –Supervised v/s Unsupervised Learning - Basic algorithms for Association Rules, Data Classification, Clustering, Prediction, Outlier Analysis - Measures of Performance / Interestingness as applicable to each predictive analytics technique - domain specific feature extraction, similarity measures, Recent advances in Data Mining such as closed, maximal itemsets, bucket brigade classifiers, clustering paradigms [12L, 4T] Mapreduce abstraction, Cluster and Data center network, Distributed Storage, Data deduplication storage systems, Venti and DDFS - Shingles and minhashing, locality sensitive hashing - Clustering in high dimensional space[10L, 2T] Mining Data Streams - Stream Data Model – Sampling Data in the Stream – Filtering Streams – Counting Distance Elements in a Stream Web link analysis [11L, 3T]					
Essential Reading	1. Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, Second Edition, 2014, ISBN 978-1316638491					
Supplementary Reading	2. J Han, M Kamber, Data Mining Concepts & Techniques, Elsevier, 3rd Edition, 2007, ISBN: 9780123814791 3. Raj Kamal, Big Data Analytics, Introduction to Hadoop, Spark, and Machine-Learning, McGraw Hill, 2019, ISBN 9789353164973 4. www.cs.princeton.edu/courses/archive/spring13/cos598C/index.html - Princeton University Course Webpage.					

Course Title	**Analytics & Systems of Big Data Practice**	Course No	
Department/ Specialization	Computer Science and Engineering	Credits	L: 0, T: 0, P: 4, C: 2
Faculty proposing the course	Faculty, CSE	Status	Core ■ Elective □
Offered for	M.Tech CSE	Type	New ■ Revision □
To take effect from	March 2021	Submitted for approval	____ Senate
Prerequisite	Database Systems, DSA		
Learning Objectives	The course intends to expose computer engineering students to recent advances in storage and analytics involved with big data. Topics related to Mapreduce, globally distributed storage systems and analytics such as feature extraction, learning, similarity, etc. are dealt with to expose the students to current trends in data storage & analytics.		
Learning Outcomes	• Ability to understand, visualize and perform analytics of huge data • Ability to design and test drive big data and descriptive cum predictive analytics solutions for real life scenarios. • Handle and Design Live and Big Data to support analytics solutions		
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Exercises using R / Python on Descriptive Statistics, Predictive Analytics - association rule mining, classification, clustering where in various existing algorithms are tested over benchmark datasets – Exercises on Map Reduce Frame work – Hadoop / Pyspark - Selected algorithms of Predictive analytics using Map Reduce Framework for Big Data - Similarity Measures – LSH Implementation – Link Analysis - Page Rank computation		
Essential Reading	1. Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, Second Edition, 2014, SBN 978-1316638491		
Supplementary Reading	2. J Han, M Kamber, Data Mining Concepts & Techniques, Elsevier, 3rd Edition, 2007, ISBN: 9780123814791 3. Raj Kamal, Big Data Analytics, Introduction to Hadoop, Spark, and Machine-Learning, McGraw Hill, 2019, ISBN 9789353164973 4. www.cs.princeton.edu/courses/archive/spring13/cos598C/index.html - Princeton University Course Webpage.		

ANNEXURE E-III-A

Curriculum for B.Tech. ECE 2020 Batch

Semester 1					
Category	Course Name	L	T	P	C
BSC	Calculus	3	1	0	4
BSC	Engineering Electromagnetics	3	0	0	3
BEC	Electrical Circuits for Engineers	3	1	0	4
BEC	Problem Solving and Programming	3	0	0	3
BEC	Materials for Engineers	3	0	0	3
DSC	Foundation for Engineering and Product Design	1	2	0	3
BSC	Engineering Electromagnetics Practice	0	0	3	1.5
BEC	Problem Solving and Programming Practice	0	0	3	1.5
HSC	Effective Language and Communication Skills	1	0	2	2
HSC	NSO/NCC/SSG/NSS	0	0	2	P/F
					25.0
Semester 2					
Category	Course Name	L	T	P	C
BSC	Differential Equations	3	1	0	4
SEC	Science Elective 1	3	1	0	4
BEC	Engineering Graphics	2	0	4	4
ITC	Elementary Data Structures and Logical Thinking	3	0	0	3
DSC	Sociology of Design	1	2	0	3
ITC	Design and Manufacturing Lab	0	0	2	1
PCC	Digital Circuits	3	1	0	4
ITC	Elementary Data Structures and Logical Thinking Practice	0	0	4	2
HSC	NSO/NCC/SSG/NSS	0	0	2	P/F
HSC	Earth, Environment and Design	1	0	0	P/F
					25.0
Semester 3					
Category	Course Name	L	T	P	C
SEC	Science Elective 2	3	1	0	4
DSC	Systems Thinking for Design	1	2	0	3
PCC	Solid State Electronic Devices	3	1	0	4
PCC	Network Theory	3	1	0	4
PCC	Signals and Systems	3	1	0	4
PCC	Microprocessors and Microcontrollers	2	0	3	3.5
PCC	Digital Circuits Practice	0	0	3	1.5
HSC	Indian Constitution, Essence of Indian Traditional Knowledge	1	0	0	P/F
					24.0
Semester 4					
Category	Course Name	L	T	P	C
SEC	Science Elective 3	3	1	0	4
DSC	Smart Product Design	1	2	0	3
PCC	Digital Signal Processing	3	1	0	4
PCC	Electromagnetic Waves	3	1	0	4
PCC	Analog Circuits	3	1	0	4
PCC	Sensing and Instrumentation Practice	1	0	3	2.5
PCC	Embedded Systems Practice	1	0	3	2.5
HSC	Human Values and Stress Management	1	0	0	P / F
					24.0

ANNEXURE E-III-A

Curriculum for B.Tech. ECE 2020 Batch

Semester 5					
Category	Course Name	L	T	P	C
ITC	Data Science: An Applied Perspective	3	0	2	4
DSC	Entrepreneurship and Management Functions	1	2	0	3
PCC	Control Systems	3	1	0	4
PCC	Communication Systems	3	1	0	4
PEC	Professional Elective 1	3	1	0	4
PCC	Digital Signal Processing Practice	0	0	3	1.5
PCC	Analog Circuits Practice	0	0	3	1.5
HSC	Professional Ethics and Organizational Behaviour	1	0	0	P/F
					22.0
Semester 6					
DSC	Prototyping and Testing	1	2	0	3
PCC	Digital Communication	3	1	0	4
PEC	Professional Elective 2	3	1	0	4
ELC	Elective 1	3	1	0	4
ELC	Elective 2	3	1	0	4
PCC	Communication Systems Practice	0	0	2	1
HSC	Professional Communication	1	0	2	2
HSC	Intellectual Property Rights	1	0	0	P/F
					22.0
Summer					
PCD	Internship				P/F
Semester 7					
ELC	Elective 3	3	1	0	4
ELC	Elective 4	3	1	0	4
ELC	Elective 5	3	1	0	4
					12.0
Semester 8					
ELC	Elective 6	3	1	0	4
PCD	Project	0	0	16	8
					12.0

Semester wise Credit Distribution	Credits									
Category	S1	S2	S3	S4	S5	S6	S7	S8	Total	%
Basic Science Course (BSC)	8.5	4	0	0	0	0	0	0	12.5	7.5
Science Elective Course (SEC)	0	4	4	4	0	0	0	0	12	7.2
Basic Engineering Course (BEC)	11.5	4	0	0	0	0	0	0	15.5	9.3
Design Course (DSC)	3	3	3	3	3	3	0	0	18	10.8
IT Skill Course (ITC)	0	6	0	0	4	0	0	0	10	6.0
Professional Core Course (PCC)	0	4	17	17	11	5	0	0	54	32.5
Professional Elective Course (PEC)	0	0	0	0	4	4	0	0	8	4.8
Elective Course (ELC)	0	0	0	0	0	8	12	4	24	14.5
Humanities and Social Science Course (HSC)	2	0	0	0	0	2	0	0	4	2.4
Professional Career Development (PCD)	0	0	0	0	0	0	0	8	8	4.8
Total	25	25	24	24	22	22	12	12	166	100
	25	50	74	98	120	142	154	166	166	

ANNEXURE E-III-A

Curriculum for B.Tech. ECE 2020 Batch

<table>
<tr><td>Course Title</td><td>Solid State Electronic Devices</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The course is an introduction to semiconductor fundamentals and applications to the electronic devices. Students will understand the internal workings of the most basic solid state electronic devices. Course creates the background in semiconductor-based electronic devices and also prepares students for advanced courses in nano- and quantum electronics.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students would be able to
• Understand and explain the fundamental principles of modern semiconductor devices.
• Understand and describe the impact of semiconductor device capabilities and limitations on electronic circuit performance.
• Develop semiconductor devices based sensors.
• Design FET based circuits and devices.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Solid state devices – History and its relevance in the modern world. formation of energy bands in semiconductors, Density of states and Fermi level. (L3+T1)
• Charge carriers in Semiconductors- Equilibrium Carrier concentration, Recombination and Generation of carriers, Carrier transport – Drift, Diffusion and their modelling in MATLAB. (L9+T2)
• pn junction – derivation of dc and ac characteristics, Forward and reverse biasing, Static analysis, Breakdown processes; Transient analysis, metal semiconductor junction. Modelling of p-n junction. (L9+T3)
• Bipolar junction transistors– Fundamentals and characteristics, biasing, switching, Modelling of BJT. (L4+T1)
• Field Effect Transistors (JEFT, MESFET, MOSFET, HEMT), MOS capacitor, MOSFET – device physics, operation, characteristics and modelling. (L10+T3)
• Optoelectronic Devices- Fundamentals of Photodiodes, Light emitting devices, Semiconductor LASERs, Solar cells, CCDs along with Nanoelectronic devices. (L6+T1)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Robert Pierret, Semiconductor Device Fundamentals ,1st Edition, Pearson Education, ISBN:9788177589771, 2006.
2. B. G. Streetman and S. K. Banerjee, Solid State Electronic Devices, 7th Edition, Pearson, ISBN: 9780133356038, 2015.
3. Neamen, Donald A., Semiconductor Physics and Devices: Basic Principles, 4th Edition, NY: McGraw-Hill, ISBN:978-0-07-352958-5, 2012.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. S. M. Sze., K. K. Ng, Physics of Semiconductor Devices, 3rd Edition, United Kingdom, Wiley, ISBN: 978-0471143239, 2021.
2. M. S. Tyagi, Introduction to Semiconductor Materials and Devices, 1st Edition, John Wiley, ISBN: 9788126518678, 2008.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Network Theory</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To build capability in students to analyze and solve problems related networks.
• To build capability in students to design networks and circuits for different applications.
• To introduce network related concepts which can be directly related to industry applications.
• To introduce network related concepts which can be directly related to research applications.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students will be able to
• Analyse and solve problems related to networks.
• Design networks and circuits for different applications.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Network topology and graph concepts (4L + 1T)
• Network theorems using dependent sources, Tellegen's theorem (5L+3T)
• Linearity, time invariance and causality; Time-domain representation and analysis of LTI systems (3L+1T)
• Laplace transforms, Poles and Zeros, Impulse and Step response, Solution of RL, RC and RLC Circuits for Step Input and Sinusoidal Excitations using Laplace Transform method; Resonance (14L+4T)
• Coupled circuits (6L+2T)
• Two-port networks, z, y, h and transmission parameters, cascading; Network functions (10L+3T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. DeCarlo R. and Lin P., Linear Circuit Analysis: Time Domain, Phasor, and Laplace Transform Approaches, 2nd edition, Oxford University press, ISBN: 978-0195136661, 2001.
2. Van Valkenburg, Network Analysis, 3rd Edition, Pearson, ISBN: 9789353433123, 2019
3. Seshu and Balabanian, Linear Network Analysis, 1st edition, John Wiley & Sons, 1959.
4. Sudhakar A. and Shyammohan S. Pillai, Circuits and Networks Analysis and Synthesis, 5th Edition,McGraw Hill, New Delhi, ISBN:9339219604, 2017.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Alexander C. and Sadiku M. N. O., Fundamentals of Electric Circuits , 7th Edition, Tata McGraw Hill, New Delhi, ISBN: 9781260226409, 2013.
2. W. H. Hayt and T. E. Kimmerley, Engineering Circuit Analysis, 9th Edition , TMH, ISBN: 9780073545516, 2019.
3. Smarajit Ghosh, Network Theory Analysis and Synthesis, 8th Edition ,Prentice Hall of India, New Delhi, ISBN:9332511040,2011.</td></tr>
</table>

Course Title	**Signals and Systems**	Course No	
Department/ Specialization	Electronics & Communication Engineering	Credits	L: 3, T: 1, P: 0, C: 4
Faculty proposing the course	Faculty, Department of ECE	Status	Core ■ Elective □
Offered for	B.Tech	Type	New ■ Revision □
To take effect from	July 2021	Submitted for approval	44th Senate
Prerequisite	Nil		
Learning Objectives	The key objectives of this course are to understand the fundamentals characteristics of signals and systems, mathematical skills to solve the operations like convolution, correlation, sampling, etc.		
Learning Outcomes	At the end of the course, the students would be able to ● Represent continuous time and discrete time signals mathematically ● Classify systems based on their properties and determine the response of LTI system using convolution. ● Analyse the characteristics of continuous-time signals in frequency domain using Fourier series and Fourier transform. ● Apply the Laplace transform for analysing continuous-time systems.		
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	**Signals**: Signal classification, standard signals, transformations of the independent variable . Discrete functions and properties. Discrete unit step and impulse signals and their properties. (L8+T3) **Systems**: System classifications, Continuous and discrete time convolution, System properties via impulse response. (L6+T2) **Fourier series**: Fourier series representation of continuous-time periodic signals, Convergence, Properties, Fourier series and LTI systems, Filtering, Examples of continuous-time filters described by differential equations (L9+T3) **Fourier Transform**: Representation of aperiodic signals, Properties of the continuous-time Fourier transform, Convolution/multiplication property and their effect in the frequency domain, magnitude and phase response. (L8+T3) **Laplace Transform**: Introduction to Laplace transform; region of convergence. Inverse Laplace transform. Properties of Laplace transforms, initial/final value theorems. Laplace transforms and LTI systems, causality/stability. Laplace transforms and block system diagrams. (L9+T2) **Sampling theorem**: Introduction to the sampling theorem and its implications (L2+T1)		
Essential Reading	1. Oppenheim, Willsky and Nawab, Principles of Linear Systems and Signals, 2nd Edition, Pearson, ISBN: 9788120312463, 1997. 2. B P Lathi, Principles of Linear Signals and Systems, 2nd edition, ISBN: 978-0198062271, 2009.		
Supplementary Reading	1. S. S. Soliman & M.D. Srinath, Continuous and Discrete Signals and Systems, 2nd Edition,Prentice- Hall, ISBN:0-13-774308-4,1990.		

<table>
<tr><td>Course Title</td><td>Microprocessors and Microcontrollers Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>3</td><td>3.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The goal of this course is to help the students have thorough understanding with the programming and usage of microprocessors and microcontrollers so as to build simple systems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, students would be able to:
• program and use microprocessor 8086 for real time applications
• Interface ARM controller with external devices</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Intel 8086 Microprocessor: Introduction, Internal architecture, Hardware description, Segmentation, Instruction set, Addressing modes, Assembly Language Programming, Interfacing with Programmable Peripheral Interface. (18)
• ARM Microcontroller: Architecture, Hardware description, Register and Memory organization, Structure and interrupt priorities, Interfacing with external devices. (10)

Practice includes experiments from following topics:

• Programming with 8086 and ARM processors

Arithmetic operations, Sorting, Operations on Matrices and String, Number conversion, Interfacing-LED, LCD, Stepper motor and 7-segment display</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Kenneth J. Ayala, The 8086 Microprocessor: Programming and Interfacing The PC, 1st Edition, Delmar Publishers, ISBN: 9780314012425, 2007.
2. J. W. Valavno, Embedded Systems: Introduction to Arm® Cortex(TM)-M Microcontrollers, 5th Edition, Create Space, ISBN: 978-1477508992, 2012.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. A. K. Ray, K. M. Bhurchandi, Advanced Microprocessors and Peripherals, 3rd Edition, Tata McGraw Hill, ISBN:007014022, 2007.
2. A. N. Sloss, D. Symes, C. Wright, ARM System Developer's Guide,1st Edition, Morgan Kaufmann,ISBN:9781493303748, 2004.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Digital Circuits Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Course Objectives</td><td colspan="6">● The goal of this course is to provide a hands on experience in design and implementation of digital circuits and systems.
● This includes formulating the logic for a given problem, minimizing or optimizing the logic using different approaches and realizing it using gates and other digital ICs. This is done in three phases: Spice simulation of circuit, experimental verification and Verilog/VHDL implementation</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">The course would equip the students to
● Understand digital circuits
● Design Combinational circuits
● Design sequential circuits
● Formulate logic and design circuits for practical problems</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">● HDL implementation and digital design flow practice
● Formulating Boolean expressions and truth tables from practical statements,Designing logic diagrams, simplifying using k-map, designing NAND-NAND & NOR-NOR diagrams & verifying the same by simulation and experiment.
● Combinational Circuits: Code Converters, Arithmetic Circuits, Mux/Demux,Encoder/Decoder, Comparators etc
● Sequential circuits including flip flops, shift registers, counters, sequence generators etc.
● Simple design examples with Moore and Mealy machines
● Digital implementation of practical problems with HDL</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. R. J. Tocci, N. S.Widmer, and G. L.Moss Digital Systems Principles and applications, 12th Edition, Pearson Prentice Hall Edition ISBN : 9780134220215, 2017.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. V.A.Pedroni, Digital Electronics and Design with VHDL, 2nd Edition, Denise E.M. Penrose, ISBN 97801237042704. 2008.
2. Taub and Schilling, Digital Principles and Applications, 7th Edition, TMH, ISBN: 978-0-07-014170-4., 2011.
3. J. F. Wakerly, Digital Design- Principles and Practices, 4th Edition, Pearson, ISBN: 9780131863897, 2006.
4. M. Morris. Mano, Digital Design, 5th Edition , Pearson, ISBN : 9780132774208, 2013.
5. M. Morris.Mano, Digital Design With an Introduction to the Verilog HDL, VHDL, and System Verilog, 6th Edition, Pearson, ISBN : 9780134549903, 2018.
6. T. L. Floyd and R. P. Jain, Digital Fundamentals, 10th Edition, Pearson, ISBN: 978-8131734483, 2017.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Digital Signal Processing</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>Jan 2022</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Signals and Systems</td></tr>
<tr><td>Course Objectives</td><td colspan="6">The primary goal of this course is to introduce discrete-time signals and systems: their analysis and characterizations. This course is a foundation for various other courses such as Analog and Digital Filters, Digital Communications, Control theory, Image processing, Power spectral estimations, etc.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">At the end of the course, the students are expected to
• Understand various properties of discrete-time signals
• Analyze discrete time LTI systems, and their impulse responses
• Synthesize discrete signals from analog signals
• Reconstruct analog signals from discrete signals
• Analyze systems commonly used in Communications, Control, and Signal Processing</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Review of Signals and Systems: Basic signals, system properties (linearity, time-invariance,
memory, causality, BIBO stability) (L3+T2)
• Discrete-time Signals and Systems: Discrete-time signals, discrete-time systems, LTI systems, Linear constant-coefficient difference equations (LCCDE), Frequency domain representation of discrete-time signals and systems, Fourier Series, Fourier transforms, properties of Fourier transform (L12+T3)
• Transform Analysis of Linear Time Invariant Systems: The frequency response of LTI systems, System functions for systems characterized by LCCDE (L3+T1)
• Discrete-time Fourier Transform: Introduction to DTFT, Properties (L3+T1)
• Sampling Theorem: Periodic sampling, Frequency domain representation of sampling, Reconstruction of bandlimited signals from its samples (L3+T1)
• Discrete Fourier Transform: Introduction to DFT, Properties of DFT, Linear convolution using the DFT, Fast Fourier Transform, DIT and DIF algorithms (L10+T4)
• The Z-transform: Introduction, Properties of z- transform, inverse z-transform (L8+T2)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. A.V. Oppenheim, R.W. Schafer, and J. R. Buck, Discrete-Time Signal Processing, 3rd Edition, Pearson Education , ISBN: 9780132158176, 2010.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. S. K. Mitra, Digital Signal Processing: A Computer-Based Approach, 4th Edition, Tata Mcgraw Hill Publication, ISBN: 9781259098581 , 2013.
2. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles,Algorithms and Applications, Fourth edition, Pearson,ISBN 9780132341998, 2007.</td></tr>
</table>

Course Title	**Electromagnetic Waves**	Course No				
Department/ Specialization	Electronics & Communication Engineering	Credits	L	T	P	C
			3	1	0	4
Faculty proposing the course	Faculty, Department of ECE	Status	Core ■		Elective □	
Offered for	B.Tech	Type	New ■		Revision □	
To take effect from	Jan 2022	Submitted for approval	44th Senate			
Prerequisite	Engineering Electromagnetics					
Course Objectives	This course is designed to be an application oriented course in Electromagnetics for Communication Engineers. This should serve as a bridge course between a first level Electromagnetics course and advanced level courses such as Antenna Theory and Design, Computational Electromagnetics etc.					
Course Outcomes	At the end of the course, the learners are expected to do the following: • Analyze the propagation of uniform plane electromagnetic waves in free space, unbounded media and at interfaces • Determine the characteristics of electromagnetic waves in bounded media • Apply the electromagnetic wave theory to transmission lines, antennas and guided wave communication					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Transmission Lines – Concept of Distributed elements – Transmission line parameters and equations – Line terminated by an arbitrary load - Impedance transformation – Transmission line matching – Transmission line discontinuities - Transients on Transmission Lines (L10+T3) • EM waves - Review of Maxwell's equations - Wave equation and uniform plane-wave solution – Polarization – Power flow and Poynting vector (L5+T2) • EM Wave propagation in unbounded media – dielectrics and conductors - Skin effect - Plane wave at media interface – Boundary conditions - normal and oblique incidence (L10+T3) • EM Wave propagation in bounded media - Parallel plane waveguide - TEM mode - Rectangular waveguides – Dispersion and attenuation – TE and TM modes – Surface current and attenuation - Cavity Resonators - Dielectric waveguides (L9+T3) • Antennas and Electromagnetic Radiation – Potential functions - Hertzian dipole – Fundamental antenna parameters – Dipole and Monopole antennas - Antenna arrays (L8+T3)					
Essential Reading	1. R K Shevgaonkar, Electromagnetic Waves, 1ST Edition, Tata McGraw Hill, ISBN: 9780070591165, 2006. 2. C. A. Balanis, Antenna Theory and Design, 3rd Edition, John Wiley & Sons, ISBN-047166782X, 2005.					
Supplementary Reading	1. David K. Cheng, Field and Wave Electromagnetics, 2nd Edition, Pearson Education, ISBN: 9781292026565 2014. 2. Nannapaneni Narayana Rao, Elements of Engineering Electromagnetics, 6th Edition, Pearson Education, ISBN: 978 0131139619, 2013. 3. Fawwaz T. Ulaby Eric Michielssen and Umberto Ravaioli, Fundamentals of Applied Electromagnetics, 7th Edition, Pearson Education, ISBN: 9781292082486, 2015. 4. David. M. Pozar, Microwave Engineering, 4th Edition, John Wiley, ISBN: 9781118298138, 2011. 5. J. D. Kraus and R. J. Marhefka, Antennas for All Applications, 3rd Edition, Tata McGraw Hill,ISBN: 978-0071122405 , 2002.					

ANNEXURE E-III-A

Curriculum for B.Tech. ECE 2020 Batch

Course Title	**Analog Circuits**	Course No				
Department/ Specialization	Electronics & Communication Engineering	Credits	L: 3	T: 1	P: 0	C: 4
Faculty proposing the course	Faculty, Department of ECE	Status	Core ■		Elective □	
Offered for	B.Tech	Type	New □		Revision ■	
To take effect from	Jan 2022	Submitted for approval	44th Senate			
Prerequisite	Nil					
Course Objectives	• This course introduces how to build amplifiers using transistors • How to realize different controlled sources using same transistor • Frequency compensation techniques to stabilize higher order systems • How to build an opamp and use it for applications with negative and positive feedback					
Course Outcomes	• Students should be able to identify the biasing arrangements and amplifier configurations in transistor circuits • Perform dominant-pole compensation for higher order amplifiers and stabilize them • Build analog systems with opamp and other components for different applications					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Analysis of circuits with nonlinear elements, incremental analysis, ideal and real MOSFET for amplification (L2+T1) • Synthesis of Common Source Amplifier: biasing, AC coupling, swing limits, negative feedback biasing, bias stabilization for NMOS and PMOS (L7+T2) • MOSFET based VCVS, VCCS, CCCS, CCVS with NMOS and PMOS (L5+T2) • Frequency Response of Amplifiers (L3+T1) • Differential Circuits: differential pair, active load, small and large signal analysis, CM and DM, 1-stage and 2-stage opamp (L7+T2) • Miller compensation, Stability, frequency compensation (L6+T2) • Opamp circuits with negative feedback: Arithmetic, linear and nonlinear, Filters (L6+T2) • Opamp circuits with positive feedback: Sinusoidal oscillators, Comparators, Schmitt Trigger, Multi-vibrators (L6+T2)					
Essential Reading	1. Behzad Razavi, Fundamentals of Microelectronics, 2nd Edition, Wiley, ISBN 9781119695141, 2021. 2. Sergio Franco, Design With Operational Amplifiers And Analog Integrated Circuits, 4th Edition, McGraw Hill, ISBN: 9789352601943, 2016.					
Supplementary Reading	1. Adel S. Sedra, Kenneth C. Smith & Arun N. Chandorkar, Microelectronic Circuits, Theory and Application, 7th Edition, Oxford University Press, ISBN 9780199476299, 2017. 2. Donald A. Neamen, Electronic Circuits: Analysis And Design, 4th Edition, McGraw Hill, ISBN : 9780073380643, 2010.					

ANNEXURE E-III-A

Curriculum for B.Tech. ECE 2020 Batch

<table>
<tr><td>Course Title</td><td>Sensing and Instrumentation Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>1</td><td>0</td><td>3</td><td>2.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>Jan 2022</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To familiarize the students with different sensors and their signal conditioning circuits required for different applications.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">By the end of the course, the students would be able to
• build systems which would sense the different physical signals
• process the signals in the required analog or digital formats.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Transducers, transducer sensing and functions, Passive and active – Resistance, inductance and capacitance, Strain Gauges, Hall Effect sensors, Optical sensors
• Measurement of non-electrical quantities such as displacement/velocity/ acceleration, pressure, force, flow and temperature
• Calibration of sensors, Data acquisition and detection techniques, Signal conversion,
• PC-based Instrumentation Systems
Practice includes experiments from following topics:
• Signal generation, Instrumentation amplifiers, Signal conversion and processing, Characteristics of Transducers, Calibration of sensors, Measurement of physical quantities.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Alan S. Morris, Measurement and Instrumentation Principles, 3rd Edition, Elsevier, ISBN-9780080496481, 2001.
2. A. K. Sawhney, Course in Electrical & Electronics Measurement & Instrumentation, Dhanpat Rai, 2012.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Bruce Mihura, LabVIEW for Data Acquisition (National Instruments Virtual Instrumentation Series), Prentice Hall, ISBN: 9780130153623, 2001.
2. Howard Austerlitz, Data acquisition techniques using PCs, 2nd edition, Academic Press, ISBN:9780080530253, 2002.</td></tr>
</table>

ANNEXURE E-III-A

Curriculum for B.Tech. ECE 2020 Batch

Course Title	**Embedded Systems Practice**	Course No				
Department/ Specialization	Electronics & Communication Engineering	Credits	L	T	P	C
			1	0	3	2.5
Faculty proposing the course	Faculty, Department of ECE	Status	Core ■		Elective □	
Offered for	B.Tech	Type	New ■		Revision □	
To take effect from	Jan 2022	Submitted for approval	44^{th} Senate			
Prerequisite	Nil					
Learning Objectives	• To familiarize with the design and implementation of different embedded systems with real time applications.					
Learning Outcomes	The course would equip the students to • Design embedded systems using ARM SoC platform • Use RTOS for system design and IoT systems design.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Implementation of embedded systems • TivaLaunchpad and TM4C microcontroller setup and Parallel I/O: LEDs and switches. • Embedded systems design using ARM Cortex, • Hardware-software co-design, • Real-time operating systems in embedded systems					
Essential Reading	1. J. W. Valvano, Embedded Systems: Introduction to Arm® Cortex (TM)-M Microcontrollers, 5^{th} Edition, Create Space, ISBN: 978-1477508992, 2012. 2. A. S. Berger, Embedded Systems Design: An Introduction to Processes, Tools, and Techniques, CMP, ISBN: 1578200733, 2002. 3. J. W. Valvano, Embedded Microcomputer Systems: Real Time Interfacing, 2^{nd} Edition, Create Space, ISBN: 9780534551629, 2006.					
Supplementary Reading	1. J. W. Valvano, Embedded Systems: Real-Time Interfacing to Arm® Cortex (TM)-M Microcontrollers, 2^{nd} Edition, Create Space, ISBN: 9781463590154, 2011. 2. J. W. Valvano, Embedded Systems: Real-Time Operating Systems for Arm Cortex M, 2^{nd} Edition, Create Space, ISBN: 9781466468863, 2012.					

ANNEXURE E-III-A

Curriculum for B.Tech. ECE 2020 Batch

Course Title	**Data Science –An Applied Perspective**	Course No	
Department/ Specialization	Computer Science and Engineering	Credits	L: 3, T: 0, P: 2, C: 4
Faculty proposing the course	Faculty, Dept. of CSE	Status	Core ■ Elective □
Offered for	B.Tech	Type	New ■ Revision □
To take effect from	July 2021	Submitted for approval	44th Senate
Prerequisite	Nil		
Learning Objectives	This course covers the basic concepts of Data Science to help the student to learn, understand and practice data analytics encompassing concepts from descriptive, inferential statistics and predictive techniques and big data concepts.		
Learning Outcomes	• Ability to identify the characteristics of datasets ; Ability to select and implement machine learning techniques suitable for the respective application ; • Ability to solve problems associated with big data characteristics such as high dimensionality; • Ability to integrate machine learning libraries and mathematical and statistical tools		
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Introduction to relevant industry applications and analytics – Descriptive Statistics – Data Visualization & Interpretation -Measures of Central Tendency & Dispersion - Basic and advanced plots such as Stem-Leaf Plots, Histograms, Pie charts, Box Plots, Violin Plots etc. – Merits of Demerits & Interpretation (10) Inferential Statistics – Hypothesis Testing - Tests of Significance – Analysis of Variance - Regression – Linear and Logistic (8) Predictive Analytics – Supervised and Unsupervised – Association Rules, Classification, Clustering, Outlier Analysis, Time Series Modeling (14) Big Data Characteristics – Map Reduce – Deduplication, Distributed Storage, Implementation using Hadoop / Pyspark platforms (8) **Practice Component:** Concepts from Descriptive Statistics, Inferential and Predictive Analytics would be test driven using platforms such as Python, R etc. ML support in these platforms for rule mining and application, classification & clustering algorithms etc. would also be test driven as part of the practice exercises. Modern technologies for big data handling such as Pyspark – support for Map reduce would also be test driven. Applications relevant to the students stream of specialization would be explored for exercises / course project as case studies. (14 sessions – weekly exercises)		
Essential Reading	1. J Han, M Kamber, Data Mining Concepts & Techniques, Elsevier, 3rd Edition, 2007, ISBN 9780123814791		
Supplementary Reading	1. Joel Grus, Data Science from Scratch, Orielly, 2nd Edn, 2019, ISBN 9781492041139 2. Leskovec, Anand Rajaraman,, Ullmann, Mining of Massive Data Sets, Cambridge University Press, Open Source free version , ISBN 9781107015357 3. P Bruce, Practical Statistics for Data Scientists, O'Reilly, 2017, iSBN 9789352135653		

<table>
<tr><td>Course Title</td><td>Control Systems</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2022</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Preliminary Mathematics</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course develops the fundamentals of feedback control using linear transfer function and state space system models. Topics covered include analysis in time and frequency domains; design in the s-plane and in the frequency domain. Students have to complete an extended design case study.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">This course will teach fundamentals of control design and analysis using state-space methods. By the end of the course, a student should be able to design controllers using classical and modern control methods and evaluate whether these controllers are robust to some types of modeling errors and nonlinearities. They will learn to:
● Design controllers and analyze using classical tools.
● Understand impact of implementation issues (nonlinearity, delay).
● Indicate the robustness of control design.
● Linearize a nonlinear system, and analyze stability</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">● Introduction: Scope of control, Parts of a control system, Multidisciplinary nature, Scope of present course (L2)
● Mathematical modeling of physical systems: Differential equation, Transfer function, and State variable representations; Equivalence between the elements of different types of systems (L6+T2)
● Linear systems and their s-domain representations: Linearity and linearization, Transfer function and its interpretation in terms of impulse and frequency responses, Block-diagram and signal flow graph manipulations. (L8+T3)
● Characterization of systems: Stability - concept and definition, poles, Routh array, internal stability of coupled systems, Time domain response and Frequency domain response; Link between time and frequency domain response features. (L8+T3)
● Closed loop operation - Advantages: Sensitivity, Disturbance and noise reduction, Structured and unstructured plant uncertainties. (L3)
● Analysis of closed loop systems : Stability and relative stability using root-locus approach, Nyquist stability criterion, Steady state errors and system types (L7+T2)
● Compensation techniques: Performance goals, specifications, PID, lag-lead and algebraic approaches for controller design. (L8+T3)
● Case study of a closed loop system to design controller for any system.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. N. S. Nise, Control Systems Engineering, 7th edition, Wiley, ISBN: 978-1-118-17051-9, 2015.
2. Kuo, Golnaraghi:, Automatic Control Systems, 9th Edition, John Wiley, ISBN: 978-8126552337, 2014.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. I. J. Nagrath and M. Gopal, Control System Engineering, 6th edition, New Age International publishers, ISBN : 978-9386070111, 2018.
2. J. J. Distefano, A. R. Stubberud, and I. J. Williams, Control Systems, Schaum's outline Series, 2nd Edition, McGraw Hill, ISBN: 9780071829489, 2014.</td></tr>
</table>

ANNEXURE E-III-A

Curriculum for B.Tech. ECE 2020 Batch

<table>
<tr><td>Course Title</td><td>Communication Systems</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2022</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Signals & Systems</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The objectives of this course are to
• Review the fundamentals of the signal and probability theory
• Introduce various modulation techniques such as AM, FM etc.
• Analyze different parameters of analog communication techniques and study the superheterodyne receiver structure
• Investigate the quantization process in depth and study the pulse modulation techniques</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">After successful completion of the course students will able to
• Recollect the fundamentals and apply those fundamentals in the subject
• Understand the transmitter and receiver structures and operation of the various modulation techniques
• Identify different performance metrics and formula and use them to solve the problems
• Understand the delta modulation and investigate its associated noises</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Basic tools for communication, Fourier Series/Transform, Properties, Autocorrelation, Energy Spectral Density, Parseval’s Relation.(L3+T2)
• Basics of Probability, Random Variables, Random Process, Filtering of random signals through LTI systems. Additive White Gaussian Noise(L5+T3)
• Amplitude Modulation (AM), Double Sideband Suppressed Carrier (DSB-SC), Quadrature Carrier Multiplexing (QCM), Costas Receiver, Single Sideband Modulation (SS), Hilbert Transform, Vestigial Sideband Modulation (VSB), Superheterodyne Receivers(L12+T4)
• Frequency Modulation (FM), Phase Modulation (PM),Spectral Analysis, Carson’s Rule, Narrowband/Wideband FM Generation, Slope detector, Noise in AM/FM systems (L10+T3)
• Review of Sampling concepts, Pulse Amplitude Modulation, Quantization, Uniform/Non-UniformQuantizer, Quantization Noise, Lloyd Max Quantization Algorithm(L8+T2)
• Differential Pulse Code Modulation (DPCM), Delta Modulation(L4+T1)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Simon Haykin, Communication Systems, 4th Edition, John Wiley,ISBN: 9780471178699,2001.
2. B. P. Lathi, Modern Digital and Analog Communication Systems, 3rd Edition, Oxford Univ. press, ISBN: 0195110099, 2006.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. A Bruce Carlson, PB Crilly, JC Rutledge, Communication Systems, 4th Edition, McGraw Hill New York,ISBN: 978-0071210287, 2002.</td></tr>
</table>

ANNEXURE E-III-A

Curriculum for B.Tech. ECE 2020 Batch

<table>
<tr><td>Course Title</td><td>Digital Signal Processing Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B. Tech, ECE</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2022</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Signals and Systems, Digital Signal Processing</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">

The objective of this practice is to provide a hands-on experience in the implementation of signal processing tools.
This begins with basics such as discretizing a signal, transforming it across time and frequency domains, applying Fourier series, Fourier transform, and takes the students through some real time applications etc.
</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">The practice would equip students to

Understand digital signals and analyze them
Implement signal processing tools on various applications
</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">

Basics of MATLAB (Signal Processing Toolbox) and Code Composer Studio
Generation of Basic signals and basic operations
Convolution
Fourier Series
DTFT
Z-transform
Sampling
Applications (Image Processing, Speech Processing, Communication, Control systems etc.)
</td></tr>
<tr><td>Essential Reading</td><td colspan="6">
1. Vinay K. Ingle and John G Proakis, Digital Signal Processing Using MATLAB, 3rd Edition, Cengage Learning, ISBN: 9781111427375, 2012.
2. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Fourth edition, Pearson, ISBN: 9780131873742, 2007.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. A.V. Oppenheim, R.W. Schafer, and J. R. Buck, Discrete-Time Signal Processing, 3rd Edition, Pearson Education, ISBN: 9780131988422, 2010.</td></tr>
</table>

ANNEXURE E-III-A

Curriculum for B.Tech. ECE 2020 Batch

Course Title	**Analog Circuits Practice**	Course No				
Department/ Specialization	Electronics & Communication Engineering	Credits	L	T	P	C
			0	0	3	1.5
Offered for	B.Tech	Status	Core ■		Elective □	
To take effect from	July 2022	Type	New □		Revision ■	
Prerequisite	Nil	Submitted for approval	44th Senate			
Learning Objectives	• To build amplifiers for real world applications • To build simple analog systems using transistors, R, L, C and Opamps • To generate multiple signals using analog circuits and process them suitably for an application					
Learning Outcomes	• Students should be able to build amplifiers for any load and interface • Generate signals, process them using circuits and analyse results • Building substituent blocks and coupling them together to build bigger systems					
Course Contents with approximate breakup of hours for lecture (L)/ tutorial (T) /practice (P)	Diode Circuits (2P), MOSFET Amplifiers (2P), Opamp Circuits (8P), 555 Timer-based circuits (1P) Note: • The lab should include both simulation and hardware. • Simulation could be done in any SPICE software like LT Spice. • Components would be issued to the students one week before; they should build the circuit and come to the lab. • Lab time is to be utilized for applying input, verifying output, trouble shooting, thorough analyses and report submission.					
Essential Reading	1. Behzad Razavi, Fundamentals of Microelectronics, 2nd Edition, Wiley, ISBN: 9781119695141, 2021 2. Sergio Franco, Design With Operational Amplifiers And Analog Integrated Circuits, 4th Edition, McGraw Hill, ISBN: 9789352601943, 2016					
Supplementary Reading	1. Adel S. Sedra, Kenneth C. Smith & Arun N. Chandorkar, Microelectronic Circuits, Theory and Application, 7th Edition, Oxford University Press, ISBN: 9780199476299, 2017 2. Donald A. Neamen, Electronic Circuits: Analysis And Design, 4th Edition, McGraw Hill, ISBN : 9780073380643, 2010					

Course Title	**Digital Communication**	Course No	
Department/ Specialization	Electronics & Communication Engineering	Credits	L: 3, T: 1, P: 0, C: 4
Faculty proposing the course	Faculty, Department of ECE	Status	Core ■ Elective □
Offered for	B.Tech	Type	New ■ Revision □
To take effect from	Jan 2023	Submitted for approval	44th Senate
Prerequisite	Communication Systems		
Learning Objectives	The objectives of this course is to • learn the fundamentals of digital transmissions, noise and line coding techniques • analyze receiver structures and probability of error calculations for various modulation techniques • study the modulator and demodulator blocks of various digital modulation techniques. • introduce the information theory concepts and study channel coding techniques in depth.		
Learning Outcomes	After successful completion of the course students will able to • describe a digital communication system and its performance metrics • understand the receiver structure and derive the BER expressions for various modulation techniques • explain the blocks of the digital modulator/demodulators and also compare their performances • appreciate the significance of information theoretic science in communication theory and learn the different channel coding techniques		
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Basic tools of Digital communication, Line Coding, Transmission Pulse Shaping, Power Spectral Density, Additive White Gaussian Noise (AWGN) (L7+T2) • Optimal Receiver Design, Signal-to-Noise Power Ratio (SNR), Matched Filtering (MF), Maximum Likelihood (ML) and MAP Receiver, general Probability of Error (L8+T2) • Signal Space Theory, Binary Phase Shift Keying and associated Prob. of Error, Amplitude Shift Keying (ASK) , Frequency Shift Keying (FSK) and associated Prob. of Error (L8+T2) • M-ary Phase Shift Keying (MPSK) and associated Prob. of Error, Quadrature Amplitude Modulation (QAM) (L3+T1) • Introduction to Information Theory, Mutual Information, Differential Entropy (DE), Conditional , Joint Conditional DE, Capacity of Gaussian Channel (L6+T3) • Hamming Weight and Distance Properties, Syndrome Decoding, Convolutional Codes: Trellis Structure and Viterbi Decoding (L5+T2) • Pulse Shaping Filter Design, Nyquist Pulse Shaping Criterion, Raised-Cosine Filter, Passband-Baseband Equivalence (L4) • Basics of TDMA, FDMA and CDMA (L2+T2)		
Essential Reading	1. Simon Haykin, Digital Communications, 1st Edition, John Wiley & Sons, ISBN: 9789971512057, 2009. 2. B.Sklar, Digital Communications, 2nd Edition, Pearson Education, ISBN:9780130847881, 2009.		
Supplementary Reading	1. J. G. Proakis, Digital Communications, 5 th edition, McGraw-Hill, ISBN: 978-0072957167, 2014. 2. B. P. Lathi and Z. Ding, Modern Digital and Analog Communication Systems, 4 th edition, Oxford University Press, ISBN: 978-0195331455, 2013.		

<table>
<tr><td>Course Title</td><td>Communication Systems Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>Jan 2023</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Communication Systems</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The primary goal of this course is to have hands on experience with the analog and digital communication systems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">After successful completion of the course students will able to
● analyze different analog and digital modulation schemes
● evaluate the performance of various communication systems
● analyze error probability of various digital communication systems</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">● Analog Modulation: AM, DSB-SC, SSB, FM, white noise analysis
● Digital Modulation: PCM, PAM, MPSK (M=2,4, M), MQAM, MFSK(M=2,4), modulation and demodulation/detection, PSD and BER computation</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. B. P. Lathi and Z. Ding, Modern Digital and Analog Communication Systems, 4th edition, Oxford University Press, ISBN: 978-0195331455, 2013.
2. B.Sklar, Digital Communications, 2nd Edition, Pearson Education, ISBN: 9780130847881,New Delhi, 2009</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. J. G. Proakis, Digital Communications, 5th edition, McGraw-Hill, ISBN: 978-0072957167, 2014
2. Simon Haykin, Digital Communications, 1st Edition, John Wiley & Sons, ISBN: 9789971512057, 2009.</td></tr>
</table>

Course Title	**Professional Communication**	Course No	**HS3001**

ANNEXURE E-III-A

Curriculum for B.Tech. ECE 2020 Batch

<table>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">English</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>1</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Faculty proposing the course</td><td>Dr. Parvathy Das
Faculty, Dept. of SH</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech.</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• Develop the capability to apply for a job and participate in selection process
• Acquire interview skills
• Gain proficiency in language skills indispensable for a successful professional
• Develop emotional intelligence</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• Prepare résumé and cover letter
• Ready to perform at different levels of the interview process
• Able to use interpersonal skills in challenging situations
• Competent to draft various documents for specific purposes</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Preparing cover letter, résumé, digital profile; video profile; Email etiquette (L2,P4)
• Interview skills, Group discussion and impromptu speech (L2,P6)
• Social communication skills (L4,P6)
  ○ Conversational English appropriateness, context based speaking in general situations, discussion and associated vocabulary in professional situations)
  ○ Non-verbal communication – relevance and effective use of paralinguistic features – body language, chronemics, haptics, proxemics
  ○ Emotional intelligence (EI) and social intelligence at workplace – theoretical perspectives and their application in relevant workplace situations – EI and leadership skills – assessments and best practices in organizations
• Conflict management and communication at workplace (L4,P6)
  ○ Cross-cultural communication, Argumentation, negotiation, persuasion, decision making, case study of challenging situations
  ○ Organizing a meeting, working as part of a team, briefing
  ○ Business presentations – Preparing effective presentations, delivering presentaions and handling questions
• Writing proposals, statement of purpose, research article, agreements, summary Proofreading (L1,P4)
• Training for proficiency assessment (L1,P2)</td></tr>
<tr><td>References</td><td colspan="6">1. Tebeaux, Elizabeth, and Sam Dragga. The Essentials of Technical Communication. OUP, 2018.
2. Sabin, William A. The Gregg Reference Manual: A Manual of Style, Grammar, Usage, and Formatting. McGraw-Hill, 2011, pp 408-421.
3. Raman, Meenakshi and Sangeeta Sharma. Technical Communication: Principles and Practice. OUP, 2015.
4. Caruso, David R. and Peter Salovey. The Emotionally Intelligent Manager: How to Develop and Use the Four Key Emotional Skills of Leadership. John Wiley and Sons, 2004.
5. https://learnenglish.britishcouncil.org/business-english/youre-hired/episode-01
6. https://www.youtube.com/watch?v=HAnw168hugA
7. https://www.youtube.com/watch?v=azrqlQ_SLW8
8. https://owl.purdue.edu/owl/purdue_owl.html
9. Turabian,Kate L. Student's Guide to Writing College Papers. University of Chicago Press, 2010.</td></tr>
<tr><td>Methodology for content delivery</td><td colspan="6">Since students have been introduced to the basics of technical and professional communication in the first semester, this course is designed with the purpose of giving them intense training in professional and academic communication with global competence. Once the concept is introduced, adequate time should be devoted to practice and review.</td></tr>
</table>

ANNEXURE E-III-B

Curriculum for M.Tech. ECE-Communication Systems 2021 Batch

M.TECH CURRICULUM 2021					
Semester 1					
Category	Course Name	L	T	P	C
PCC	Random Processes	3	1	0	4
PCC	Digital Communication	3	1	0	4
PCC	Wave Propagation in Communication	3	1	0	4
PCC	Digital Signal Processing	3	1	0	4
PCC	RF System Design	3	1	0	4
PCC	Digital Communication Practice	0	0	3	1.5
PCC	RF System Design Practice	0	0	3	1.5
					23.0
Semester 2					
Category	Course Name	L	T	P	C
PCC	Wireless Communication	3	1	0	4
PCC	Advanced Digital Signal Processing	3	1	0	4
ELC	Elective 1	3	1	0	4
ELC	Elective 2	3	1	0	4
ELC	Elective 3	3	1	0	4
ELC	Elective 4	3	1	0	4
					24.0
Summer					
Category	Course Name	L	T	P	C
PCD	Project I	0	0	20	10
					10.0
Semester 3					
Category	Course Name	L	T	P	C
PCD	Project II	0	0	32	16
					16.0
Semester 4					
Category	Course Name	L	T	P	C
PCD	Project III	0	0	32	16
					16.0

Semester wise Credit Distribution	Credits						
Category	S1	S2	Summer	S3	S4	Total	%
Professional Core Course (PCC)	23	8	0	0	0	31	34.8
Elective Course (ELC)	0	16	0	0	0	16	18.0
Professional Career Development (PCD)	0	0	10	16	16	42	47.2
Total	23.0	24.0	10.0	16.0	16.0	89.0	100.0
	23.0	47.0	57.0	73.0	89.0		

ANNEXURE E-III-B

Curriculum for M.Tech. ECE-Communication Systems 2021 Batch

<table>
<tr><td>Course Title</td><td>Random Processes</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics and Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce various tools needed to analyze randomness, and concepts of likelihood (that arises in communications).
• To introduce modeling of various engineering systems using processes like Markov chains, Poisson processes, etc.
• To analyze systems for performance metrics.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students are expected to
• Understand various concepts and tools in Random Processes
• Analyze various performance metrics (like throughput) using the concepts covered
• Model various engineering systems using the tools studied.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Introduction to Probability: Sets, Events, Axioms of Probability, Conditional Probability and Independence, Bayes Theorem and MAP Decision Rule (9L + 2T)
• Random Variables: Definitions, Cumulative Distribution Functions, mass and density functions, joint and conditional distributions, Functions of Random Variables (8L + 3T)
• Expectations: Mean, Variance, Moments, Correlation, Chebychev and Schwarz Inequalities, Moment-generating and Characteristic Functions, Chernoff Bounds, Conditional Expectations (8L + 3T)
• Random Vectors: Jointly Gaussian random variables, Covariance Matrices, Linear Transformations, Diagonalization of Covariance Matrices (8L + 3T)
• Random Sequences: Sequences of independent random variables, correlation functions, wide-sense stationary sequences, LTI filtering of sequences Law of Large Numbers, Central Limit Theorem (9L + 3T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Scott L. Miller and Donald G. Childers, Probability and Random Processes: With Applications to Signal Processing and Communications, Academic Press; 2nd edition, 2012, ISBN: 9780123869814.
1. Stark and Woods, Probability and Random Processes with Applications to Signal Processing, Pearson Education, 3rd edition, 2002, ISBN: 9780130200716.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Dimitri P. Bertsekas and John N. Tsitsiklis, Introduction to Probability, Athena Scientific, 2nd edition, 2008, ISBN: 9781886529236.
2. Geoffrey Grimmett and David Stirzaker, Probability and Random Processes, Oxford; 3rd edition, 2001, ISBN: 9780198572220.
1. Bruce Hajek, Random Processes for Engineers, Cambridge University Press, 2014, ISBN: 9781107100121.</td></tr>
</table>

ANNEXURE E-III-B

Curriculum for M.Tech. ECE-Communication Systems 2021 Batch

<table>
<tr><td>Course Title</td><td>Digital Communication</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/
Specialization</td><td rowspan="2">Electronics and Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce the concepts of digital communication.
• To study various modulation schemes and their performance.
• To study and understand basic channel coding techniques.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">The students are able to
• understand any digital communication system
• design a digital communication system
• analyze various channel coding techniques</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Introduction to digital communications, review of sampling theorem, and representation of band-pass signals (6L + 2T)
• Digital communications through AWGN channel – Signal representation, PAM, PSK, and QAM signals, multi-dimensional signals, optimum receiver for AWGN, probability of error for symbol detection, approximations using Union bound, Chernoff bound (12L+4T)
• Digital communications through band-limited channels – Power spectrum of random digital signal, signal design for band-limited channels - Nyquist criterion, partial response signals, Timing and frequency synchronization for linearly modulated digital signals. (6L+2T)
• Digital communications through dispersive channels – Channel equalization, maximum likelihood sequence detection and the Viterbi algorithm, and practical (fractionally-spaced, adaptive) receivers for ISI channels, MAP sequence estimation and symbol detection (6L+2T)
• Block codes and syndrome decoding, convolutional codes and MLSE, Trellis coded modulation, Turbo codes (12L+4T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. J. G. Proakis and M. Salehi, Communication Systems Engineering, Pearson, 2nd edition, 2018, ISBN: 9780130617934.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. U. Madhow, Introduction to Communication Systems, Cambridge University Press, 1st edition, 2014, ISBN: 9781107022775.
1. B. P. Lathi and Z. Ding, Modern Digital and Analog Communication Systems, 5th edition, Oxford University Press, 2018, ISBN: 9780190686840.</td></tr>
</table>

ANNEXURE E-III-B

Curriculum for M.Tech. ECE-Communication Systems 2021 Batch

<table>
<tr><td>Course Title</td><td>Wave Propagation in Communication</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>UG/PG/Ph.D.</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Undergraduate level Electromagnetics</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course is designed as a graduate course to provide a conceptual understanding of the basics of electromagnetism and its application to the principles of wave propagation for communication.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the learners are expected to do the following:
▪ Understand the properties of electromagnetic (EM) waves
▪ Analyze the propagation of plane EM waves in free space, media and at interfaces
▪ Determine the characteristics of EM waves in bounded media
▪ Apply the EM wave theory to transmission lines, antennas, guided wave and fiber-optic communication</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Transmission Lines: TEM mode – transmission line equivalence -Distributed capacitance and inductance - Digital transmission lines (10 L+3T)
Plane Electromagnetic Waves: Review of Maxwell's equations (integral and differential form) – Plane waves in lossless media – Plane waves in lossy media – dielectrics and conductors – Poynting theorem - Plane waves at boundaries – Wave reflection and transmission (12L+4T)
Wave propagation in bounded media: Parallel plate waveguide - TEM modes - Rectangular waveguides – Resonators - Lossy waveguides -Dielectric waveguides – optical fibers - Dispersion and group velocity (10L+4T)
Antennas: Basics of radiation theory - Types of antennas – Antenna arrays (10L+3T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. David K. Cheng, Field and Wave Electromagnetics, 2nd Edition, Pearson Education, ISBN: 9781292026565 2014.
2. C. A. Balanis, Antenna Theory and Design, 3rd Edition, John Wiley & Sons, ISBN-047166782X, 2005.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Nannapaneni Narayana Rao, Elements of Engineering Electromagnetics, 6th Edition, Pearson Education, ISBN: 978 0131139619, 2013.
2. Fawwaz T. Ulaby Eric Michielssen and Umberto Ravaioli, Fundamentals of Applied Electromagnetics, 7th Edition, Pearson Education, ISBN: 9781292082486, 2015.
3. David. M. Pozar, Microwave Engineering, 4th Edition, John Wiley, ISBN: 9781118298138, 2011.
4. J. D. Kraus and R. J. Marhefka, Antennas for All Applications, 3rd Edition, Tata McGraw Hill,ISBN: 978-0071122405 , 2002.</td></tr>
</table>

ANNEXURE E-III-B

Curriculum for M.Tech. ECE-Communication Systems 2021 Batch

<table>
<tr><td>Course Title</td><td>Digital Signal Processing</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>3</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>UD, PG, Ph.D.</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Signal and Systems</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To make students familiar with the most important methods in DSP, including digital filter design, transform-domain processing and importance of Signal Processors.
• To make students aware about the meaning and implications of the properties of systems and signals.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• Students will learn the essential primary topics in DSP that are necessary for successful Postgraduate level research.
• Students will have the ability to solve various types of practical problems in DSP.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Review of signals and systems: Basic discrete time signals, classifications and operations, convolution and correlation. (6L+2T)
Fourier Domain Analysis of LTI Systems: Frequency domain characteristics of LTI systems, Frequency response of LTI system, Magnitude and phase response, Extension to higher order systems, filters, principle phase and phase responses, All pass systems, minimum phase systems, group delay, linear phase systems, (11L+5T)
Discrete time Fourier transform (DTFT): Definition of DTFT, Inverse formula, properties and relationship with continuous time Fourier series (CTFS). (6L+2T)
Sampling: Sampling, aliasing and oversampling effects. (3L+1T)
Discrete Fourier Transform: Definition of DFT and Inverse DFT, Relationship with DTFT, Circular convolution, windowing methods, Introduction to Fast Fourier Transform, Decimation in time and Decimation in Frequency algorithm (8L+2T)
z Transform: Definition of z transform, Inverse z transform, Region of convergence, Pole zero plots, properties of ROC and z (8L+2T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. V. Oppenheium, R. W. Schafer, Discrete-time signal processing, 2nd edition, Prentice Hall, 2010.
2. S. K. Mitra, Digital Signal Processing: A computer base approach, 3rd edition, Mc Graw Hill Higher Education, 2016.
3. J. G. Proakis and D. G. Manolakis, Introduction to Digital Signal Processing, 4th edition, Prentice Hall, 2012.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Monson H. Hayes, Statistical Digital Signal Processing and Modeling, Wiley-India, 2008.
2. Simon Haykin, Adaptive Filter Theory, Pearson Education, Fourth Edition, 2011.
3. Manolakis, D., Ingle, M., Kogon, S., Statistical and Adaptive Signal Processing, McGraw-Hill, 2000.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>RF System Design</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/
Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>UG/PG/Ph.D.</td><td>Type</td><td colspan="2">New □</td><td colspan="2">Revision ■</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Basic knowledge of electromagnetics at undergraduate level (Engineering Electromagnetics/Electromagnetic Waves/Any equivalent course)</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The key objective of this course is to provide a comprehensive understanding of high frequency circuit design principles, and the analysis and design of passive and active RF circuits for communication systems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students are expected to be able to:
▪ Understand the principles and behavior of high frequency circuits.
▪ Use the Smith Chart to perform impedance matching and other RF system design.
▪ Design and analyze various RF front end systems such as power dividers/combiners, couplers, filters, attenuators, switches, phase shifters, amplifiers, mixers, oscillators, etc.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">▪ Review of transmission line theory, lumped and distributed approach, network analysis, Scattering parameters, the Smith Chart and its applications. (8L+3T)
▪ Impedance matching circuits: Lumped and distributed element approaches. (3L+1T)
▪ Design of power dividers/combiners, couplers. (6L+2T)
▪ RF Filter design: lumped and distributed element realizations. (6L+2T)
▪ Design of microwave attenuators, RF switches, phase shifters, isolators. (5L+1T)
▪ Amplifier design, gain and stability analysis, design for maximum gain and specific gain, low noise amplifier design. (8L+3T)
▪ Design of mixers and oscillators. (6L+2T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. David M. Pozar, Microwave Engineering, 4th edition, John Wiley & Sons, ISBN: 9781118298138, 2011.
2. R. Ludwig, P. Bretchko, RF Circuit Design: Theory and Applications, 2nd edition, Prentice-Hall, ISBN: 9780130953230, 2000.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. C. Bowick, RF Circuit Design, 2nd edition, Newnes, ISBN: 9780750685184, 2007.</td></tr>
</table>

ANNEXURE E-III-B

Curriculum for M.Tech. ECE-Communication Systems 2021 Batch

Course Title	**Digital Communication Practice**	Course No					
Department/ Specialization	Electronics & Communication Engineering	Credits	L	T	P	C	
			0	0	3	1.5	
Faculty proposing the course	Faculty, Department of ECE	Status	Core ■	Elective □			
Offered for	M.Tech EC	Type	New ■	Revision □			
To take effect from	July 2021	Submitted for approval	44th Senate				
Prerequisite	Nil						
Learning Objectives	• To introduce the concepts of digital communication. • To study various modulation schemes and their performance. • To study and understand basic channel coding techniques.						
Learning Outcomes	The students are able to • understand any digital communication system • design a digital communication system • analyze various channel coding techniques						
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	The experiments are numerical evaluations done in a programming environment like MATLAB/GNU Octave or Python. Experiments include • BER/SER performance of Digital communications through AWGN channels – PAM, PSK, QAM, multi-dimensional constellation • Channel equalization: MLSE, Viterbi algorithm, MAP sequence estimation • Block codes and convolutional codes						
Essential Reading	1. J. G. Proakis and M. Salehi, Communication Systems Engineering, Pearson, 2nd edition, 2015, ISBN: 9780130617934.						
Supplementary Reading	1. U. Madhow, Introduction to Communication Systems, Cambridge University Press, 1st edition, 2014, ISBN: 9781107022775.. 1. B. P. Lathi and Z. Ding, Modern Digital and Analog Communication Systems, 5th edition, Oxford University Press, 2018, ISBN: 9780190686840.						

ANNEXURE E-III-B

Curriculum for M.Tech. ECE-Communication Systems 2021 Batch

<table>
<tr><td>Course Title</td><td>RF System Design Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech. (Communication Systems)</td><td>Type</td><td colspan="2">New □</td><td colspan="2">Revision ■</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Basic knowledge of electromagnetics at undergraduate level (Engineering Electromagnetics/Electromagnetic Waves/Any equivalent course)</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The key objectives of this course are to:
▪ Equip the students to design RF circuits and integrate these components to build an RF system.
▪ Build proficiency in using CAD tools such as RF circuit simulator and full wave simulator.
▪ Provide a hands-on experience in characterization and measurement of RF circuits and components.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of this course, the students should be able to:
▪ Design passive and active RF circuits such as filters, power dividers, couplers, attenuators, switches, phase shifters, amplifiers, mixers, oscillators, etc.
▪ Design RF circuits and integrate them together to build the RF front-end for communication systems.
▪ Become proficient with RF circuit characterization and measurements.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Analysis and design of various RF circuits: impedance matching circuits, low pass, high pass, bandpass and bandstop filters, stepped impedance low pass filter, power dividers and combiners, couplers, attenuators, switches, phase shifters, amplifiers, mixers and oscillators.
Characterization and measurement of RF components using Vector Network Analyzer.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. David M. Pozar, Microwave Engineering, 4th edition, John Wiley & Sons, ISBN: 9781118298138, 2011.
2. R. Ludwig, P. Bretchko, RF Circuit Design: Theory and Applications, 2nd edition, Prentice-Hall, ISBN: 9780130953230, 2000.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. C. Bowick, RF Circuit Design, 2nd edition, Newnes, ISBN: 9780750685184, 2007.</td></tr>
</table>

ANNEXURE E-III-B

Curriculum for M.Tech. ECE-Communication Systems 2021 Batch

Course Title	**Wireless Communication**	Course No	
Department/ Specialization	Electronics & Communication Engineering	Credits	L: 3, T: 1, P: 0, C: 4
Faculty proposing the course	Faculty, Department of ECE	Status	Core ■ Elective □
Offered for	UG/PG/Ph.D.	Type	New ■ Revision □
To take effect from	Jul 2021	Submitted for approval	44th Senate
Prerequisite	Random Processes, Digital Communication		
Learning Objectives	The course objectives are as follows: • To provide an thorough understanding of the wireless channel and related impairments • To understand various multiple access technologies, antenna diversity and MIMO system • To get an exposure to the current and emerging wireless systems (LTE, 802.11 etc.)		
Learning Outcomes	At the end of the course, the learners are expected to do the following: ▪ Describe the fading natures of a wireless channel and various impairments ▪ Analyze the BER performance over fading channels including diversity ▪ Analyze the performance parameters of various wireless technologies like CDMA, OFDM and MIMO		
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	**Wireless Communications and Diversity**: Review of basic concepts, Multipath Propagation, Path Loss models, Wireless Channel Modeling – Fading, BER Performance (8L+3T) **Wireless Channel Modeling**: Power delay profile- Delay Spread, Inter Symbol Interference, Coherence Bandwidth – flat, frequency selective Fading, Mobility - Doppler Shift and Coherence Time, Slow, Fast fading (6L+2T) **Diversity in Wireless Systems**: Multiple Antenna Wireless Systems, System Model, Diversity Combining : Maximal Ratio Combining, Equal Gain Combining, Selection Combining (6L+2T) **CDMA:** Introduction to CDMA, Features of CDMA2000 and WCDMA, Rake Receiver for CDMA systems, Multiuser CDMA performance (4L+1T) **OFDM and OFDMA Technologies**: Multicarrier Modulation (MCM) and OFDM, OFDM System Model, IFFT/ FFT Transceiver Model, BER performance, Successive Interference Cancellation (9L+3T) **Multiple Input Multiple Output (MIMO) Technology**: MIMO System Model, MIMO Zero-Forcing and Minimum Mean Square Error (MMSE) Receivers, MIMO Channel Capacity, Optimal Power Allocation, Alamouti Coding, MIMO Beamforming (9L+3T)		
Essential Reading	1. A. Goldsmith, Wireless Communication, 1st edition, Cambridge University Press, 2009, ISBN: 9780521704168 2. Simon Haykin and Michael Moher, Modern Wireless Communications, 1st edition, Pearson, ISBN:978-81-317-0443-1, 2011.		
Supplementary Reading	1. Tse, David, and Pramod Viswanath, Fundamentals of Wireless Communication. Cambridge, UK: Cambridge University Press, 2005. ISBN: 0521845270. Online version. 2. T.S. Rappaport, Wireless Communications, Principles and Practice, 2nd Ed., Pearson Education, 2010. 3. Aditya K Jagannatham, Principles of Modern Wireless Communication Systems, 1st edition, Mc Graw Hill, ISBN: 978-1-259-02957-8, 2016.		

ANNEXURE E-III-B

Curriculum for M.Tech. ECE-Communication Systems 2021 Batch

<table>
<tr><td>Course Title</td><td>Advanced Digital Signal Processing</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>UD, PG, Ph.D.</td><td>Type</td><td colspan="2">New □</td><td colspan="2">Revision ■</td></tr>
<tr><td>To take effect from</td><td>Jul 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Digital Signal Processing</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course covers the techniques and gain proficiency of modern signal processing that are fundamental to a wide variety of application areas. In this course various aspects of advanced signal processing along with applications in filter design and modern communication systems will be comprehensively discussed which are prime focus of signal processing industries all over the world.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• Students will learn the essential advanced topics in DSP that are necessary for successful Postgraduate level research.
• Students will have the ability to solve various types of practical problems in DSP.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Introduction to the course: Review of transforms, Sampling theorem, Quantization, AD and DA conversion. (8L+3T)
Implementation of Discrete-time Systems: Structures of FIR, IIR systems, Representation of numbers, State-space representation-Quantization of filter coefficients, Round-off effects in digital filters (15L+5T)
Multirate Digital Signal Processing: Mathematical description of change of sampling rate, Interpolation and Decimation, Implementation of sampling rate conversion, Polyphase decomposition, digital filter banks (15L+5T)
Applications: Spectrum analysis using DFT, Power spectral estimation (4L+1T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. J. G. Proakis and D. G. Manolakis, Introduction to Digital Signal Processing, 4th edition, Prentice Hall, 2012.
2. S. K. Mitra, Digital Signal Processing: A computer base approach, 3rd edition, Mc Graw Hill Higher Education, 2016.
3. V. Oppenheium, R. W. Schafer, Discrete-time signal processing, 2nd edition, Prentice Hall, 2010.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Simon Haykin, Adaptive Filter Theory, Pearson Education, Fourth Edition, 2011.
2. Manolakis, D., Ingle, M., Kogon, S., Statistical and Adaptive Signal Processing, McGraw-Hill, 2000.
3. Monson H. Hayes, Statistical Digital Signal Processing and Modeling, Wiley-India, 2008.</td></tr>
</table>

ANNEXURE E-III-C

Curriculum for M.Tech. ECE-Microelectronics and VLSI systems 2021 Batch

PROPOSED M.TECH CURRICULUM 2021 (Microelectronics and VLSI Systems)					
Semester 1					
Category	Course Name	L	T	P	C
PCC	MOSFET Modeling for VLSI Circuits	3	1	0	4
PCC	Analog IC Design	3	1	0	4
PCC	VLSI Testing and Testable Design	3	1	0	4
ELC	Elective-1:	3	1	0	4
ELC	Elective 2:	3	1	0	4
PCC	Device Modeling and Simulation Practice	0	0	3	1.5
PCC	SoPC and VLSI Testing Practice	0	0	3	1.5
					23.0
Semester 2					
Category	Course Name	L	T	P	C
PCC	Digital IC Design	3	1	0	4
PCC	VLSI System Design	3	1	0	4
PCC	VLSI Technology	3	1	0	4
ELC	Elective 3:	3	1	0	4
ELC	Elective 4:	3	1	0	4
PCC	IC Design Practice	0	0	3	1.5
PCC	Verification Practice	0	0	3	1.5
					23.0
Summer					
Category	Course Name	L	T	P	C
PCD	Project I	0	0	20	10
					10.0
Semester 3					
Category	Course Name	L	T	P	C
PCD	Project II	0	0	32	16
					16.0
Semester 4					
Category	Course Name	L	T	P	C
PCD	Project III	0	0	32	16
					16.0

Semester wise Credit Distribution	Credits						
Category	S1	S2	Summer	S3	S4	Total	%
Professional Core Course (PCC)	15	15	0	0	0	30	34.1
Elective Course (ELC)	8	8	0	0	0	16	18.2
Professional Career Development (PCD)	0	0	10	16	16	42	47.7
Total	23.0	23.0	10.0	16.0	16.0	88.0	100.0
	23.0	46.0	56.0	72.0	88.0		

<table>
<tr><td>Course Title</td><td>MOSFET Modeling for VLSI Circuits</td><td>Course No</td><td colspan="4">EC5XXX</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics and Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech/DD</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Basics of Semiconductor Devices, Digital Electronics</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To demonstrate and apply basic concepts of semiconductor physics relevant to devices
• To describe and use physics-based numerical and analytical device modeling for the inclusion in circuit applications</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students would be able to
• Model any kind of MOS Devices in 2-D or 3-D
• Relate the models for further inclusion in circuits</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Intuitive analysis of MOS Transistor- Two-Terminal MOS Structure – Flatband Voltage, Surface Condition, General Analysis, Inversion, Strong Inversion, Weak Inversion, Small- Signal Capacitance, Three-Terminal MOS Structure (7L+3T)
• Long-Channel MOS Transistor, Introduction All-Region Models, Strong Inversion Models, Weak Inversion Models, Source Reference vs. Body Reference, Effective Mobility (5L+2T)
• Small-Dimension Effects - Velocity Saturation, Channel Length Modulation, Charge Sharing, Drain-Induced Barrier Lowering, Hot Carrier Effects, Velocity Overshoot Ballistic Operation, Polysilicon Depletion (6L+2L)
• Small-Dimension Effects-Modeling for Circuits Simulation- Quantum-Mechanical Effects; Gate Current, Junction Leakage, Scaling and New Technologies, Approaches, and Properties of Good Models, Model Formulation Considerations, Parameter Extraction, Compact Models, Benchmark Tests (7L+3L)
Small-Signal Modeling - Conductance Parameter Definitions and Equivalent Circuits, Conductance Parameters Due to Gate and Body Leakage, Transconductance, Source-Drain and Output Conductance, Capacitance Definitions and Equivalent Circuits, Capacitance Evaluation and Properties, y-Parameter Model, RF Models (11L+2T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Y. Tsividis and C. McAndrew, MOSFET modeling for Circuit Simulation, Oxford University Press, 2011</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. BSIM Manuals available on BSIM homepage on the internet.
2. T. A. Fjeldly, T. Yetterdal and M. Shur, Introduction to Device Modeling and Circuit Simulation, John Wiley, 1998.
3. Y. Taur and T. H. Ning, Fundamentals of Modern VLSI Devices, Cambridge University Press, 1998.
1. Y. P. Tsividis, Mixed Analog-digital VLSI Devices and Technology, World Scientific Publishing Co Pte Ltd, 2002</td></tr>
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<table>
<tr><td>Course Title</td><td>Analog IC Design</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics and Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Dept. of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech/DD</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>CoT for Elective</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To impart in depth knowledge in CMOS based analog circuits, performance metrics, design and analysis of operational amplifiers and circuits using them
• To be capable of designing an opamp for given specifications</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• To analyse effect of mismatch between components in the performance of ICs
• To model MOSFET in IC
• To analyse noise in different components in the IC
• To derive the Data Sheet / Specifications of Single stage, two stage, folded cascade opamps
• To understand fully differential operation, opamp and make such circuits</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Components and mismatch in CMOS process, models and Layout techniques. (4L+2T)
• MOS Transistor: Layout, model, Body effect, transit frequency. (4L+2T)
• Noise: Noise in Resistor, capacitor, and MOSFET, spectral density (4L+2T)
• Single stage opamp: Noise, offset, swing limits and slew rate, Loop gain and stability Analysis in two and higher order opamp (10L+2T)
• Cascode current mirror, Cascode, Folded Cascode multi stage and Miller compensated op amps. (8L+2T)
• Fully differential circuits and opamp, common mode feedback circuits. (6L+2T)
• PLL (6L+2T)
Tutorials will include pen-paper analysis and circuit simulation at schematic and layout level</td></tr>
<tr><td>Essential Reading</td><td colspan="6">2. Behzad Razavi, Design of Analog CMOS Integrated Circuits, 2nd edition McGraw-Hill Education, 2016, ISBN: 978-0-07-252493-2</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">2. Tony Chan Carusone, David A. Johns, Kenneth W. Martin, Analog Integrated Circuit Design, John Wiley & Sons, Inc., 2012, ISBN: 978-0-470-77010-8.
3. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, Analysis And Design Of Analog Integrated Circuits, 5th edition, John Wiley & Sons, Inc., 2009. ISBN: 978-0-470-24599-6.
4. Tertulien Ndjountche, CMOS Analog Integrated Circuits High-Speed And Power-Efficient Design, CRC Press Taylor & Francis Group, 2011. ISBN: 978-1-4398-5500-3.</td></tr>
</table>

Course Title	**VLSI Testing and Testable Design**	Course No					
Department/ Specialization	Electronics and Communication Engineering	Credits	L	T	P	C	
			3	1	0	4	
Faculty proposing the course	Faculty, Department of ECE	Status	Core ■		Elective □		
Offered for	DD/M.Tech	Type	New ■		Revision □		
To take effect from	July 2021	Submitted for approval	44th Senate				
Prerequisite	Basics of Digital Electronics						
Learning Objectives	• The course aims at imparting skills required for the design of an efficient testable circuit and optimal test vectors to detect all faults						
Learning Outcomes	At the end of the course, the students would be able to • Model the faults in the combination and sequential circuits • Perform the fault analysis and test pattern generation using ATPG algorithms • Build the testable circuit with test vectors.						
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Basic of Test and Role of HDL - Design and Test, Test Concerns, HDLs in Digital System Test, ATE Architecture and Instrumentation. (3L+1T) • Verilog HDL for Design and Test: Using Verilog in Design, Using Verilog in Test, Basic Structures of Verilog, Combinational Circuits, Sequential Circuits, Testbench Techniques. (3L+1T) • Fault and Defect Modeling: Fault Modeling, Structural Gate Level Faults, Issues Related to Gate Level Faults, Fault Collapsing in Verilog. (5L+2T) • Fault Simulation Application and Methods: Fault Simulation, Fault Simulation Applications, Fault Simulation Technologies. (5L+1T) • Test pattern Generation Methods and Algorithm: Test Generation Basics, Controllability and Observability, Random Test Generation. (4L+1T) • Deterministic Test Generation Algorithms: Deterministic Test Generation Methods, Sequential Circuit Test Generation, Test Data Compaction. (4L+1T) • Design for Test by Means of Scan: Making circuits Testable, Testability Insertion, Full Scan DFT Technique, Scan Architectures and RT level Scan Design. (4L+2T) • Standard IEEE Test Access Methods: Boundary Scan Basics, Boundary Scan Architecture, Boundary Scan Test Instructions, Board Level Scan Chain Structure, RT level Boundary Scan and Boundary Scan Description Language. (5L+2T) • Logic Built-in Self-test: BIST Basics, Test Pattern Generation, Output Response Analysis, BIST Architectures, RT Level BIST Design. (4L+1T) • Test Compression: Test Data Compression, Compression Methods and Decompression Methods. (3L+1T) • Memory Testing by Means of Memory BIST: Memory Testing, Memory Structure. (2L+1T)						
Essential Reading	1. Zainalabedin Navabi, Test and Testable Design using HDL Models and Architecture, 1st edition, Springer, 2010, ISBN: 978-1-4419-7547-8.						
Supplementary Reading	1. M. Abramovici, M. A. Breuer and A. D. Figriieta, Digital Systems Testing and Testable Design, Wiley-IEEE Press, 1994, ISBN: 978-0-7803-1062-9. 2. Niraj K. Jha, Sandeep Gupta, Testing of Digital Systems, 1st edition, Cambridge University Press, 2003. ISBN: 0521-77356-3 3. Michael L. Bushnell, Vishwani D. Agrawal, Essentials of Electronic Testing for Digital, Memory, and Mixed-Signal VLSI Circuits, Springer, 2004. ISBN: 7923-7991-8.						

<table>
<tr><td>Course Title</td><td>SoPC and VLSI Testing Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics and Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>DD, M. Tech</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• Design and development complete hardware/software system on FPGA and VLSI testing</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Student can able to design and develop the hardware/software system on FPGA, can able to effectively use commercially available building block (IP) to construct highly integrated systems, can able to efficiently break down complex computational tasks into hardware and software components and build co-processor.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Verify fault coverage of test patterns, simulate fault, apply test pattern, and observe output
• Hands-on on Design for test (DFT) – insert test points, scan chains, to improve testability
• Writing ATPG and Designs for Combinational and Sequential Circuits.
• Implement BIST for Memory blocks
• Scan Chain based Sequential Circuit Testing
• Fault Models simulations and verifications, Structural Testing with Fault Models
• Implement path delay fault testing
• Introduction to System-on-Chip, Register Transfer Language, Folding, Re-timing and Recoding
• Protocol and Interface, System-C Components, Basic SoC components,
• Electronic system level modeling, Transactional level modeling, Assertion based Design, Network on chip and Bus Structures
• SoC Engineering and associated Tools, Architectural design exploration, High Level Design Capture and Synthesis.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Wang, “VLSI Test Principles and Architectures: Design for Testability”, Elsevier; First edition (1 January 2011). ISBN: 9380501552
2. Louise H. Crockett, Ross A. Elliot, Martin A. Enderwitz, Robert W. Stewart, The Zynq Book: Embedded Processing with the ARM Cortex-A9 on the Xilinx Zynq-7000 All, 1st edition, Strathclyde Academic Media, 2014. ISBN: 099297870X.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Wayne Wolf, FPGA based System Design, 1st edition, Prentice Hall, 2004. ISBN: 0131424610.
2. Steve Furber, ARM System on Chip Architecture, 2nd edition, Addison-Wesley, 2000. ISBN: 0201675196.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Device Modelling and Simulation Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics and Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech/DD</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To make the students familiar with semiconductor device Physics.
• To impart a flavor of different semiconductor device modeling with the help of simulation tools.
• The lab is intended to teach students about device structure and provide confidence to design the device structure and plotting necessary characteristics in relevant device modeling tools.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, students would be able to:
• simulate and analyze structure, doping profile, terminal characteristics and distributions of carriers, current, field, potential and energy band diagrams within 2-dimensional device structures</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Introduction to Technology computer aided design (TCAD) tools; inputs and outputs of device and process simulations.
• Device simulation: observing the terminal characteristics and distributions of carriers, current, field, potential and energy band diagrams within the device.
• Process simulation: observation of device structure and doping profile
• Simulation of 2-D MOSFETs through device and process simulations
• Simulation of novel 3-D transistors such as III-V HEMT, LEDs, FinFETs, GAA devices, solar cells etc, through device simulation
• DC, AC, RF mixed mode and noise simulation for the devices</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. C K Maiti, “Introducing Technology Computer-Aided Design (TCAD): Fundamentals, Simulations, and Applications”, Jenny Stanford Publishing; 1st Edition, 2017, ISBN: 978-9814745512.
2. Wu, Yung-Chun, Jhan, Yi-Ruei, “3D TCAD Simulation for CMOS Nanoeletronic Devices”, Springer, 2017, ISBN 978-981-10-3066-6.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. C K Sarkar, “Technology Computer Aided Design: Simulation for VLSI MOSFET”, CRC Press, 1st Edition, 2013, ISBN: 978-1466512658.
2. J.-P. Colinge, “FinFETs and Other Multi-Gate Transistors”, Springer, 2008, ISBN: 978-0-387-71751-7
3. TCAD Manual (Available Online)</td></tr>
</table>

ANNEXURE E-III-C

Curriculum for M.Tech. ECE-Microelectronics and VLSI systems 2021 Batch

Course Title	**Digital IC Design**	Course No				
Department/ Specialization	Electronics and Communication Engineering	Credits	L	T	P	C
			3	1	0	4
Faculty proposing the course	Faculty, Dept. of ECE	Status	Core ■	Elective □		
Offered for	M Tech/DD	Type	New ■	Revision □		
To take effect from	July 2021	Submitted for approval	44^{th} Senate			
Prerequisite	CoT for Elective					
Learning Objectives	• To impart in depth knowledge in CMOS digital circuits, performance metrics, design procedures for complex combinational and sequential circuits and subsystems. • Students would be able to design and analyze complex digital integrated circuits using semicustom and full custom design procedures.					
Learning Outcomes	• To design series of masks required for IC Design using pen paper upto 5 level and using tool for higher level • To model MOSFETs and Interconnects in ICs • To determine Noise margins, switching voltage, delay parametrs, power etc in ICs • To develop combinational and sequential circuits with static and dynamic CMOS and Pass Transistors • To build arithmetic and Memory ICs					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Issues in Digital Integrated Circuit Design (1L) • Fabrication of CMOS IC and packaging (4L+1T) • MOS Device: Threshold Voltage, Secondary Effects, SPICE Models (4L+2T) • Interconnect: Parameters, Electrical Wire Models, SPICE Wire Models (2L+1T) • CMOS Inverter: Transfer Characteristics, Noise margin, Capacitances, Propagation Delay, Power (5L+2T) • Combinational Logic Circuits: Static CMOS, Pass-Transistors, Dynamic CMOS, Dynamic Logic, Cascading (7L+2T) • Sequential Logic Circuits: Timing Metrics, Static and Dynamic Latches, Registers, C2MOS, NORA-CMOS (7L+2T) • Arithmetic Building Blocks: Datapaths in Digital Processor Architectures (7L+2T) • Memory and Array Structures: ROM, RAM, CAM, Peripheral Circuitry, PLA and Flash Memory (5L+2T) Tutorials will include pen-paper analysis and circuit simulation at schematic and layout level					
Essential Reading	1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Digital Integrated Circuits, 2 nd edition, Pearson, 2003. ISBN-10: 0130909963, ISBN-13: 978-0130909961					
Supplementary Reading	1. John E. Ayers, Digital Integrated Circuits: Analysis and Design, 2 nd edition, CRC Press, 2009. ISBN-10: 142006987X, ISBN-13: 978-1420069877. 2. R. Jacob Baker, CMOS Circuit Design, Layout, and Simulation, 3rd edition, Wiley-Blackwell, 2010. ISBN-10: 0470881321, ISBN-13: 978-0470881323. 3. Sung-Mo (Steve) Kang, Yusuf Leblebici, Chilwoo Kim, CMOS Digital Integrated Circuits Analysis & Design, 4th edition, McGraw-Hill Higher Education, 2014. ISBN- 10: 0073380628, ISBN-13: 978-0073380629.					

<table>
<tr><td>Course Title</td><td>VLSI Technology</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics and Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech/DD</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To bring both Circuits and System views on technology together.
• To offer a profound understanding of the design of complex VLSI devices, and synthesis tools for fabrication.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, students would be able to
• Appreciate the intricacies involved in VLSI circuit fabrication.
• Understand the various processes needed to fabricate the VLSI devices.
• Learn fabrication steps for existing and coming generation devices.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Introduction to VLSI Design, Bipolar Junction Transistor Fabrication, MOSFET Fabrication. (L4+T1)
• Crystal Structure of Si, Defects in Crystal, Crystal growth (L3+T1)
• Epitaxy, Vapour phase Epitaxy, Doping during Epitaxy, Molecular beam Epitaxy (L4+T1)
• Oxidation – Kinetics, Rate constants, Dopant Redistribution, Oxide Charges (L5+T2)
• Diffusion-Theory of Diffusion, Doping Profiles, Diffusion Systems Ion Implantation - Process, Annealing of Damages, Masking during Implantation (L5+T2)
• Lithography, immersion lithography, e-beam lithography (L5+T2)
• Etching-Wet Chemical Etching, Dry Etching, Plasma Etching, Si, SiO_2, SiN and other materials (L3+T1)
• Deposition-Plasma Deposition, Metallization, Problems in Aluminium Metal contacts, Copper interconnects (L4+T1)
• IC BJT - LOCOS, Trench isolation, Poly-emitter-poly-base-BJT and its suitability for high-speed applications (L3+T1)
• MOSFET - Metal gate vs. Self-aligned Poly-gate, Tailoring of Device Parameters, CMOS Technology, Latch - up in CMOS, MOSFET structures with strained channels and high-k gate dielectrics, Bi-CMOS Technology (L6+T2))</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. S. K. Ghandhi, VLSI Fabrication Principles- Silicon and Galium Arsenide, John</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">2. S. M. Sze, VLSI Technology, Tata McGraw Hill, 2008
3. J. Plummer, M. D. Deal, P. B. Griffin, Silicon VLSI Technology, Fundamentals, Practice and Modeling, Pearson Higher Education, 2000</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>VLSI System Design</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics and Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech/DD</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To impart in depth knowledge in the design, simulation and analyses of complex VLSI circuits including both digital and analog building blocks.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, students would be able to
• Understand circuits and system level issues while integrating sub blocks in integrated circuits
• Design and analyze complex VLSI systems using industry level design and verification tools
• Gain proficiency in hardware design and scripting languages</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Review of VLSI, Classifications of VLSI Circuits, Design Methodologies and implementation options of VLSI Systems. Y-Chart, Design Abstraction Levels. Modeling Styles (L5+1T)
• Designing Fast CMOS Circuits, Various Techniques for Delay Estimation, Logical Effort and Optimization, Low Power Design Techniques, Power Management Techniques at Circuit and System Levels, Tradeoffs in Power & Delay and mitigation Techniques. (L8+T3)
• VLSI system design with HDL: Module concepts and modeling styles: Behavioral, dataflow, structural and mixed style modeling, Synthesis and verification of designs. Data path subsystem design: Combinational and sequential circuits, arithmetic circuits and interconnects; implementation of such systems with HDL and design verification including post layout simulations. (L7+T2)
• Interconnect Design: Design issues with Resistive, Capacitive and Inductive Parasitics, Interconnect Techniques, Power Distribution and Clock Design: Power Distribution Networks, Clock Generation and Distribution Networks, Layout Designs: Design considerations for signal integrity, manufacturability and reliability. (L7+T2)
• Input/Output Modules and ESD Protection Networks: Input Buffers, Output Drivers, and ESD Protection Circuits, Overall System Design examples with HDL (L5+T2)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Ming-Bo Lin, Introduction to VLSI Systems A logic, circuit and Systems Perspective, CRC Press, 2012, ISBN: 978-1-4398-6859.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Neil H. E. Weste, David Money Harris, CMOS VLSI Design, A Circuits and Systems Perspective, 4th edition, Addison-Wesley, Pearson, 2013, ISBN: 978-0-321-54774-3.
2. Liming Xiu, VLSI Circuit Design, Methodology Demystified, A conceptual Taxonomy, IEEE Press, A John Wiley & Sons, Inc., 2008, ISBN: 978-0-470-12742-1.
3. Hubert Kaeslin, Morgan Kaufman, Top-Down Digital VLSI Design, Elsevier, 2015, ISBN: 978-0-12-800730-3.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>IC Design Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics and Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M Tech/DD</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To impart in depth knowledge in the design, simulation and analyses of CMOS based analog integrated circuits especially operational amplifiers and transconductor amplifiers and Digital integrated circuits.
• Students would be able to design and analyze complex analog and digital integrated circuits using industry level analog and digital IC Design tools.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• To be capable of simulating Schematic level analog circuits with at least 20+ transistors
• To be capable of generating layout with full custom / semicustom tools and to perform post layout simulations and extracting parameters to schematic model
• To design Digital building blocks using VHDL / Verilog
• To generate synthesizable design, create layout and post layout simulations for ASIC Design</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Design of analog ICs with Schematic and layout simulation using Cadence and Synopsys tools (6 weeks)
• Design of digital building blocks with Schematic and layout simulation using Cadence and Synopsys tools (6 weeks)
Project will include identifying analog / digital IC from papers of IEEE JSSC, IEEETCASI, IEEE TCASII, IEEE TBioCAS, ISCAS, ISICAS, NEWCAS, APCCAS, MWCAS, simulate both schematic & layout and analyse the results.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Behzad Razavi, Design of Analog CMOS Integrated Circuits, 2nd edition McGraw-Hill Education, 2016, ISBN: 978-0-07-252493-2
2. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Digital Integrated Circuits, 2nd edition, Pearson, 2003, ISBN-10: 0130909963, ISBN-13: 978-0130909961.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Tony Chan Carusone, David A. Johns, Kenneth W. Martin, Analog Integrated Circuit Design, John Wiley & Sons, Inc., 2012, ISBN: 978-0-470-77010-8.
2. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, Analysis And Design Of Analog Integrated Circuits, 5th edition, John Wiley & Sons, Inc., 2009. ISBN: 978-0- 470-24599-6
3. Sung-Mo (Steve) Kang, Yusuf Leblebici, Chilwoo Kim, CMOS Digital Integrated Circuits Analysis & Design, 4th edition, Mcgraw-Hill Higher Education, 2014. ISBN-10: 0073380628.
4. Ronald Mehler, Digital Integrated Circuit Design Using Verilog and System Verilog, 1st edition, Newnes, 2015. ISBN: 978-0-12-408059-1.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Verification Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics and Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>DD, M. Tech</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Hold on Digital Logic Design, and HDL with design flow of VLSI Systems</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To impart in depth knowledge and hands-on on the Design, Simulation and Verification Flow of Digital Circuits & Systems. Analyses of complex VLSI circuits including both digital and analog building blocks.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students would be able to design and analyze complex VLSI systems using industry level Design and verification tools.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Overview of the HDL and Design Methodologies.
• Understand and use the SystemVerilog/HDL RTL design and synthesis features, including new data types, literals, procedural blocks, statements, and operators, relaxation of Verilog language rules, fixes for synthesis issues, enhancements to tasks and functions, new hierarchy and connectivity features, and interfaces, clocking blocks, assertions, cover. Verify the design to ensure 100% coverage.
• Generate & analyze functional coverage, code coverage, line coverage & FSM coverage
• Basic UVM constructs & classes, design a basic test environment using UVM
• SystemVerilog/HDL verification features, including classes, constrained random stimulus, coverage, strings, queues and dynamic arrays, and learn how to utilize these features for more effective and efficient verification.
• Power and Clock Routing, Interconnects design considerations
• Floor planning, placement & Routing of the Digital Blocks, physical fixes and signoffs.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">0. Ming-Bo Lin, Introduction to VLSI Systems A logic, circuit and Systems Perspective, CRC Press, 2012, ISBN: 978-1-4398-6859.
1. SystemVerilog for Design: A Guide to Using SystemVerilog for Hardware Design and Modeling, 2nd Edition, ISBN-13: 978-0387333991</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Chris Spear, SystemVerilog for Verification: A Guide to Learning the Testbench Language Features, Springer. 2012, ISBBN: 978-1461407140.
2. Donald Thomas, Logic Design and Verification Using SystemVerilog, 2016, ISBN: 1523364025.
3. UVM Primer: A Step-by-Step Introduction to the Universal Verification Methodology, 2013, ISBN: 0974164933.</td></tr>
</table>

ANNEXURE E-III-D

Curriculum for M.Tech. ECE-Power Electronic System Design 2021 Batch

M.Tech. - Power Electronic System Design (2021)					
Semester 1					
Category	Course Name	L	T	P	C
PCC	Analog and Digital Controllers in Power Electronics Applications	3	1	0	4
PCC	Discrete Data Systems	3	1	0	4
PCC	Power Converters Analysis and Design	3	1	0	4
ELC	Elective 1	3	1	0	4
ELC	Elective 2	3	1	0	4
PCC	Power Electronic Circuits Practice	0	0	3	1.5
PCC	Analog and Digital Controllers in Power Electronics Practice	0	0	3	1.5
					23.0
Semester 2					
Category	Course Name	L	T	P	C
PCC	Power Electronic Control of Electrical Machines	3	1	0	4
PCC	Switched Mode Power Converters	3	1	0	4
ELC	Elective 3	3	1	0	4
ELC	Elective 4	3	1	0	4
ELC	Elective 5	3	1	0	4
PCC	Power Electronic Control of Electrical Machines Practice	0	0	3	1.5
PCC	Switched Mode Power Converters Practice	0	0	3	1.5
					23.0
Summer					
Category	Course Name	L	T	P	C
PCD	Project I	0	0	20	10
					10.0
Semester 3					
Category	Course Name	L	T	P	C
PCD	Project II	0	0	32	16
					16.0
Semester 4					
Category	Course Name	L	T	P	C
PCD	Project III	0	0	32	16
					16.0

Semester wise Credit Distribution	**Credits**						
Category	**S1**	**S2**	**Summer**	**S3**	**S4**	**Total**	**%**
Professional Core Course (PCC)	**15**	**11**	**0**	**0**	**0**	**26**	**29.5**
Elective Course (ELC)	**8**	**12**	**0**	**0**	**0**	**20**	**22.7**
Professional Career Development (PCD)	**0**	**0**	**10**	**16**	**16**	**42**	**47.7**
Total	**23.0**	**23.0**	**10.0**	**16.0**	**16.0**	**88.0**	**100.0**
	23.0	**46.0**	**56.0**	**72.0**	**88.0**		

ANNEXURE E-III-D

Curriculum for M.Tech. ECE-Power Electronic System Design 2021 Batch

<table>
<tr><td>Course Title</td><td>Analog and Digital Controllers in Power Electronics Applications</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>PG/PhD</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td></td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To enrich the learner with analog and digital controller concepts and its application in the field of Power Electronic Systems</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Upon completion of the course, the students will be able to
• Understand the architecture of DSP core and its functionalities
• Acquire knowledge on operation of interrupts and peripherals
• Explore the possibilities of hardware implementation using digital and analog controllers
• Design of controllers for power converters</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Analog Controllers - Proportional controllers, Proportional – Integral controllers, PI controllers - cascaded control, Feed forward control, ON/OFF controller, control algorithms - sensors for high voltage and current applications(8L+2T)
Signal conditioners-Instrumentation amplifiers - Isolation circuits(8L+2T)
Numeric Systems, Architecture of DSP - C2000, Memory Mapping in DSP, Peripheral Modules(5L+2T)
Instruction sets in C2000 and its optimal usage for power applications. Lab: Installation, configuration and initialization in C2000. Introduction to the C2xx DSP core and code generation - The components of the C2xx DSP core- Memory - Types of Physical Memory - Memory addressing Modes(5L+2T)
Instruction Set - Multiplexing and General Purpose I/O Control Registers - Interrupt Hierarchy - Interrupt Control Registers - ADC Overview - Operation of the ADC in the DSP - Event manager (EV) - General Purpose (GP) Timers - Compare Units - Capture Units And Quadrature Enclosed Pulse (QEP) Circuitry(5L+2T)
Interfacing with DAC, Interfacing with ADC, generation of sawtooth and triangular waveforms, PWM generation, Understanding digital control of DC/DC converters, Generation of sine wave and viewing in DAC(4L+2T)
Mini projects and case studies with analog and digital controllers(7L+2T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Campbell, Steven G., and Toliyat, Hamid A.DSP-Based Electromechanical Motion Control. United Kingdom, CRC Press, 2003.ISBN:9780203486337, 0203486331
• Luo, Fang Lin, et al. Digital Power Electronics and Applications. Netherlands, Elsevier Science, 2010.ISBN:9780080459028, 0080459021
• Michael Jacob, ‘Industrial Control Electronics – Applications and Design’, Prentice Hall, 1995.ISBN:9789813026919, 981302691X
• Thomas E. Kissell, ‘Industrial Electronics’, Prentice Hall India, 2003. ISBN:9780130602411, 0130602418
• Wayne Wolf, ‘FPGA based system design’, Prentice hall, 2004.ISBN:9780132441636, 0132441632</td></tr>
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<table>
<tr><td>Course Title</td><td>Discrete Data Systems</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core □</td><td colspan="2">Elective ■</td></tr>
<tr><td>Offered for</td><td>PG/PhD</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44thSenate</td></tr>
<tr><td>Prerequisite</td><td>Control Systems</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The purpose of this course is to present the fundamentals of the theory and application of digital control systems. In particular, this course will provide methods for design and analysis of digital control systems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">● Students will be introduced to the fundamental concepts, principles and application of digital control system analysis and design.
● Students will be able to design systems applying classical control methods as well as the modern control design.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Introduction to digital control: Discrete time system representation, Mathematical modeling of sampling process, Data reconstruction (4L)
Modeling discrete-time systems by pulse transfer function: Revisiting z-transform, Mapping of s-plane to z-plane, Pulse transfer function, Pulse transfer function of closed loop system (6L+2T)
Design of sampled data control systems: Design of compensators using Bode plot and root locus (8L+3T)
Deadbeat response design: Design of digital control systems with deadbeat response, Practical issues with deadbeat response design, Sampled data control systems with deadbeat response (6L+2T)
Discrete state space models: Controllability, observability and stability (6L)
State feedback and Output feedback design: Pole-placement by state feedback, output feedback design, Observer, Kalman Filter (8L+3T)
Introduction to optimal control: Basics of optimal control, Performance indices, Linear Quadratic Regulator (LQR) design (4L+3T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">● Digital Control and State Variable Methods, Madan Gopal, MCGRAW HILL, 4/e, 2012, ISBN: 9780071333276
● Digital Control of Dynamic Systems, G. F. Franklin, J. D. Powell and M. L. Workman, Pearson Education, Asia, 3/e,2016, ISBN:9780979122606
● Digital Control Systems, B. C. Kuo, Oxford University Press stability theorem, 2/e, 2012, ISBN:9780198083542
● Discrete Time Control Systems, K. Ogata, Prentice Hall, 2/e 2015, ISBN:9789332549661
● Computer Controlled Systems - Theory and Design, K. J. Astrom and B. Wittenmark, Prentice Hall, 3/e, 2012, ISBN: 978-0486486130</td></tr>
</table>

ANNEXURE E-III-D

Curriculum for M.Tech. ECE-Power Electronic System Design 2021 Batch

<table>
<tr><td>Course Title</td><td>Power Converters Analysis and Design</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>PG/PhD</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td></td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course is a graduate level course for Electrical Engineering students. This course introduces the students to design aspects of various elements of both conventional and advanced power conditioning systems. This includes both at the device level and the system level.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Upon completion of the course, the students will be able to
● Design of power converters
● Selection of appropriate components and devices for power converters
● Analyze and design various power converter systems</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Power Devices and their driving circuitry: IGBT, Power MOSFET, IGCT, SCR - data sheet interpretation and gate drive Circuit Design, SiC and GaN MOSFET devices and their characteristics. (9L+3T)
AC/DC Converters: Review of three phase SCR bridge converters and performance analysis. Three phase and cascaded bridge structure with phase shifting transformer. IGBT front end converter and their control in synchronous reference frame, four quadrant operation, and resistance emulation methods. (9L+3T)
Single phase Power Factor Correction circuits and control DC/AC converters: Two level inverters: Selective Harmonic Elimination, SPWM, Space Vector, Advances in Space Vector Approach, Effect of dead time on performance and compensation schemes. (8L+3T)
Multilevel Converters NPC, Flying capacitor, and cascaded structures: Analysis and triggering schemes Matrix Converters and their operation Structure and their methods of control. (8L+3T)
Elements of Power Converter Design: For a given application power rating selection of device, loss calculation, driving circuitry design, device protection, current/voltage sensors and their datasheets (LEM). (8L+2T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. N.Mohan, T.M.Undeland and W.P.Robbins, Power Electronics, Wiley, 2007.ISBN:9788126510900, 8126510900
2. L.Umanand, Power Electronics - Essentials and Applications, Wiley India, 2009.ISBN:9788126519453, 8126519452
3. B. K. Bose, Power Electronics and AC Drives, Prentice Hall, 2001. ISBN:9780130167439, 0130167436
4. Marty Brown, Power Supply Cookbook, Newnes Publishers, 2001. ISBN:9780080480121, 0080480128</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Power Electronic Circuits Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>PG/PhD</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td></td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The experiments will be conducted based on the following criteria. From the requirement of the load, the ratings of components such as power devices, L and C are identified using standard steady state equations. The performance is verified through simulations in relevant software and the design can be validated.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">On completion of the course, the students are expected to be able to :
● Test and analyse the basic rectifier and inverter circuits
● Test and analyse controller circuits
● Analyse the power electronic circuit performance</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">● Single-phase and three-phase half-controlled rectifiers
● Single-phase and three-phase fully-controlled rectifiers
● Buck, Boost and Buck-Boost converters
● Single-phase and three-phase Voltage-source inverters
● Single-phase and three-phase Current-source inverters
● Single-phase and three-phase AC voltage regulators</td></tr>
<tr><td>Essential Reading</td><td colspan="6">● N.Mohan, T.M.Undeland and W.P.Robbins, Power Electronics, Wiley, 2007. ISBN:9788126510900, 8126510900
● L.Umanand, Power Electronics - Essentials and Applications, Wiley India, 2009. ISBN:9788126519453, 8126519452</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Analog and Digital Controllers in Power Electronics practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>PG/PhD</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td></td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To enrich the learner with analog and digital controller concepts and its application in the field of Power Electronic Systems</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Upon completion of the course, the students will be able to
● Will understand the analog circuits application in power electronics
● Design of signal conditioning and amplifiers for prototype development
● Hardware implementation using digital and analog controllers.
● Implementation of controllers for power converters.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">● Amplifiers and buffer design and verification by using Opamp
● Filter design and verification by using Opamp
● ON/OFF controller design and verification by using analog circuits
● PI controller design and verification for DC-DC converter
● ADC module testing in DSP controller
● DAC module testing in DSP controller
● Waveform Generation in DSP controller
● PWM pulse generation in DSP controller
● Closed loop ON/OFF controller implementation in DSP</td></tr>
<tr><td>Essential Reading</td><td colspan="6">● Campbell, Steven G., and Toliyat, Hamid A.DSP-Based Electromechanical Motion Control. United Kingdom, CRC Press, 2003.ISBN:9780203486337, 0203486331
● Luo, Fang Lin, et al. Digital Power Electronics and Applications. Netherlands, Elsevier Science, 2010. ISBN:9780080459028, 0080459021
● Michael Jacob, ‘Industrial Control Electronics – Applications and Design’, Prentice Hall, 1995. ISBN:9789813026919, 981302691X</td></tr>
</table>

ANNEXURE E-III-D

Curriculum for M.Tech. ECE-Power Electronic System Design 2021 Batch

<table>
<tr><td>ourse Title</td><td>Power Electronic Control of Electric Machines</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>PG/PhD</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td></td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course is a graduate level course for Electrical Engineering students. This course introduces the students to various motor-load coupling arrangements, power ratings selection, performance characteristics etc., various control principles (ranging from basic to advance) of dc-dc and ac-dc power conversion systems and their effects on machines.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Upon completion of the course, the students will be able to
● Understand and analyze DC and AC motors supplied from different power converters.
● Simulate and study motor characteristics with different converter configurations
● Design and implement a prototype drive system.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Principles of Drives Drivetrain methods - Gear, belt, Ball Screw arrangements. Thermal considerations for motor rating and overloads. Quadrants of operation. Stability considerations. Duty classes S1 - S10 and IP class. Relevant standards (6L+2T).
DC Drives SCR bridge (3-phase) based drive: power circuit operation: continuous and discontinuous conduction, torque ripple. Line reactors for harmonic reduction. Modeling of drive and control system design, example. Control by back emf estimation. Two quadrant operations. H-bridge controlled drive and four quadrant operation Dual Converter based drives and control strategy for reversible operation (9L+3T).
Field Weakening AC Drives: Induction Motor Drives Scalar Control methods Variable voltage method and its implementation in simulation, properties and behavior, limitations, loss and efficiency in variable slip operation Rotor resistance control / Rotor Chopper Control implementation in simulation, analysis of performance - currents in rotor and stator. Slip energy recovery scheme - static Kramer drive estimation of performance curves and control principles (9L+3T).
V/f control, VSI estimation of V/f characteristics, SPWM operations: selection of switching frequency, variable switching frequency. Various schemes of V/f implementation, constant slip, constant slip speed, Field oriented control strategies (9L+3T).
Current Source Inverters and their usage for induction motor control - characteristics of CSI controlled drives. Triggering Schemes for CSI (9L+3T).</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. B. K. Bose, Power Electronics and AC Drives, Prentice Hall, 2001. ISBN:9780130167439, 0130167436
2. Marty Brown, Power Supply Cookbook, Newnes Publishers, 2001. ISBN:9780080480121, 0080480128
3. W. Leonhard, Control of Electrical Drives, Springer, 3rd ed. 2012. ISBN:9783642976469, 3642976468
4. Dubey, G. K.. Fundamentals of Electrical Drives. India, Alpha Science International Limited, 2002. ISBN:9780849324222, 084932422X
5. Krishnan, Ramu. Electric Motor Drives: Modeling, Analysis, and Control. India, Pearson, 2015. ISBN:9788120321687, 8120321685
6. L.Umanand, Power Electronics - Essentials and Applications, Wiley India, 2009. ISBN:9788126519453, 8126519452</td></tr>
<tr><td>Course Title</td><td>Switched Mode Power Converters</td><td>Course No</td><td colspan="4"></td></tr>
</table>

ANNEXURE E-III-D

Curriculum for M.Tech. ECE-Power Electronic System Design 2021 Batch

Department/ Specialization	Electronics & Communication Engineering	Credits	L	T	P	C
			3	1	0	4
Faculty proposing the course	Faculty, Department of ECE	Status	Core ■		Elective □	
Offered for	PG/PhD	Type	New ■		Revision □	
To take effect from	July 2021	Submitted for approval	44thSenate			
Prerequisite						
Learning Objectives	Understand the concepts, basic operation, steady-state operation of efficient switched mode power conversion techniques, including basic circuit operation and magnetic design.					
Learning Outcomes	Upon completion of the course, the students will be able to recognize and use the following concepts, ideas, and/or tools: ● Steady-State Analysis of switched-mode dc-dc power converters. ● Design of Switched-Mode Converters, including selection of component values based on steady-state dc and ac ripple specifications. ● Dynamic Modelling Development and Analysis for switched-mode dc-dc converters using averaging techniques, including the derivation and visualization of converter small-signal transfer functions. ● Analysis and Design of Control Loops around switched-mode power converters using averaging small-signal dynamic models and classical control theory.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Switching devices: Ideal and real characteristics, control, drive and protection. (4L+1T) Design constraints of reactive elements in Power Electronic Systems: Design of inductor, transformer and capacitors for power electronic applications, Input filter requirement(6L+2T) Switching power converters: Circuit topology, operation, steady-state model, dynamic model. PWM DC - DC Converters (CCM and DCM) - operating principles, constituent elements, characteristics, comparisons and selection criteria. (8L+3T) Soft-switching DC - DC Converters: Zero-voltage-switching converters, zero-current switching converters, Multi-resonant converters and Load resonant converters. (8L+2T) Pulse Width Modulated Rectifiers: Properties of ideal rectifier, realization of near ideal rectifier, control of the current waveform, single phase and three-phase converter systems incorporating ideal rectifiers and design examples. (8L+3T) Review of linear control theory. Closed-loop control of switching power converters. Sample designs and construction projects. (8L+3T)					
Essential Reading	● Erickson. Fundamentals of Power Electronics. Netherlands, Springer US, 2013.ISBN:9781461576464, 1461576466 ● Marian K. Kazimierczuk, 'Pulse-width Modulated DC-DC Power Converters' John Wiley & Sons Ltd, 2008. ISBN:9780470694657, 0470694653 ● Philip T Krein, 'Elements of Power Electronics', Oxford University Press, 2012. ISBN:9780199388424, 0199388423 ● Batarseh, 'Power Electronic Circuits', John Wiley, 2004. ISBN:9780471452287, 0471452289 ● H. W. Whittington, B. W. Flynn, D. E. Macpherson, 'Switched Mode Power Supplies', John Wiley & Sons Inc, 1997. ISBN:9780471967729, 0471967726					

Course Title	**Power Electronic Control of Electrical Machines Practice**	Course No	

ANNEXURE E-III-D

Curriculum for M.Tech. ECE-Power Electronic System Design 2021 Batch

<table>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>1</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>PG/PhD</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td></td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To train the students in the emerging area of Power Electronic and Drive Systems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">▪ Hands on study to understand and develop controllers for DC and AC drives.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Experiments on drive systems with converter fed DC and AC drives and their control.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. B. K. Bose, Power Electronics and AC Drives, Prentice Hall, 2001. ISBN:9780130167439, 0130167436
2. Krishnan, Ramu. Electric Motor Drives: Modeling, Analysis, and Control. India, Pearson, 2015.ISBN:9788120321687, 8120321685</td></tr>
</table>

ANNEXURE E-III-D

Curriculum for M.Tech. ECE-Power Electronic System Design 2021 Batch

<table>
<tr><td>Course Title</td><td colspan="2">Switched Mode Power Converters Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td colspan="2" rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td colspan="2">Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td colspan="2">PG/PhD</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td colspan="2">July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td colspan="2"></td></tr>
<tr><td>Learning Objectives</td><td colspan="7">Simulation and prototype development to understand the concepts, basic operation, steady-state operation of efficient switched mode power conversion techniques, including basic circuit operation and magnetic design.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="7">Upon completion of the course, the students will be able to
● Design of Switched-Mode Converters, including selection of component values based on steady-state dc and ac ripple specifications.
● Analysis and Design of Control Loops around switched-mode power converters
● Become proficient with computer skills (e.g., MATLAB) for the analysis and design of switched-mode power converters.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="7">Simulation and modelling of DC-DC converters
Transient analysis of DC-DC converters
Selection and Design of components for DC-DC converters
Isolated converter design and verification
Non-isolated converter design and verification
Open and closed loop controller design of DC-DC converters
Mini projects and demonstration</td></tr>
<tr><td>Essential Reading</td><td colspan="7">1. Erickson. Fundamentals of Power Electronics. Netherlands, Springer US, 2013.ISBN:9781461576464, 1461576466
2. Philip T Krein, ‘Elements of Power Electronics’, Oxford University Press, 2012. ISBN:9780199388424, 0199388423
3. Batarseh, ‘Power Electronic Circuits’, John Wiley, 2004. ISBN:9780471452287, 0471452289</td></tr>
</table>

ANNEXURE E-IV-A

B.Tech. Mechanical Engineering
Curriculum & Syllabus from 2020 Batch

B.Tech (Mechanical Engineering) offered by IIITDM Kancheepuram prepares students in fundamental aspects of Mechanical Engineering with a primary focus on Engineering Materials and Design, Manufacturing methods and Thermal and Fluid Sciences along with Design Thinking required for a product designer. With the required Science and Math courses as foundation courses, the Choice-Based Credit Systems and elective courses allow the students to excel in both analytical and experimental techniques, critical thinking, and mastering problem-solving skills in the aforementioned core areas. A student is eligible for a Mechanical Engineering degree upon completion of all core courses and at least six departmental electives. Further, the free electives also permit the student to gain knowledge in the interdepartmental courses especially in IT and Electronic Engineering. Primarily with a blend of required science and math courses, the curriculum is aimed to produce an industry-ready engineer with fundamental and interdisciplinary concepts, intellectual skills, courage and integrity and society awareness.

Semester 1					
Category	Course Name	L	T	P	C
BSC	Calculus	3	1	0	4
BSC	Engineering Electromagnetics	3	0	0	3
BEC	Electrical Circuits for Engineers	3	1	0	4
BEC	Problem Solving and Programming	3	0	0	3
BEC	Materials for Engineers	3	0	0	3
DSC	Foundation for Engineering and Product Design	1	2	0	3
BSC	Engineering Electromagnetics Practice	0	0	3	1.5
BEC	Problem Solving and Programming Practice	0	0	3	1.5
HSC	Effective Language and Communication Skills	1	0	2	2
HSC	NSO/NCC/SSG/NSS	0	0	2	P/F
					25.0
Semester 2					
Category	Course Name	L	T	P	C
BSC	Differential Equations	3	1	0	4
SEC	Science Elective 1	3	1	0	4
BEC	Engineering Graphics	2	0	4	4
ITC	Elementary Data Structures and Logical Thinking	3	0	0	3
DSC	Sociology of Design	1	2	0	3
ITC	Design and Manufacturing Lab	0	0	2	1
PCC	Engineering Mechanics	3	0	0	3
ITC	Elementary Data Structures and Logical Thinking Practice	0	0	4	2
PCC	Mechanics and Materials Practice	0	0	2	1
HSC	NSO/NCC/SSG/NSS	0	0	2	P/F
HSC	Earth, Environment and Design	1	0	0	P/F
					25.0

B.Tech. Mechanical Engineering
Curriculum & Syllabus from 2020 Batch

Semester 3					
Category	Course Name	L	T	P	C
SEC	Science Elective 2	3	1	0	4
DSC	Systems Thinking for Design	1	2	0	3
PCC	Engineering Thermodynamics	3	1	0	4
PCC	Fluid Mechanics and Fluid Machinery	3	1	0	4
PCC	Mechanics of Materials	3	1	0	4
PCC	Manufacturing Processes - 1	3	1	0	4
PCC	Manufacturing Processes Practice - 1	0	0	4	2
HSC	Indian Constitution, Essence of Indian Traditional Knowledge	1	0	0	P/F
					25.0

Semester 4					
Category	Course Name	L	T	P	C
SEC	Science Elective 3	3	1	0	4
DSC	Smart Product Design	1	2	0	3
PCC	Heat Transfer	3	1	0	4
PCC	Kinematics and Dynamics of Machinery	3	1	0	4
PCC	Manufacturing Processes - 2	3	1	0	4
PCC	Fluid Mechanics and Heat Transfer Practice	0	0	3	1.5
PCC	Mechanical Design Practice	0	0	4	2
PCC	Manufacturing Processes Practice - 2	0	0	3	1.5
HSC	Human Values and Stress Management	1	0	0	P / F
					24.0

Semester 5					
Category	Course Name	L	T	P	C
ITC	Introduction to Data Sciences	3	1	0	4
DSC	Entrepreneurship and Management Functions	1	2	0	3
PCC	Design of Machine Elements	3	1	0	4
PCC	Measurement and Automation	3	1	0	4
PCC	Thermal Engineering Practice	0	0	3	1.5
PCC	Production Drawing and Inspection Practice	0	0	3	1.5
PEC	Professional Elective 1	3	1	0	4
HSC	Professional Ethics and Organizational Behaviour	1	0	0	P/F
					22.0

Semester 6					
Category	Course Name	L	T	P	C
DSC	Prototyping and Testing	1	2	0	3
PEC	Professional Elective 2	3	1	0	4
PEC	Professional Elective 3	3	1	0	4
ELC	Elective 1	3	1	0	4
ELC	Elective 2	3	1	0	4
HSC	Professional Communication	1	0	2	2
HSC	Intellectual Property Rights	1	0	0	P/F
					21.0
Summer					
PCD	Internship				P/F
Semester 7					
Category	Course Name	L	T	P	C
ELC	Elective 3	3	1	0	4
ELC	Elective 4	3	1	0	4
ELC	Elective 5	3	1	0	4
					12.0
Semester 8					
Category	Course Name	L	T	P	C
ELC	Elective 6	3	1	0	4
PCD	Project	0	0	16	8
					12.0

Semester wise Credit Distribution	Credits									
Category	S1	S2	S3	S4	S5	S6	S7	S8	Total	%
Basic Science Course (BSC)	8.5	4	0	0	0	0	0	0	12.5	7.5
Science Elective Course (SEC)	0	4	4	4	0	0	0	0	12	7.2
Basic Engineering Course (BEC)	11.5	4	0	0	0	0	0	0	15.5	9.3
Design Course (DSC)	3	3	3	3	3	3	0	0	18	10.8
IT Skill Course (ITC)	0	6	0	0	4	0	0	0	10	6.0
Professional Core Course (PCC)	0	4	18	17	11	0	0	0	50	30.1
Professional Elective Course (PEC)	0	0	0	0	4	8	0	0	12	7.2
Elective Course (ELC)	0	0	0	0	0	8	12	4	24	14.5
Humanities and Social Science Course (HSC)	2	0	0	0	0	2	0	0	4	2.4
Professional Career Development (PCD)	0	0	0	0	0	0	0	8	8	4.8
Total	25.0	25.0	25.0	24.0	22.0	21.0	12.0	12.0	166.0	100.0

Course Title	**Engineering Mechanics**	Course No	*To be assigned by Academic Cell*
Department/ Specialization	Mechanical Engineering	Credits	L: 3, T: 0, P: 0, C: 3
Faculty proposing the course	Faculty, Department of Mechanical Engineering	Status	Core ■ Elective □
Offered for	B.Tech. MDM	Type	New ■ Revision □
To take effect from	March 2021	Submitted for approval	Senate
Prerequisite	Basic Maths and Physics		
Learning Objectives	• To analyze the components and systems of engineering structures under static and dynamic conditions in terms of forces and moments.		
Learning Outcomes	At the end of the course, a student will be able to: • determine various forces acting on a component and structure, and calculate the resultant forces and moments • apply governing equations of equilibrium, work-energy and impulse-momentum principles to solve engineering problems • analyse the characteristics of single degree of freedom vibration systems		
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Equivalent force systems; free-body diagrams; degrees of freedom; equilibrium of particles and rigid bodies; analysis of determinate structures. (9 hrs) Properties of surfaces and volumes. Friction and applications. Principle of virtual work. (9 hrs) Particle Dynamics: equations of motion; work-energy and impulse-momentum principles; System of particles. (9 hrs) Rigid body dynamics: plane kinematics and kinetics of rigid bodies; Coriolis acceleration; work-energy and impulse-momentum principles. (9 hrs) Introduction to vibrations; single degree of freedom systems. (6 hrs)		
Essential Reading	1. F. Beer. R. Johnston, P.J. Cornwell, S. Sanghi, Vector mechanics for engineers: statics and dynamics, McGraw Hill Education; Eleventh edition, 2017.		
Supplementary Reading	1. J. L Meriam, L.G. Kraige, J.N. Bolton, Engineering Mechanics, Vol. I – Statics, Vol 2: Dynamics, SI version, Wiley, 2018. 2. Irving H Shames, Engineering mechanics: statics and dynamics, Pearson Education India, Fourth Edition, 2005. 3. R.C. Hibbeler, Engineering Mechanics: Statics & Dynamics, Pearson, Fourteenth Edition, 2016.		

<table>
<tr><td>Course Title</td><td>Mechanics and Materials Practice</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. MDM</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Basic Maths and Physics</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To assess a few important geometric and material properties of given objects relevant for engineering applications</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, a student will be able:
1. To measure friction coefficients, radius of gyration, rigidity modulus, strength and elastic modulus of materials.
2. To determine the hardness and examine the microstructure of materials
3. To analyze the stiffness and damping characteristics of single degree of freedom systems</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Experiments to measure rigidity modulus and radius of gyration Experiments to measure strength and elastic modulus of materials Experiments to study the hardness of materials and their microstructure Experiments on small oscillations and friction</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. IIITD&M Laboratory manual for Mechanics and Materials Practice</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. F. Beer. R. Johnston, P.J. Cornwell, S. Sanghi, Vector mechanics for engineers: statics and dynamics, McGraw Hill Education, Eleventh edition, 2017.
2. F.P. Beer, E.R. Johnston, J.T. DeWolf, D. Mazurek, Mechanics of Materials, McGraw-Hill Education, Seventh edition, 2014.
3. Callister's Materials Science and Engineering, Adapted by R. Balasubramaniam, Wiley, Second edition, 2010.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Engineering Thermodynamics</td><td>Course No
(to be assigned by Academic</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. MDM</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">____Senate</td></tr>
<tr><td>Prerequisite</td><td>Basic Maths and Physics</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To develop the basic understanding of thermal concepts and applications to analyze heat, work, energy interaction and thermodynamic cycles.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students will be able to:
● Use thermodynamic terminology correctly
● Assess thermodynamic applications using thermodynamic laws
● Solve problems using the properties and relationships of engineering fluids
● Analyse the performance of ideal and actual thermodynamic cycles such as vapour-power, refrigeration and air-standard cycles.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Basic Concepts and First Law of Thermodynamics: (L3+T1)
Continuum and macroscopic approach; systems (closed and open); thermodynamic properties and equilibrium; paths, processes and cycles; zeroth law of thermodynamics; internal energy, enthalpy; specific heats. Applications: Thermometer, First law applied to elementary processes.
Second Law of Thermodynamics and Entropy: (L6+T2)
Concepts of heat engines and reversed heat engines, Kelvin-Planck and Clausius statements; reversible and irreversible processes; Carnot cycle and Carnot principles/theorems; Clausius inequality and concept of entropy; t-s diagrams; availability and irreversibility; third law of thermodynamics. Applications: Heat pumps/refrigerators and its performance evaluation.
Properties of Pure Substances: (L6+T2)
Thermodynamic properties diagrams of pure substances, steam property tables and charts, steam quality or dryness fraction. Applications: Calculation of thermodynamic properties of liquid water/steam.
Thermodynamic Cycles: (L20+T7)
Carnot vapor cycle, ideal Rankine cycle, modified Rankine cycles. Application: Steam power plant. Otto cycle, air-standard Diesel cycle, air-standard dual cycle, air-standard Brayton cycle Applications: IC Engines and Gas turbines. Simple vapor-compression refrigeration cycle, modified vapor-compression refrigeration cycle. Vapour absorption refrigeration Applications: Refrigerators.
Thermodynamic Relations and Ideal Gas Mixtures: (L7+T2)
T-ds relations, Helmholtz and Gibbs functions, Gibbs relations, Maxwell relations, Clapeyron and Clapeyron-Clausius equations. Air-water vapor mixtures; atmospheric air properties, psychrometric chart. Applications: Air-conditioning Systems</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Nag, P. K. Engineering thermodynamics. Tata McGraw-Hill Education, 2013.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Cengel, Yunus A., and Michael A. Boles. Thermodynamics: An Engineering Approach 6th Editon (SI Units). The McGraw-Hill Companies, Inc., New York, 2007.
2. Kroos, Kenneth A., Merle C. Potter and Shaligram Tiwari. Thermodynamics for engineers. Cengage Learning India Private Limited, 2015.
3. Moran, Michael J., Howard N. Shapiro, Daisie D. Boettner, and Margaret B. Bailey. Fundamentals of engineering thermodynamics. John Wiley & Sons, 2010.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Fluid Mechanics and Fluid Machinery</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty Proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>To be offered for</td><td>B.Tech. MDM</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">_______ Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To introduce different concepts and governing equations for fluid mechanics.
To demonstrate application of the learned concepts.
To discuss the concepts of various fluid machines (both prime mover and non-prime mover) with design concepts</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of this course the students will be able to
Understand the concepts of fluid mechanics and can relate them with practical scenarios and can apply them suitably.
Solve fundamental problems of fluid mechanics which help them to understand the fluid mechanics consideration of mechanical design
Analyse the performance of various turbo machineries which a foundation for the design of turbomachines</td></tr>
<tr><td>Contents of the course
(With approximate break up of hours)</td><td colspan="6">Introduction to fundamental concepts and Fluid Statics (L9+T3)
Introduction to fluid, stress, fluid properties - Density, viscosity, surface tension, different types of flows, Forces on fluid elements, concept of pressure, concept of pressure measurement, stability of submerged and floating object, tutorials
Fluid Kinematics (L3+T1)
The principles governing fluids in motion, the momentum equation, Physical similarity and dimensional analysis
Fluid Dynamics (L18+T7)
Laminar flow between solid boundaries, Flow and losses in pipes and fittings, Boundary layers, wakes and other shear layers, The flow of an inviscid fluid, Flow with a free surface, Application of flow through a pipe, Application of Unsteady flow, Compressible flow of gases, Turbulent flow
Fluid Machinery – Concepts and Design(L12+T3)
Hydraulic turbine – Impulse, Reaction turbine, Pump – Centrifugal pump, reciprocating pump
Wind turbine - Drag and lift turbine - Performance parameters</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Introduction to fluid mechanics and fluid machines, S Som, G Biswash, S Chakraborty, 3e. Tata McGraw-Hill Education, 2017.
2. Fluid Mechanics, F M White, 6e, McGraw-Hill Education, 2017.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Fox and McDonald's Introduction to Fluid Mechanics, J. Pritchard, 8e, John Wiley and sons, 2010
2. Fluid Mechanics: Fundamentals and Applications, Yunus A. Cengel, John A Cimbala. Tata McGraw-Hill Education, 2010.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Mechanics of Materials</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. MDM</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">Senate</td></tr>
<tr><td>Prerequisite</td><td>Engineering mechanics</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To understand the principles of solid mechanics as applied to the simplified case of elastic solids.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, a student will be able to:
1. analyse the material behaviour under different static loading conditions
2. solve problems related to deformation of elastic bodies
3. design the geometry of elements like beams, shafts, columns, under equilibrium loads</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Equilibrium of a deformable body, stress, deformation, strain, Hooke’s law for simple tension, compression and shear; axial loads; Torsion of circular shafts. (9L+3T)
Beam Bending: Shear force and bending moment diagrams, Euler-Bernoulli beam, bending stresses, shearing stress, deflection of beams. (12L+4T)
Buckling of Columns: eccentric loading under various end constraints. (3L+1T)
Biaxial and Triaxial states of stress and strain, Transformations, Principal stresses and strains, Mohr’s circle. (9L+3T)
Theories of failure; Design of thin cylinders, shafts and beams; Energy methods. (9L+3T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. F. P. Beer, E. R. Johnston, J. T. Dewolf, D. F. Mazurek and S. Sanghi, Mechanics of Materials, Mc Graw Hill, 8th edition, 2020.
2. J. M. Gere and B. J. Goodno, Mechanics of Materials, 8th edition, Cengage, 2013.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. R. C. Hibbeler, Mechanics of Materials, Pearson education, 9th edition, 2013.
2. A. C. Ugural, Mechanics of Materials, Wiley India Pvt Ltd, 2013.
3. E. P. Popov, Mechanics of Materials, Pearson education, 2nd edition, 2015.</td></tr>
</table>

Course Title	**Manufacturing Processes - 1**	Course No	*To be assigned by Academic Cell*
Department/ Specialization	Mechanical Engineering	Credits	L T P C 3 1 0 4
Faculty proposing the course	Faculty, Department of Mechanical Engineering	Status	Core ■ Elective □
Offered for	B. Tech. MDM & MSM	Type	New ■ Revision □
To take effect from	2021	Submitted for approval	Senate
Prerequisite	Science and Engineering of Materials		
Learning Objectives	To study the fundamentals of manufacturing processes and equipment.		
Learning Outcomes	● At the end, the students will be able to select the range of manufacturing processes suitable to realize the intended physical components/products. ● At the end the students will be able to identify the causes of the defects if any found in the components/products manufactured and rectify using suitable combinations of parameters.		
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	**Molding and Casting Practices:** (16 *L* + 5 *T*) Introduction to casting and foundry industry; basic principle; sequence in foundry operations; patterns; molding practice; ingredients of molding sand and cores. Melting furnaces. Special casting techniques: investment casting, shell molding, die casting, centrifugal casting, plaster mould casting, magnetic casting, squeeze casting, full mould process, strip casting, CO_2 molding. Gating system design. Casting defects and foundry automation. **Forming and Forging:** (14 *L* + 5 *T*) Basics of plastic forming & forging, forging process – classification – equipment – calculation of forging loads – forging defects – residual stresses, rolling and extrusion – classification -rolling mills - rolling of bars & shapes – rolling forces – defects in rolling - theories of hot & cold rolling – torque power estimation. Extrusion: classification-equipment – deformation lubrication and defects – analysis – hydrostatic extrusion – tube extrusion. Drawing & sheet metal forming- rod & wire drawing, deep drawing, tube drawing, shearing and blanking. **Welding processes:** (12 *L* + 4 *T*) Classification of welding processes, V-I relationship, types of weld joints. Fusion welding processes, solid state welding processes, thermo-chemical welding processes, brazing and soldering. Weld Metallurgy; concept of HAZ, defects in welds, their causes and remedies.		
Essential Reading	1. S. Kalpakjian, S. R. Schmidt, Manufacturing Engineering and Technology, 7th edition, Pearson India, 2009. ISBN: 978-0133128741 2. M. P. Groover, Principles of Modern Manufacturing, 5th edition, Wiley, 2014. 978-8126547371.		
Supplementary Reading	1. B. Wulff, H. F. Taylor and M. C. Fleming, Foundry Engineering, Wiley Eastern, 2009. 2. American Welding Society, Welding Handbook, AWS, 2009. 3. G. E Dieter, Mechanical Metallurgy, Tata McGraw Hill, 2007.		

Course Title	**Manufacturing Processes Practice - 1**	Course No	*To be assigned by Academic Cell*
Department/ Specialization	Mechanical Engineering	Credits	L: 0, T: 0, P: 4, C: 2
Faculty proposing the course	Faculty, Department of Mechanical Engineering	Status	Core ■ Elective □
Offered for	B.Tech MDM & MSM	Type	New ■ Revision □
To take effect from	2021	Submitted for approval	Senate
Prerequisite	Basics of Manufacturing Processes		
Learning Objectives	To perform experiments on fundamental manufacturing processes to understand the process, equipment, tooling and set-up involved in these processes.		
Learning Outcomes	• At the end, students will be able to apply: • A suitable casting process to shape the component and identify the defects involved and rectify them. • Select suitable welding processes based on the application. • The concepts of different forming processes and thus to get desired part shape. • Can identify the effect of process parameters on the outputs and can select suitable process parameter values.		
Course Contents	• Determination of molding properties of sodium silicate bonded sand • Study of the shrinkage behavior during phase change processes • Study of sheet metal forming processes • Study on the springback in forming processes • Study of injection molding process • Study of manual metal arc welding process • Study of gas metal arc welding (GMAW) process • Study of gas tungsten arc welding processes • Study of friction stir welding processes • Study on process control and optimization in welding and casting		
Essential Reading	1. S. Kalpakjian, S. R. Schmidt, Manufacturing Engineering and Technology, 7th edition, Pearson India, 2009. ISBN: 978-0133128741 2. E. P. DeGarmo, J. T. Black, and R. A. Kohser, DeGarmo's materials and processes in manufacturing, 11th edition, John Wiley & Sons, 2013. ISBN: 978-8126540464		
Supplementary Reading	1. M. P. Groover, Principles of Modern Manufacturing, 5th edition, Wiley, 2014. ISBN: 978-8126547371		

ANNEXURE – E-IV-A

<table>
<tr><td>Course Title</td><td>Heat Transfer</td><td>Course No
(to be assigned by Academic Cell)</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty Proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. MDM</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">________ Senate</td></tr>
<tr><td>Prerequisite</td><td>Engineering Thermodynamics, and Fluid Mechanics.</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The course will make the students learn various fundamental concepts in Heat transfer and helps students to develop the problem-solving skills essential to good engineering practice of heat transfer in real-world applications.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At end of the course the students will be able to understand the heat transfer concepts and apply them to solve the real-world heat transfer problems.</td></tr>
<tr><td>Contents of the course
(With approximate break up of hours)</td><td colspan="6">Introduction: (L2+T1)
Modes of heat transfer, Fourier law, Material properties of importance in heat transfer, Thermal conductivity and Specific heat capacity of various materials.
Conduction:(L12+T4)
General Differential equation of Heat Conduction, One Dimensional Steady State Heat Conduction in Cartesian and Polar Coordinates, plane and Composite Systems, Critical insulation thickness, Conduction with Internal Heat Generation, Fins or Extended Surfaces, Unsteady Heat Conduction, Lumped-system Analysis, Slab, Semi-infinite Solids.
Convection and Mass Transfer:(L15+T5)
Energy Equation, Forced and Free Convection, Hydrodynamic and Thermal Boundary Layer. Concept of heat transfer coefficient, Heat transfer in Turbulent and Laminar flows, Free and Forced Convection - external flow over Plates, Cylinders and Spheres. Internal flow through tubes and ducts. Empirical correlations. Mass Transfer - Diffusion, Fick's Law of Diffusion, Steady state Molecular Diffusion, Heat and Mass Transfer Analogy, Mass Transfer Correlations.
Applications: (L8+T2)
Heat Exchanger Types, Overall Heat Transfer Coefficient, Fouling Factors, LMTD method, NTU method. Regimes of Pool boiling and Flow boiling. Correlations in boiling and condensation.
Radiation:(L5+T2)
Basic definitions of radiation. Black Body Radiation, Planck's law, Wien's law, Stefan-Boltzmann law, Kirchhoff's law, and Grey body radiation. Radiative heat transfer between surfaces, View factor. Electrical Analogy, Radiation Shields.</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 10th Edition, 2010.
2. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 5th Edition, 2015</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. A. Bejan, Heat Transfer, John Wiley, 1993
2. F.P.Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, 1998.
3. Massoud Kaviany, Principles of Heat Transfer, John Wiley, 2002
4. A. Bejan, Convection Heat Transfer, John Wiley, 4th Edition, 2013</td></tr>
</table>

B.Tech. Mechanical Engineering
Curriculum & Syllabus from 2020 Batch

Course Title	**Fluid Mechanics and Heat Transfer Practice**	Course No	*To be assigned by Academic Cell*
Department/ Specialization	Mechanical Engineering	Credits	L: 0, T: 0, P: 3, C: 1.5
Faculty proposing the course	Faculty, Department of Mechanical Engineering	Status	Core ■ Elective □
Offered for	B.Tech. MDM	Type	New ■ Revision □
To take effect from	March 2021	Submitted for approval	——— Senate
Prerequisite	Engineering Thermodynamics, Fluid Mechanics and Heat Transfer		

Learning Objectives	• The objective of this course is to provide an experimental exposure for fluid mechanics and heat transfer concepts such as viscosity, pressure, flow, hydrostatic forces, conduction, convection, radiation, etc.
Learning Outcomes	• To acquire practical knowledge in various fluid mechanic, fluid machinery, and Heat transfer concepts
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	The following fluid mechanics and heat transfer experiments will be performed 1. Buoyancy and stability of bodies through metacentric height. 2. Flow Visualization 3. Study of Losses in Flow through Valves 4. Flow Measuring devices 5. Performance analysis of impulse turbine 6. Performance Analysis of Francis Turbine 7. Heat Transfer from Fins 8. Heat Transfer Coefficient in Forced Convection 9. Heat Transfer Coefficient in Natural Convection. 10. Emissivity Measurement.
Essential Reading	1. IIITD&M Laboratory manual for Fluid Mechanics and Heat Transfer Practice.
Supplementary Reading	1. Fluid Mechanics and Heat Transfer Laboratory Manual, IIITDM Kancheepuram. 2. Van Dyke, Milton. An Album of Fluid Motion. Stanford, Calif: Parabolic Press, 1982. 3. Ascher Shapiro. National Committee for Fluid Mechanics Films (NCFMF) in cooperation with the Education Development Center. (A series of 39 videos and accompanying texts which revolutionized the teaching of fluid mechanics)

Course Title	**Kinematics and Dynamics of Machinery**	Course No	*To be assigned by Academic Cell*
Department/ Specialization	Mechanical Engineering	Credits	L: 3, T: 1, P: 0, C: 4
Faculty proposing the course	Faculty, Department of Mechanical Engineering	Status	Core ■ Elective □
Offered for	B.Tech. MDM	Type	New ■ Revision □
To take effect from	March 2021	Submitted for approval	____ Senate
Prerequisite	Engineering Mechanics		
Learning Objectives	• To understand the kinematics and kinetics of various planar mechanisms in different machineries		
Learning Outcomes	At the end of the course, a student will be able to: 1. investigate the motion of a planar mechanisms using graphical and analytic methods 2. synthesize cams, followers, gears and gear-trains 3. analyze the imbalance in rotating and reciprocating masses		
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Introduction to mechanisms- joints, pairs and couplings; Constraints, mobility and degree of freedom, Grashof's law, Kinematic inversions. (7 L + 2 T) Kinematics (Position, Velocity and Acceleration) of rigid bodies – analytical and graphical methods. (12 L + 4 T) Kinematic synthesis of mechanisms, gears, gear trains and cams. (12 L + 4 T) Dynamics of planar mechanisms – slider crank forces, engine balancing. (6 L + 2 T) Review of vibrations; Harmonically excited vibration; Vibration isolation, resonance, critical speeds of shafts (5 L + 2 T)		
Essential Reading	1. J.J. Uicker, G.R. Pennock and J.E. Shigley, Theory of Machines and Mechanisms, Oxford University Press, 4th Edition, 2014.		
Supplementary Reading	1. A. Ghosh and A. K. Mallik, Theory of Mechanism and Machines, Affiliated East – West Press Private Ltd., 2009. 2. S. S. Rattan, Theory of Machines, Tata McGraw-Hill, 4th Edition, 2017. 3. Norton, R.L., Design of Machinery, Third Edition, Tata McGraw Hill, New Delhi, 2005.		

<table>
<tr><td>Course Title</td><td>Manufacturing Processes - 2</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B. Tech. MDM & MSM</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Engineering Materials, Manufacturing Processes - I</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To study the fundamentals of machining processes and machine tools.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">●At the end students will be able to select and apply a suitable machining process and cutting tool upon the workpiece material and geometry.
●At the end students will be able to identify the machining defects and solution to overcome the same.
●At the end students will be able to utilize the powder metallurgy concepts.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Machining and Cutting Tool: (6 L + 2 T)
Material removal. Elements, fundamental, mechanism of deformation in metal cutting. Geometry & design of single and multi-point tool
Mechanics of Chip Formation: (6 L + 2 T)
Orthogonal & oblique cutting, mechanism of chip formation, chip types, mechanics of machining. Forces and stresses on tool and its distribution, cutting force measuring technique.
Heat flow in metal cutting and tool life: (6 L + 2 T)
Heat flow in primary, secondary and tertiary zones, tool temperature measurement, temperature distribution in tool. Machinability, tool life, Taylor’s equation, tool failure, economics in metal machining.
Cutting Tool material and Cutting life: (8 L + 3 T)
Tool materials, Alloying elements in tool steel. Carbon steel, high speed steels, co- cast alloys, carbide tools, ceramic tools, diamond. Function & requirement of cutting fluid. Type of cutting fluid. Method of application of cutting fluids.
Abrasive Machining Processes and Broaching: (8 L + 3 T)
Abrasive processes, grinding wheel - specifications and selection, types of grinding process, concepts of surface integrity, broaching machines, broach construction
Processing of Powder metals: (8 L + 2 T)
Production and compaction of metal powders, sintering, design and process capabilities. Forming, shaping and machining of ceramics. Processing semiconductors, elastomers, metal matrix composites and ceramic-matrix composite.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. S. Kalpakjian, S. R. Schmidt, Manufacturing Engineering and technology, 7th edition, Pearson India, 2009. ISBN: 978-0133128741
2. M. P. Groover, Principles of Modern Manufacturing, 5th edition, Wiley, 2014. 978-8126547371.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1.E. P. DeGarmo, J. T. Black, and R. A. Kohser, DeGarmo's materials and processes in manufacturing, 11th edition, John Wiley & Sons, 2013.
2.D. A. Stephenson, and J. S. Agapiou, Metal cutting theory and practice, CRC Press, 2005.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Manufacturing Processes Practice - 2</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech MDM & MSM</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">—— Senate</td></tr>
<tr><td>Prerequisite</td><td>Basics of Manufacturing Processes</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To study and practice the various operations that can be performed in lathe, milling machines etc. and to equip with the practical knowledge required in the core industries.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of this course the student will be able to select and apply
1. Methods to solve problems on cutting forces, tool life and analytical methods of estimating cutting temperature.
2. Suitable machining operations to subtractively remove the materials and thus to get the component/workpiece with desired geometry.</td></tr>
<tr><td>Course Contents</td><td colspan="6">Lathe Exercises
Machining and machining time estimations for
● Taper Turning
● External Thread cutting
● Internal Thread Cutting
● Knurling
Milling Exercises
● Simple prismatic parts
● Contour milling using vertical milling machine
● Spur gear cutting in milling machine
● Helical gear cutting in milling machine
Drilling Exercises
● Effect of Primary Cutting Edges
● Effect of Secondary Cutting Edges
Grinding Exercises
● Plain Surface grinding
● Cylindrical grinding
Determination of material removal rate in various processes
Measurement of cutting forces in basic processes</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. S. Kalpakjian, S. R. Schmidt, Manufacturing Engineering and Technology, 7th edition, Pearson India, 2009. ISBN: 978-0133128741</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. M. P. Groover, Principles of Modern Manufacturing, 5th edition, Wiley, 2014. ISBN: 978-8126547371</td></tr>
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<table>
<tr><td>Course Title</td><td>Mechanical Design Practice</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. MDM</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">—— Senate</td></tr>
<tr><td>Prerequisite</td><td>Engineering mechanics</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To understand the kinematics and kinetics of various mechanisms.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, a student will be able:
1. To analyse the effects of force, motion and their interactions on simple machineries.
2. To investigate the resonance conditions in slender shafts and simple vibrating systems</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Experiments on kinematic simulations for few mechanisms and inversions.
Experiments based on the concepts of kinematics and dynamics of machine elements and machineries, like cams, balancing of masses, gyroscope, gear-trains.
Experiments related to resonance in shafts, and different damping conditions of longitudinal vibrations.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. IIITD&M Laboratory manual for Mechanical Design Practice</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. J.J. Uicker, G.R. Pennock and J.E. Shigley, Theory of Machines and Mechanisms, Oxford University Press, 4th Edition, 2014.
2. A. Ghosh and A. K. Mallik, Theory of Mechanism and Machines, Affiliated East – West Press Private Ltd., 2009.
3. Norton, R.L., Design of Machinery, Third Edition, Tata McGraw Hill, New Delhi, 2005.</td></tr>
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<table>
<tr><td>Course Title</td><td>Data Science –An Applied Perspective</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Dept. of CSE</td><td>Status</td><td>Core</td><td>■</td><td>Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td>Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course covers the basic concepts of Data Science to help the student to learn, understand and practice data analytics encompassing concepts from descriptive, inferential statistics and predictive techniques and big data concepts.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">● Ability to identify the characteristics of datasets ; Ability to select and implement machine learning techniques suitable for the respective application ;
● Ability to solve problems associated with big data characteristics such as high dimensionality;
● Ability to integrate machine learning libraries and mathematical and statistical tools</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Introduction to relevant industry applications and analytics – Descriptive Statistics – Data Visualization & Interpretation -Measures of Central Tendency & Dispersion - Basic and advanced plots such as Stem-Leaf Plots, Histograms, Pie charts, Box Plots, Violin Plots etc. – Merits of Demerits & Interpretation (10)
Inferential Statistics – Hypothesis Testing - Tests of Significance – Analysis of Variance - Regression – Linear and Logistic (8)
Predictive Analytics – Supervised and Unsupervised – Association Rules, Classification, Clustering, Outlier Analysis, Time Series Modeling (14)
Big Data Characteristics – Map Reduce – Deduplication, Distributed Storage, Implementation using Hadoop / Pyspark platforms (8)
Practice Component: Concepts from Descriptive Statistics, Inferential and Predictive Analytics would be test driven using platforms such as Python, R etc. ML support in these platforms for rule mining and application, classification & clustering algorithms etc. would also be test driven as part of the practice exercises. Modern technologies for big data handling such as Pyspark – support for Map reduce would also be test driven. Applications relevant to the students stream of specialization would be explored for exercises / course project as case studies. (14 sessions – weekly exercises)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. J Han, M Kamber, Data Mining Concepts & Techniques, Elsevier, 3rd Edition, 2007, ISBN 9780123814791</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Joel Grus, Data Science from Scratch, Orielly, 2nd Edn, 2019, ISBN 9781492041139
2. Leskovec, Anand Rajaraman,, Ullmann, Mining of Massive Data Sets, Cambridge University Press, Open Source free version , ISBN 9781107015357
3. P Bruce, Practical Statistics for Data Scientists, O'Reilly, 2017, iSBN 9789352135653</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Design of Machine Elements</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/
Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. MDM</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">—— Senate</td></tr>
<tr><td>Prerequisite</td><td>Engineering Mechanics, Mechanics of Materials</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To understand design concepts and procedures necessary to design and/or select a machine component in terms of geometry and materials</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, a student will be able to:
1. analyze the stresses in machine elements and structural members under various loads
2. apply multidimensional failure criteria in the analysis and design of machine components
3. design and select power transmission systems involving belts, clutches, gears</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Review of failure theories; Design for variable loading - fatigue strength and design; design of shafts and springs. (L11+T4)
Design of rivets, bolts and Power Screws. (L6+T2)
Theory of friction drives. Design and selection of belt drives; Design of clutches. (L7+T2)
Design of Gears – spur, helical and worm gears – Contact and bending fatigue strength – Gear accuracy. (L10+T4)
Tribology – Lubricant theories; Design of Journal bearings; Selection of ball and roller bearings. (L8+T2)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Richard G Budynas and J Keith Nisbett, Shigley's Mechanical Engineering Design, McGraw-Hill Education, 10th Edition, 2017</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. V Bhandari, Design of Machine Elements, McGraw-Hill Education, 4th Edition, 2017.
2. Robert L. Norton, Machine Design, Pearson Education, 5th Edition, 2018</td></tr>
</table>

ANNEXURE E-IV-A

<table>
<tr><td>Course Title</td><td>Measurement and Automation</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/
Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. MDM</td><td>Type</td><td colspan="2"><s>New</s> ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">● To understand the importance of automation in the field of manufacturing.
● Analyse the characteristics of measurement systems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course student will able to:
● Apply basic principles of measuring systems and applications of robot in automation industries.
● Analyse the magnetic measurements and working principle of various transducers
● Understand hydraulic and pneumatic systems, and their performance characteristics.
● Describe the importance and application of automation in Industry.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">General principles of measurements: Measurement system, True value, Accuracy, Precision, Resolution, Drift, Hysteresis, Dead-band, Sensitivity, Significance, Mean, Standard deviation, Six-sigma estimation. (3L + 1T) Magnetic Measurements: Measurement of flux and permeability, BH curve and permeability measurement, Determination of BH curve. Transducers- Definition and classification, Transducers for measurement of displacement, Velocity, Flow, Force, Pressure, Strain and temperature, Basic principles of LVDT, Electromagnetic and ultrasonic flow meters, Piezoelectric force transducer, Load cell, Strain gauge, Thermistors, Thermocouple. (12 L + 4 T) Hydraulic Systems: Hydraulic systems, Flow, Pressure and direction control valves, Actuators, Supporting and control elements, Pumps, Servo valves and actuators, Electro hydraulic servo-valves, Proportional valves and their application, Design of hydraulic circuits for manufacturing automation and performance analysis. (11 L + 4 T)
Pneumatic Systems: Distribution and conditioning of compressed air, System components and graphic representations, Design of circuits-switching circuits and sequential circuits, Cascade methods, Step counter method, Compound circuit design. (11 L + 4 T)
Automated flow lines analysis: Automation strategies, Historical developments of the assembly process, Selection of assembly, Design for automated assembly, Transfer systems, Vibratory bowl feeder mechanism, Non-vibratory feeder's mechanism, Analysis and design of part orienting devices, Feed tracks and part placing mechanisms, Robot based automation. (5 L + 1 T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. F.W. Roller, Electric and Magnetic Measurements and Measuring Instruments, Forgotten books press, 2018.
2. Anthony Esposito, Fluid power with applications, 7th Ed., 2016, Prentice Hall.
3. M.P. Groover, Automation, Production Systems and Computer-Integrated Manufacturing, 5th Ed, Pearson, 2020.
4. S.R. Deb and S. Deb, Robotics Technology and Flexible Automation, McGraw Hill, 2017.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. W. Bolton, Pneumatic & Hydraulic Systems, Butterworth-Heinemann, ISBN: 9780080966748, 2011.
2. A. Moris and R. Langari, Measurement and Instrumentation, 3rd Ed, 2020.
3. C.P. Boothroyd and L.E. Murch, Assembly Automation and Product Design Automatic Assembly, CRC Press, 2005.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Production Drawing & Inspection Practice</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. MDM</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">——— Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">● To familiarize with 3D modeling and to gain an understanding of industrial drafting practices
● To familiarize with precision measurement methods and inspection practices followed in industrial metrology.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, a student will be able to:
1. Develop 3D models of machine components and generate 2D drawing from 3D models; digitize existing products using reverse engineering
2. Create assembled and exploded views of machine components
3. Apply inspection practices to industry scale products and systems.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Part modeling of machine components; Assembly of machine components; Machine drawing – drafting of assembly.
Production drawings of machine parts – Dimensional and geometric tolerances; surface roughness and welding symbols; Bill of materials and process charts.
Calibration experiments using precision measurement methods and devices; gear and screw–thread metrology; flatness measurement; quality control and statistical inferencing – Hypothesis testing.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. IIITD&M Laboratory manual for Metrology & Inspection Practice</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Bertoline, Wiebe, Miller, Nasma., “Technical Graphics Communication,” IR WIN Graphic Series, 2008.
2. S. Bogolyubov. A. Voinov., “Engineering Drawing,” Van Nostrand Reinhold Company, 2001.
3. D. E. Hewitt., “Engineering Drawing and Design for Mechanical Technicians,” The Macmillan Press Ltd, London, 2006.
4. Michael F. Ashby, “Materials and the Environment: ECO-Informed Material Choice, Elsevier, 2012.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Thermal Engineering Practice</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. MDM</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Engineering Thermodynamics, Fluid Mechanics and Heat Transfer</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• In this practice course, undergraduate engineering students will conduct experiments to understand the various concepts taught in thermal engineering courses.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">To acquire practical knowledge in various modern thermal systems</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">To familiarize students with thermal engineering related equipment and experimental setups such as Flash-point & fire-point, Calorific value, Reciprocating compressor, Refrigeration system, Air-conditioning system, Mini power-plant(Rankine Cycle), Solar water-heater, Valve-timing diagram, SI-Engine, Cooling-tower</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. IIITD&M Laboratory manual for Thermal Engineering Practice</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Eastop, T. D., and A. McConkey. "Applied Thermodynamics for Engineering Technologists", Pearson Education India (2002).</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Professional Communication</td><td>Course No</td><td colspan="4">HS3001</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">English</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>1</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Faculty proposing the course</td><td>Dr. Parvathy Das
Faculty, Dept. of SH</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech.</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• Develop the capability to apply for a job and participate in selection process
• Acquire interview skills
• Gain proficiency in language skills indispensable for a successful professional
• Develop emotional intelligence</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• Prepare résumé and cover letter
• Ready to perform at different levels of the interview process
• Able to use interpersonal skills in challenging situations
• Competent to draft various documents for specific purposes</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Preparing cover letter, résumé, digital profile; video profile; Email etiquette (L2,P4)
• Interview skills, Group discussion and impromptu speech (L2,P6)
• Social communication skills (L4,P6)
  ○ Conversational English appropriateness, context based speaking in general situations, discussion and associated vocabulary in professional situations)
  ○ Non-verbal communication – relevance and effective use of paralinguistic features – body language, chronemics, haptics, proxemics
  ○ Emotional intelligence (EI) and social intelligence at workplace – theoretical perspectives and their application in relevant workplace situations – EI and leadership skills – assessments and best practices in organizations
• Conflict management and communication at workplace (L4,P6)
  ○ Cross-cultural communication, Argumentation, negotiation, persuasion, decision making, case study of challenging situations
  ○ Organizing a meeting, working as part of a team, briefing
  ○ Business presentations – Preparing effective presentations, delivering presentaions and handling questions
• Writing proposals, statement of purpose, research article, agreements, summary Proofreading (L1,P4)
• Training for proficiency assessment (L1,P2)</td></tr>
<tr><td>References</td><td colspan="6">1. Tebeaux, Elizabeth, and Sam Dragga. The Essentials of Technical Communication. OUP, 2018.
2. Sabin, William A. The Gregg Reference Manual: A Manual of Style, Grammar, Usage, and Formatting. McGraw-Hill, 2011, pp 408-421.
3. Raman, Meenakshi and Sangeeta Sharma. Technical Communication: Principles and Practice. OUP, 2015.
4. Caruso, David R. and Peter Salovey. The Emotionally Intelligent Manager: How to Develop and Use the Four Key Emotional Skills of Leadership. John Wiley and Sons, 2004.
5. https://learnenglish.britishcouncil.org/business-english/youre-hired/episode-01
6. https://www.youtube.com/watch?v=HAnw168hugA
7. https://www.youtube.com/watch?v=azrqlQ_SLW8
8. https://owl.purdue.edu/owl/purdue_owl.html
9. Turabian,Kate L. Student's Guide to Writing College Papers. University of Chicago Press, 2010.</td></tr>
<tr><td>Methodology for content delivery</td><td colspan="6">Since students have been introduced to the basics of technical and professional communication in the first semester, this course is designed with the purpose of giving them intense training in professional and academic communication with global competence. Once the concept is introduced, adequate time should be devoted to practice and review.</td></tr>
</table>

ANNEXURE E-IV-B

B.Tech. Smart Manufacturing
Curriculum & Syllabus from 2020 Batch

B.Tech (Smart Manufacturing) program has been offered by IIITDM Kancheepuram since 2016. This program prepares the learners for the future manufacturing industries that are going to be connected globally and almost functioning autonomously. The advanced hardware and software tools are useful to make manufacturing industries socially and ecologically sustainable. This customized curriculum is highly interdisciplinary to empower the learners to design, create, operate and control at system level in manufacturing industries. The major offers the learners, the required fundamentals in Production and Industrial Engineering, Manufacturing systems, design-thinking, Electronics, and Information Technology. The learners' hands-on practices with sensors, control and automation systems, operations and supply chain management. and data science prepare them for industry. A student is eligible for a Smart Manufacturing degree upon completion of all core courses and at least six departmental electives. The free electives also permit the student to further gain knowledge in other interdepartmental or allied areas. In the overall sense, the smart manufacturing curriculum is aimed to produce an industry-ready engineer with fundamental and interdisciplinary concepts, intellectual skills, courage and integrity and society awareness.

Semester 1					
Category	**Course Name**	**L**	**T**	**P**	**C**
BSC	**Calculus**	**3**	**1**	**0**	**4**
BSC	**Engineering Electromagnetics**	**3**	**0**	**0**	**3**
BEC	**Electrical Circuits for Engineers**	**3**	**1**	**0**	**4**
BEC	**Problem Solving and Programming**	**3**	**0**	**0**	**3**
BEC	**Materials for Engineers**	**3**	**0**	**0**	**3**
DSC	**Foundation for Engineering and Product Design**	**1**	**2**	**0**	**3**
BSC	**Engineering Electromagnetics Practice**	**0**	**0**	**3**	**1.5**
BEC	**Problem Solving and Programming Practice**	**0**	**0**	**3**	**1.5**
HSC	**Effective Language and Communication Skills**	**1**	**0**	**2**	**2**
HSC	**NSO/NCC/SSG/NSS**	**0**	**0**	**2**	**P/F**
					25.0

Semester 2					
Category	**Course Name**	**L**	**T**	**P**	**C**
BSC	**Differential Equations**	**3**	**1**	**0**	**4**
SEC	**Science Elective 1**	**3**	**1**	**0**	**4**
BEC	**Engineering Graphics**	**2**	**0**	**4**	**4**
ITC	**Elementary Data Structures and Logical Thinking**	**3**	**0**	**0**	**3**
DSC	**Sociology of Design**	**1**	**2**	**0**	**3**
ITC	**Design and Manufacturing Lab**	**0**	**0**	**2**	**1**
PCC	**Applied Mechanics**	**3**	**0**	**0**	**3**
ITC	**Elementary Data Structures and Logical Thinking Practice**	**0**	**0**	**4**	**2**
PCC	**Applied Mechanics Practice**	**0**	**0**	**2**	**1**
HSC	**NSO/NCC/SSG/NSS**	**0**	**0**	**2**	**P/F**
HSC	**Earth, Environment and Design**	**1**	**0**	**0**	**P/F**
					25.0

ANNEXURE E-IV-B

B.Tech. Smart Manufacturing
Curriculum & Syllabus from 2020 Batch

Semester 3					
Category	Course Name	L	T	P	C
SEC	Science Elective 2	3	1	0	4
DSC	Systems Thinking for Design	1	2	0	3
PCC	Manufacturing Processes - 1	3	1	0	4
PCC	Theory of Machines and Design	3	0	0	3
PCC	Electrical Drives	2	0	0	2
PCC	Sensors and Controls	3	0	0	3
PCC	Manufacturing Processes Practice - 1	0	0	3	1.5
PCC	Introduction to Data Management	2	0	2	3
PCC	Electrical Drives Practice	0	0	3	1.5
HSC	Indian Constitution, Essence of Indian Traditional Knowledge	1	0	0	P/F
					25.0
Semester 4					
Category	Course Name	L	T	P	C
SEC	Science Elective 3	3	1	0	4
DSC	Smart Product Design	1	2	0	3
PCC	Manufacturing Processes - 2	3	1	0	4
PCC	Thermal and Fluids Engineering	3	0	0	3
PCC	Operations Research	3	0	0	3
PCC	Production Drawing Practice	0	0	3	1.5
PCC	Manufacturing Processes Practice - 2	0	0	3	1.5
PCC	Embedded Systems Practice	1	0	2	2
PCC	Machine to Machine Communication	2	0	2	3
HSC	Human Values and Stress Management	1	0	0	P / F
					25.0
Semester 5					
Category	Course Name	L	T	P	C
ITC	Introduction to Data Sciences	3	1	0	4
DSC	Entrepreneurship and Management Functions	1	2	0	3
PCC	Operations and Supply Chain Management	3	0	0	3
PCC	Robotics and Automation	3	0	0	3
PEC	Professional Elective 1	3	1	0	4
PCC	Quality Engineering	2	0	2	3
PCC	Robotics and Automation Practice	0	0	2	1
HSC	Professional Ethics and Organizational Behaviour	1	0	0	P/F
					21.0

B.Tech. Smart Manufacturing
Curriculum & Syllabus from 2020 Batch

Semester 6					
Category	Course Name	L	T	P	C
DSC	Prototyping and Testing	1	2	0	3
PEC	Professional Elective 2	3	1	0	4
PEC	Professional Elective 3	3	1	0	4
ELC	Elective 1	3	1	0	4
ELC	Elective 2	3	1	0	4
HSC	Professional Communication	1	0	2	2
HSC	Intellectual Property Rights	1	0	0	P/F
					21.0
Summer					
PCD	Internship				P/F
Semester 7					
Category	Course Name	L	T	P	C
ELC	Elective 3	3	1	0	4
ELC	Elective 4	3	1	0	4
ELC	Elective 5	3	1	0	4
					12.0
Semester 8					
Category	Course Name	L	T	P	C
ELC	Elective 6	3	1	0	4
PCD	Project	0	0	16	8
					12.0

Semester wise Credit Distribution	Credits									
Category	S1	S2	S3	S4	S5	S6	S7	S8	Total	%
Basic Science Course (BSC)	8.5	4	0	0	0	0	0	0	12.5	7.5
Science Elective Course (SEC)	0	4	4	4	0	0	0	0	12	7.2
Basic Engineering Course (BEC)	11.5	4	0	0	0	0	0	0	15.5	9.3
Design Course (DSC)	3	3	3	3	3	3	0	0	18	10.8
IT Skill Course (ITC)	0	6	0	0	4	0	0	0	10	6.0
Professional Core Course (PCC)	0	4	18	18	10	0	0	0	50	30.1
Professional Elective Course (PEC)	0	0	0	0	4	8	0	0	12	7.2
Elective Course (ELC)	0	0	0	0	0	8	12	4	24	14.5
Humanities and Social Science Course (HSC)	2	0	0	0	0	2	0	0	4	2.4
Professional Career Development (PCD)	0	0	0	0	0	0	0	8	8	4.8
Total	25.0	25.0	25.0	25.0	21.0	21.0	12.0	12.0	166.0	100.0

<table>
<tr><td>Course Title</td><td>Applied Mechanics</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. Smart Manufacturing</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">Senate</td></tr>
<tr><td>Prerequisite</td><td>Materials for engineers</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course is intended to give an understanding of
• the force and moment systems on mechanical structures
• the equations governing rigid body systems
• the behaviour of solid bodies subjected to various types of loads.
• the connection between the properties of materials and the behaviour of physical systems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the completion of the course, the student will be able to
• analyze the interactions of various structural elements
• apply the principles to practical structural analysis
• carry out design and failure analyses of basic mechanical structures.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Engineering mechanics:
Equivalent force systems, free body concepts, equations of equilibrium; Trusses (L12)

Strength of materials:
stress, strain and their relation for simple tension, compression and shear; Axial load; Torsion (L9)

Bending – Shear force and Bending moment, Stresses, Deflection; Euler's theory of columns (L9)

Analysis of stress and strain – Transformations, Principal stresses and strains, Plane stress, Mohr's circle; Thin cylinders; Theories of failure. (L12)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. B. J. Goodno and J. M. Gere, Statics and Mechanics of Materials, CL Engineering, SI edition, 2018. ISBN-13: 978-133364412.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. F. P. Beer, E. R. Johnston, J. T. Dewolf, and D. F. Mazurek, Statics and Mechanics of Materials, McGraw Hill, 3rd edition, 2021, ISBN-13: 978-0073398167.
2. R. C. Hibbeler, Statics and Mechanics of Materials, 5th edition, Pearson education, 2016, ISBN-13: 978-0134382593.
3. W. F. Riley, L. D. Sturges and D. H. Morris, Statics and Mechanics of Materials: An integrated approach, Willey, 2nd edition, 2018, ISBN-13: 978-0471013341.
4. A. Bedford, K.Liechti and W. Fowler, Statics and Mechanics of Materials, 5th edition, Pearson education, 2002, ISBN-13: 978-0130285935.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Applied Mechanics Practice</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. Smart Manufacturing</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">—— Senate</td></tr>
<tr><td>Prerequisite</td><td>Materials for engineers</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course is intended to give a hands-on experience to
● relate theoretical principles of rigid body mechanics to various practical systems
● find the properties of materials by applying various experimental methods.
● apply the equations and see the real time behavior of deformable bodies and various structural elements
● handle the instruments and present the results</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the completion of the course, the student will be able to
● analyze the interactions of various structural elements experimentally
● do mechanical characterization of the materials
● apply standard methods of testing materials.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Experiments to investigate the variation of static coefficient of friction with various combinations of material surfaces and radius of gyration with bar and torsional pendulums. (P9)

Experiments to measure various material properties such as rigidity modulus, Young’s modulus, flexural modulus, Poisson's ratio, etc. (P12)

Experiments to study the influence of microstructure on Young’s modulus, hardness, tensile strength, creep, etc. (P6)

Experiments to study the influence of geometry and the strength of materials on structural elements like beam and column. (P6)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. B. J. Goodno and J. M. Gere, Statics and Mechanics of Materials, CL Engineering, SI edition, 2018. ISBN-13: 978-133364412.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. F. P. Beer, E. R. Johnston, J. T. Dewolf, and D. F. Mazurek, Statics and Mechanics of Materials, McGraw Hill, 3rd edition, 2021, ISBN-13: 978-0073398167.
2. R. C. Hibbeler, Statics and Mechanics of Materials, 5th edition, Pearson education, 2016, ISBN-13: 978-0134382593.
3. W. F. Riley, L. D. Sturges and D. H. Morris, Statics and Mechanics of Materials: An integrated approach, Willey, 2nd edition, 2018, ISBN-13: 978-0471013341.
4. A. Bedford, K.Liechti and W. Fowler, Statics and Mechanics of Materials, 5th edition, Pearson education, 2002, ISBN-13: 978-0130285935.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Manufacturing Processes - 1</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core</td><td colspan="2">Elective</td></tr>
<tr><td>Offered for</td><td>B.Tech. Mechanical Engineering & Smart Manufacturing</td><td>Type</td><td colspan="2">New □</td><td colspan="2">Revision ■</td></tr>
<tr><td>To take effect from</td><td>2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Materials for engineers</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To study the fundamentals of manufacturing processes and equipment.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• At the end, the students will be able to select the range of manufacturing processes suitable to realize the intended physical components/products.
• At the end the students will be able to identify the causes of the defects if any found in the components/products manufactured and rectify using suitable combinations of parameters.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Molding and Casting Practices: (16L + 5T)
Introduction to casting and foundry industry; basic principle; sequence in foundry operations; patterns; molding practice; ingredients of molding sand and cores. Melting furnaces. Special casting techniques: investment casting, shell molding, die casting, centrifugal casting, plaster mould casting, magnetic casting, squeeze casting, full mould process, strip casting, CO_2 molding. Gating system design. Casting defects and foundry automation.
Forming and Forging: (14L + 5T)
Basics of plastic forming & forging, forging process – classification – equipment - calculation of forging loads – forging defects – residual stresses, rolling and extrusion – classification -rolling mills - rolling of bars & shapes – rolling forces - defects in rolling - theories of hot & cold rolling – torque power estimation. Extrusion: classification-equipment – deformation lubrication and defects – analysis – hydrostatic extrusion – tube extrusion. Drawing & sheet metal forming- rod & wire drawing, deep drawing, tube drawing, shearing and blanking.
Welding processes: (12L + 4T)
Classification of welding processes, V-I relationship, types of weld joints. Fusion welding processes, solid state welding processes, thermo-chemical welding processes, brazing and soldering. Weld Metallurgy; concept of HAZ, defects in welds, their causes and remedies.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. S. Kalpakjian, S. R. Schmidt, Manufacturing Engineering and Technology, 7th edition, Pearson India, 2009. ISBN: 978-0133128741
2. M. P. Groover, Principles of Modern Manufacturing, 5th edition, Wiley, 2014. 978-8126547371.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. B. Wulff, H. F. Taylor and M. C. Fleming, Foundry Engineering, Wiley Eastern, 2009.
2. American Welding Society, Welding Handbook, AWS, 2009.
3. G. E Dieter, Mechanical Metallurgy, Tata McGraw Hill, 2007.</td></tr>
</table>

B.Tech. Smart Manufacturing
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<table>
<tr><td>Course Title</td><td>Manufacturing Processes Practice - 1</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. Mechanical Engineering & Smart Manufacturing</td><td>Type</td><td colspan="2">New □</td><td colspan="2">Revision ■</td></tr>
<tr><td>To take effect from</td><td>2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Basics of Manufacturing Processes</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To perform experiments on fundamental manufacturing processes to understand the process, equipment, tooling and set-up involved in these processes.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• At the end, students will be able to apply:
• A suitable casting process to shape the component and identify the defects involved and rectify them.
• Select suitable welding processes based on the application.
• The concepts of different forming processes and thus to get desired part shape. Can identify the effect of process parameters on the outputs and can select suitable process parameter values.</td></tr>
<tr><td>Course Contents</td><td colspan="6">1. Determination of molding properties of sodium silicate bonded sand
2. Study of the shrinkage behavior during phase change processes
3. Study of sheet metal forming processes
4. Study on the springback in forming processes
5. Study of injection molding process
6. Study of manual metal arc welding process
7. Study of gas metal arc welding (GMAW) process
8. Study of gas tungsten arc welding processes
9. Study of friction stir welding processes
10. Study on process control and optimization in welding and casting</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. S. Kalpakjian, S. R. Schmidt, Manufacturing Engineering and Technology, 7th edition, Pearson India, 2009. ISBN: 978-0133128741
2. E. P. DeGarmo, J. T. Black, and R. A. Kohser, DeGarmo's materials and processes in manufacturing, 11th edition, John Wiley & Sons, 2013. ISBN: 978-8126540464</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. M. P. Groover, Principles of Modern Manufacturing, 5th edition, Wiley, 2014. ISBN: 978-8126547371</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Theory of Machines and Design</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/
Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. Smart Manufacturing</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Applied Mechanics</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To understand the kinematics and kinetics of various planar mechanisms.
• To understand design concepts and procedures necessary to design and/or select a machine component in terms of geometry and materials.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, a student will be able to:
• Investigate the motion of planar mechanisms using graphical and analytic methods.
• Apply multidimensional failure criteria in the analysis and design of machine components.
• Design of power transmission systems involving shafts, gears, belts and bearings.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Introduction to mechanisms- joints, pairs and couplings; Constraints, mobility and degree of freedom, mobility criterion, Grashof’s law. (6L)
• Analysis of Planar Mechanism (Position, Velocity and Acceleration); Cams and Followers. (8L)
• Design based on Failure theories; Design of Shafts, Keys and Couplings.
(8L) Design of Joints - Bolted, Riveted and Welded Joints (8L)
• Design of Spur Gears and Belt Drives
(6L)
• Design of Clutches and Bearings (6L)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. J.J. Uicker, G.R. Pennock and J.E. Shigley, Theory of Machines and Mechanisms, Oxford University Press, 4th Edition, 2014.
2. R.G. Budynas and J.K. Nisbett, Shigley's Mechanical Engineering Design, McGraw-Hill Education, 10^{th} Edition, 2017</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Ghosh and A. K. Mallik, Theory of Mechanism and Machines, Affiliated East – West Press Private Ltd., 2009.
2. Norton, R.L., Design of Machinery, Third Edition, Tata McGraw Hill, New Delhi, 2005.
3. V Bhandari, Design of Machine Elements, McGraw-Hill Education, 4^{th} Edition, 2017.
4. Robert L. Norton, Machine Design, Pearson Education, 5^{th} Edition, 2018</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Sensors and Controls</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. Smart Manufacturing</td><td>Type</td><td colspan="2">New □</td><td colspan="2">Revision ■</td></tr>
<tr><td>To take effect from</td><td>2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Electric Circuits and Mathematics</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The objective of this course is (a) to learn the basic working principle and operation of various sensors and its characteristics (b) to leverage the application of seniors in engineering application (c) to learn the concepts of control systems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• At the end of the course, a student will be able
(a) to leverage sensors for various engineering applications and choose sensors for required specification
(b) to understand control systems and its relevance different applications</td></tr>
<tr><td>Course Contents</td><td colspan="6">Introduction: Description of measuring devices - static and dynamic characteristics, calibration, active and passive sensors , transducers, classifications. (L6)

Displacement Sensors - Resistive strain gauge, LVDT, RVDT, capacitive, piezo, seismic pickups. proximity, vibrometers and accelerometers - conventional and semiconductor based sensors. (L8)

Sensors for flow, temperature, force, pressure, Radiation and torque, Hall effect - Current and speed measurements - conventional and semiconductor based sensors - Digital measurement techniques. (L8)

Optical Sensor: Lasers. photo-detectors and optical fiber as sensors, Application of sensors in Robotics - Internal Sensors, External sensors – touch and slip sensors - Robotic vision, Process of Imaging , Vision Systems, and its components, Image Representation and Processing. (L8)

Chemical, magnetic and other signals, Catalytic devices, gas sensors and acoustic sensors. (L4)

Open and closed loop systems, actuators - electrical, pneumatic and hydraulic, Transfer functions - root locus method, Design of controllers - case studies (L8)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. J. Vetelino and A . Reghu, Introduction to sensors, CRC Press, 2010
2. Norman S Nise, Control System, John Wiley, 7th Edition, 2015
3. A.K. Sawhney, A Course in Electronic Measurements and Instrumentation, Dhanpat Rai, 2015</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. T. G. Beckwith, R. D. Marangoni and J. H. Lienhard V., Mechanical Measurements, Pearson Prentice Hall, 2009.
2. J. Fraden, Handbook of Modern Sensors: Physics, Designs and Applications, 4th edition, Springer, 2010
3. Doebelin, Measurement systems: Applications and Design, 5th edition, McGraw Hill Book, 2004.</td></tr>
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<table>
<tr><td>Course Title</td><td>Electrical Drives</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. Smart Manufacturing</td><td>Type</td><td colspan="2">New □</td><td colspan="2">Revision ■</td></tr>
<tr><td>To take effect from</td><td>2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">Senate</td></tr>
<tr><td>Prerequisite</td><td>Basic Electrical Engineering</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">● In this course fundamental applications of electromechanical and power electronic systems will be studied as applied to mechanical systems.
● The capabilities and limitations of different types of electric machines (e.g., permanent magnet, induction) in various drive applications will be covered</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, a student will be able to,
● Understand how power electronic rectifiers, converters and inverters operate.
● Possess an understanding of control of electrical drives.
● Analyze and compare the performance of DC and AC machines.
● Select and design a suitable drive system for the given application.</td></tr>
<tr><td>Course Contents</td><td colspan="6">Energy conversion principles, Introduction to Electrical Drives, controlled Rectifiers, DC/DC converters, inverters (L6)

Characteristics and control (starting, braking and speed control-static methods only) of Basic machine types:
DC motor (L8)

Three phase Induction motor (L8)

BLDC motor (L3)

Servo motor, torque motor, stepper motor (L3)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Gopal K. Dubey, Fundamentals of Electrical Drives, 2nd edition, Narosa, January 2010, ISBN-13: 978-8173194283
2. Ned Mohan, Electric Machines and Drives: A First Course, 1st edition, Wiley, 2012.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Vedam Subramanyam, Electric Drives, McGraw Hill, 2017, ISBN-13: 978-0070701991
2. D.P. Kothari, Rakesh Singh Lodhi, Electric Drives, TMH, June 2020
3. I. Boldea, S. A. Nasar, Electric drives, 3rd edition, CRC Press, 2017.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Electrical Drives Practice</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of ECE</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. Smart Manufacturing</td><td>Type</td><td colspan="2">New □</td><td colspan="2">Revision ■</td></tr>
<tr><td>To take effect from</td><td>2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Basic Electrical Engineering</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce the students to conventional and static methods to control various AC and DC drives used in Industry.
• Also to deliver a thorough understanding on feedback control via interfacing various sensors for an automated system.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, a student will be able to,
• Select proper sensors, electrical drive, signal conditioning circuit and controller for the required automation.
• Design control algorithms for electric drives which achieve the regulation of torque, speed, or position in the above machines.
• Develop Simulink® models which dynamically simulate electric machine and drive systems and their controllers.</td></tr>
<tr><td>Course Contents</td><td colspan="6">Experiments conducted in this course:
• Various sensors incorporated with an understanding and hands on study towards Signal conditioning, Characteristics of Transducers, Calibration of sensors, and Measurement of various physical quantities.
• Brings out the basic concepts of different types of electrical machines and their performance.
• Introduce the concept of control of conventional electric motors such as DC motor, AC Induction motor and also special machines such as Stepper motor, Permanent magnet brushless motors, Servo motor.
• Familiarize various power electronic converters and static control of drives.
• Introduces Speed-Torque characteristics of various types of load and drive motors.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. IIITDM Kancheepuram Electrical Drives Practice Manual</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Gopal K. Dubey, Fundamentals of Electrical Drives, 2nd edition, Narosa, January 2010, ISBN-13 : 978-8173194283
2. R. Krishnan, “Electric Motor Drives: Modeling, Analysis, and Control,” Prentice Hall, 2001.
3. Ned Mohan, Electric Machines and Drives: A First Course, 1st edition, Wiley, 2012.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Introduction to Data Management</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Computer Science and Engg</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. Smart Manufacturing</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• This course covers the basic concepts of data management, database systems, and database applications.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• Understand the fundamentals of database systems, design techniques and their use in organizations;
• Comprehend how database systems are used for strategic and operational decision making;
• Understand managerial issues associated with database technologies</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Need for Efficient Data Management - Data Modelling - Entity Relationship Modeling - Relational Schema (5 L)
SQL Constructs - Data Types, Data Definition and Manipulation Language - Key constraints
- Basic Clauses of SQL query (5 L)
Basic and Advanced Operators in SQL, Functions - Table Joins - SQL Simple and Nested Queries - Views (8 L)
Introduction to MongoDB Architecture - Data setup and querying in MongoDB - Application development using case studies / course projects to connect with Databases (10 L)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Fundamentals of Database Systems - R Elmasri, S Navathe, Pearson, 2017</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. W3 Schools online references / tutorials on SQL, MongoDB
2. Learning SQL: Master SQL Fundamentals, Alan Beaulieu, Second Edition, O'Rielly,</td></tr>
</table>

Course Title	**Manufacturing Processes - 2**	Course No	*To be assigned by Academic Cell*			
Department/ Specialization	Mechanical Engineering	Credits	L	T	P	C
			3	1	0	4
Faculty proposing the	Faculty, Department of Mechanical Engineering	Status	Core ■		Elective □	
Offered for	B.Tech. Mechanical Engineering & Smart Manufacturing	Type	New □		Revision ■	
To take effect from	2021	Submitted for approval	Senate			
Prerequisite	Engineering Materials, Manufacturing Processes - I					
Learning Objectives	To study the fundamentals of machining processes and machine tools.					
Learning Outcomes	● At the end students will be able to select and apply a suitable machining process and cutting tool upon the workpiece material and geometry. ● At the end students will be able to identify the machining defects and solution to overcome the same. ● At the end students will be able to utilize the powder metallurgy concepts.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	**Machining and Cutting Tool:** (6 L + 2 T) Material removal. Elements, fundamental, mechanism of deformation in metal cutting. Geometry & design of single and multi-point tool **Mechanics of Chip Formation:** (6 L + 2 T) Orthogonal & oblique cutting, mechanism of chip formation, chip types, mechanics of machining. Forces and stresses on tool and its distribution, cutting force measuring technique. **Heat flow in metal cutting and tool life:** (6 L + 2 T) Heat flow in primary, secondary and tertiary zones, tool temperature measurement, temperature distribution in tool. Machinability, tool life, Taylor's equation, tool failure, economics in metal machining. **Cutting Tool material and Cutting life:** (8 L + 3 T) Tool materials, Alloying elements in tool steel. Carbon steel, high speed steels, co-cast alloys, carbide tools, ceramic tools, diamond. Function & requirement of cutting fluid. Type of cutting fluid. Method of application of cutting fluids. **Abrasive Machining Processes and Broaching:** (8 L + 3 T) Abrasive processes, grinding wheel - specifications and selection, types of grinding process, concepts of surface integrity, broaching machines, broach construction **Processing of Powder metals:** (8 L + 2 T) Production and compaction of metal powders, sintering, design and process capabilities. Forming, shaping and machining of ceramics. Processing semiconductors, elastomers, metal matrix composites and ceramic-matrix composite.					
Essential Reading	1. S. Kalpakjian, S. R. Schmidt, Manufacturing Engineering and technology, 7th edition, Pearson India, 2009. ISBN: 978-0133128741 2. M. P. Groover, Principles of Modern Manufacturing, 5th edition, Wiley, 2014. 978-8126547371.					
Supplementary Reading	1. E. P. DeGarmo, J. T. Black, and R. A. Kohser, DeGarmo's materials and processes in manufacturing, 11th edition, John Wiley & Sons, 2013. 2. 2.D. A. Stephenson, and J. S. Agapiou, Metal cutting theory and practice, CRC Press, 2005.					

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<table>
<tr><td>Course Title</td><td>Manufacturing Processes Practice - 2</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. Mechanical Engineering & Smart Manufacturing</td><td>Type</td><td colspan="2">New □</td><td colspan="2">Revision ■</td></tr>
<tr><td>To take effect from</td><td>2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Basics of Manufacturing Processes</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To study and practice the various operations that can be performed in lathe, milling machines etc. and to equip with the practical knowledge required in the core industries.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of this course the student will be able to select and apply
• Methods to solve problems on cutting forces, tool life and analytical methods of estimating cutting temperature.
• Suitable machining operations to subtractively remove the materials and thus to get the component/workpiece with desired geometry.</td></tr>
<tr><td>Course Contents</td><td colspan="6">Lathe Exercises
Machining and machining time estimations for
• Taper Turning
• External Thread cutting
• Internal Thread Cutting
• Knurling
Milling Exercises
• Simple prismatic parts
• Contour milling using vertical milling machine
• Spur gear cutting in milling machine
• Helical gear cutting in milling machine
Drilling Exercises
• Effect of Primary Cutting Edges
• Effect of Secondary Cutting Edges
Grinding Exercises
• Plain Surface grinding
• Cylindrical grinding
Determination of material removal rate in various processes
Measurement of cutting forces in basic processes</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. S. Kalpakjian, S. R. Schmidt, Manufacturing Engineering and Technology, 7th edition, Pearson India, 2009. ISBN: 978-0133128741</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. M. P. Groover, Principles of Modern Manufacturing, 5th edition, Wiley, 2014. ISBN: 978-8126547371</td></tr>
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<table>
<tr><td>Course Title</td><td>Thermal and Fluids Engineering</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Specialization</td><td rowspan="2">Mechanical Engineering (MSM)</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty Proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. Smart Manufacturing</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Modification □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">________ Senate</td></tr>
<tr><td>Prerequisite</td><td>None</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce different concepts and governing equations for thermodynamics and fluid mechanics.
• To apply the learned concepts to a few real-life cases.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of this course the students will be able to
• Understand and apply the concepts of thermodynamics, fluid mechanics and heat transfer.
• Analyse different thermodynamic cycles used in practical cases.
• Solve various basic fluid mechanics and heat transfer problems as a foundation for advance courses</td></tr>
<tr><td>Course Contents</td><td colspan="6">Thermodynamics (L8+T3)
Laws of thermodynamics - zeroth, first and second, concept of temperature, energy, and entropy, Calculations for work and heat transfer for a system and control volume
Fluid Mechanics (L18+T6)
Fluid properties – Density, viscosity, surface tension, capillary action
Fluid statics, concepts of pressure, stability of submerged and floating object
Fluid Dynamics – Lagrangian and Eulerian definition, concept of velocity and acceleration, equations of continuity and momentum, Bernoulli's equation, flow through pipes, laminar and turbulent flows, Dimensionless analysis
Heat Transfer (L16+T5)
Conduction – Fourier law, 1-D conduction, rectangular and polar coordinate system, insulation,
Convection – forced convection, natural convection, thermal and hydraulic boundary layer
Radiation – basic concepts and application</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. YunusCengel; Robert Turner, Fundamentals of Thermal-Fluid Sciences, McGraw-Hill Higher Education, 3rd edition 2008.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Cengel, Y.A. and Boles, M.A., 2007. Thermodynamics: An Engineering Approach 6th Edition (SI Units). The McGraw-Hill Companies, Inc., New York.
2. Introduction to fluid mechanics and fluid machines, S Som, G Biswash, S Chakraborty, 3e. Tata McGraw-Hill Education, 2017.
3. Bergman, T.L., Incropera, F.P., Lavine, A.S. and Dewitt, D.P., 2011. Introduction to heat transfer. John Wiley & Sons.</td></tr>
</table>

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Course Title	**Operations Research**	Course No	*To be assigned by Academic Cell*
Department/ Specialization	Mechanical Engineering	Credits	L: 3, T: 0, P: 0, C: 3
Faculty proposing the course	Faculty, Department of Mechanical Engineering	Status	Core ■ Elective □
Offered for	B.Tech. Smart Manufacturing	Type	New ■ Revision □
To take effect from	March 2021	Submitted for approval	——Senate
Prerequisite	Nil		
Learning Objectives	● To learn various tools and quantitative techniques for solving business decision problems and finding optimal solutions and build capabilities in students to analyze different problematic scenarios in industries involving limited resources and effective decision making		
Learning Outcomes	● Ability to understand and analyze the real life operational problems which involves resource constraints ● Ability to formulate mathematical model to various Industrial/ business decision problems ● Ability to use appropriate tools and techniques to solve various Industrial/ business decision problems, determine the optimal solution and to make effective business decisions		
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	**Introduction to OR:** Role of Operations research in decision-making, types of OR Techniques, and constructing the model. (L2) **Linear Programming:** Introduction, Assumptions, Formulation of LP Problem, Applications and Limitations (L4) **Linear Programming Techniques:** Graphical Method, Algebraic method, Simplex Method, Big M method, Two phase method, Degeneracy, Alternate Optimum, unboundedness, infeasibility, LP Solvers (L10) **Duality and Sensitivity Analysis:** Importance of Duality concepts, Formulation **of** Dual problems, Dual Simplex, Sensitivity Analysis (L4) **Transportation Problem:** Least cost method, North West corner rule, Vogel's approximation method, MODI method, degeneracy in transportation model, unbalanced and maximization models. (L6) **Assignment Problem:** Difference between transportation problem and assignment problem, Hungarian algorithm, unbalanced assignment problems, Routing Problems, traveling salesman problem (L6) **Integer Programming Problem:** Introduction, Types of IPP, Formulation, rounding off Algorithm, Branch and Bound Algorithm (L4)		
Essential Reading	1. Hamdy A Taha, "Operations Research – An Introduction", Pearson Education, New Delhi, 2014. 2. G.Srinivasan, Operations Research Principles and Applications, PHI, 3^{rd} Edition		
Supplementary Reading	1. A.Ravindran,, D.T.Phillips, J.Solberg Operation Research:Principles and Practice, Wiley Edition, Newyork. 2. Frederick S.Hiller and Gerald J.Lieberman, Inroduction to Operations Research, McGraw- Hill,2012		

Course Title	**Production Drawing Practice**	Course No	*To be assigned by Academic Cell*				
Department/ Specialization	Mechanical Engineering	Credits	L	T	P	C	
			0	0	3	1.5	
Faculty proposing the course	Faculty, Department of Mechanical Engineering	Status	Core ■		Elective □		
Offered for	B.Tech. Smart Manufacturing	Type	New □		Revision ■		
To take effect from	2021	Submitted for approval	Senate				
Prerequisite	Basics of Engineering Graphics						
Learning Objectives	Develop the necessary skills to prepare production drawings and 3D modelling						
Learning Outcomes	At the end of the course, a student will be able to: • Represent and understand drawing symbols and geometric dimensioning and tolerancing • Create 3D models of parts and assembly, and exploded views of assembly using CAD software • Prepare production drawings of machine components						
Course Contents	**Representation:** Layout of drawing sheet, title block, conventional representation of materials, machine components, welding symbols, hydraulic, pneumatic symbols, surface roughness symbols. (P9) **Limits, Fits and Tolerances:** Types of fits, exercises involving selection/interpretation of fits and estimation of limits from tables. (P3) **Form and Positional Tolerances:** Introduction and indication of the tolerances of from and position on drawings, deformation of runout and total runout and their indication. (P6) **3D Part Modeling and Assembly:** Development of 3D models of machine components using CAD software, assembly of machine components and drafting of assembly using CAD software with fits. (P9) **Production Drawings:** Creation of production drawings of parts with indications of size, dimensional and geometric tolerances, welding and surface roughness symbols, form and position errors using CAD software. (P12)						
Essential Reading	1. G. Bertoline, E. Wiebe, N. Hartman and W. Ross, Technical Graphics Communication, 4th edition, Tata McGraw Hill, 2008.						
Supplementary Reading	1. J. D. Meadows, Geometric Dimensioning and Tolerancing, CRC Press, 2009.						

<table>
<tr><td>Course Title</td><td>Embedded Systems Practice</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Department of Electronics & Communication Engg.,</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>1</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Electronics & Communication</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. Smart Manufacturing</td><td>Type</td><td colspan="2">New</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To familiarize with the design and implementation of different embedded systems with real time applications.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• The course would equip the students to design embedded systems using ARM SoC platforms. They would also be familiarized with the usage of RTOS for system design and IoT systems design.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Implementation of embedded systemsi
Tiva LaunchPad and TM4C microcontroller setup and Parallel I/O: LEDs and switches.
Embedded systems design using ARM Cortex,
Stepper motor and Servo motor interfacing,
Real-time operating systems in embedded systems.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. J. W. Valavano, Embedded Systems: Introduction to Arm® Cortex (TM)-M Microcontrollers, 5 th edition, Create Space, 2012, ISBN-10: 1477508996, ISBN-13: 978-1477508992.
2. A. S. Berger, Embedded Systems Design: An Introduction to Processes, Tools, and Techniques, CMP, 2002. ISBN: 1578200733.
3. J. W. Valavano, Embedded Microcomputer Systems: Real Time Interfacing, 2nd edition, Create Space, 2006. ISBN 0534551629.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. J. W. Valavano, Embedded Systems: Real-Time Interfacing to Arm® Cortex(TM)-M Microcontrollers, 2nd edition, Create Space, 2011. ISBN-10: 1463590156, ISBN- 13: 978-1463590154.</td></tr>
</table>

Course Title	**Machine to Machine Communication**	Course No	*To be assigned by Academic Cell*
Department/ Specialization	Computer Engineering	Credits	L: 2, T: 0, P: 2, C: 3
Faculty proposing the course	Faculty, Department of Computer Science and Engg	Status	Core ■ Elective □
Offered for	B.Tech. Smart Manufacturing	Type	New ■ Revision □
To take effect from	March 2021	Submitted for approval	Senate
Prerequisite	Nil		
Learning Objectives	• To introduce the basic concepts and techniques of Machine to Machine Communication. • How to integrate such technology into existing infrastructure		
Learning Outcomes	• Students can able to Identify the main challenges associated with M2M • Communications today, can able to list the main standards, protocols, algorithms, and research activities which address these challenges of today. Can able to identify limits of standards/protocols and algorithms with respect to M2M		
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Introduction to M2M; M2M Current Landscape; Early implementations and deployment of M2M communications. (L4+P2) Introduction to TCP/IP, OSI reference model networking commands: Ping, Traceroute, IPconfig, UDP, congestion control and avoidance (L4+P2) Connecting two nodes using Ethernet cable and study the performance evaluation parameters such as delay, effective bandwidth using socket Programming. (L2+P2 hrs) M2M Terminals and Modules – Hardware Interfaces – Power, USB, UART, Antenna, UICC, GPIO, SPI, I2C, ADC, PCM, PWM and Analog Audio, Service, Software Interface. (L4+P4) M2M Architecture and Protocols –M2M Requirements and High Level Architectural Principles. High Level Architecture Principles for M2M Communications. (L4+P2) M2M Service Architectures – High Level Service Architecture; ETSI TC M2M Service Capabilities Framework, M2M service Capabilities, M2M Resource based M2M Communication and Procedures. (L4+P2) Smart Cards in M2M Communication – Security and Privacy issues in M2M communication, hardware-based security solutions, Smart Card Properties for M2M environments (L4+P2)		
Essential Reading	1. D. Boswarthick, O. Elloumi, and O. Hersent, M2M Communications - A System Approach, Wiley, ISBN 978-1-119-99475-6. 2. D. Minoliauth, Building the Internet of Things with IPv6 and MIPv6 The Evolving World of M2M Communications, Wiley, ISBN: 978-1-118-47347-4. 3. C. Anton-Haro, M. Dohler, Machine-to-Machine (M2M) Communications-Architecture, Performance and Applications, Woodhead, ISBN 978178242102.		
Supplementary Reading	1. O. Hersent, D. Boswarthick and O. Elloumi, The Internet of Things: Key Applications and Protocols, Wiley, 2nd edition, 2012, ISBN: 978-1-119-99435-0. 2. J. Brazell, L. Donoho, J. Dexheimer, R. Hanneman and Langdon, M2M The Wireless Revolution, technical report, Innovation - Creativity – Capital Institute, University of Texas at Austin. 3. W. Webb, Understanding Weightless Technology, Equipment, and Network Deployment for M2M Communications in White Space, Cambridge, ISBN-13:		

<table>
<tr><td>Course Title</td><td>Data Science –An Applied Perspective</td><td>Course No</td><td colspan="5"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td colspan="2">P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td colspan="2">2</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Dept. of CSE</td><td>Status</td><td>Core</td><td>■</td><td colspan="2">Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>B.Tech</td><td>Type</td><td>New</td><td>■</td><td colspan="2">Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="5">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="7">This course covers the basic concepts of Data Science to help the student to learn, understand and practice data analytics encompassing concepts from descriptive, inferential statistics and predictive techniques and big data concepts.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="7">• Ability to identify the characteristics of datasets ; Ability to select and implement machine learning techniques suitable for the respective application ;
• Ability to solve problems associated with big data characteristics such as high dimensionality;
• Ability to integrate machine learning libraries and mathematical and statistical tools</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="7">Introduction to relevant industry applications and analytics – Descriptive Statistics – Data Visualization & Interpretation -Measures of Central Tendency & Dispersion - Basic and advanced plots such as Stem-Leaf Plots, Histograms, Pie charts, Box Plots, Violin Plots etc. – Merits of Demerits & Interpretation (10)
Inferential Statistics – Hypothesis Testing - Tests of Significance – Analysis of Variance - Regression – Linear and Logistic (8)
Predictive Analytics – Supervised and Unsupervised – Association Rules, Classification, Clustering, Outlier Analysis, Time Series Modeling (14)
Big Data Characteristics – Map Reduce – Deduplication, Distributed Storage, Implementation using Hadoop / Pyspark platforms (8)
Practice Component: Concepts from Descriptive Statistics, Inferential and Predictive Analytics would be test driven using platforms such as Python, R etc. ML support in these platforms for rule mining and application, classification & clustering algorithms etc. would also be test driven as part of the practice exercises. Modern technologies for big data handling such as Pyspark – support for Map reduce would also be test driven. Applications relevant to the students stream of specialization would be explored for exercises / course project as case studies. (14 sessions – weekly exercises)</td></tr>
<tr><td>Essential Reading</td><td colspan="7">1. J Han, M Kamber, Data Mining Concepts & Techniques, Elsevier, 3rd Edition, 2007, ISBN 9780123814791</td></tr>
<tr><td>Supplementary Reading</td><td colspan="7">1. Joel Grus, Data Science from Scratch, Orielly, 2nd Edn, 2019, ISBN 9781492041139
2. Leskovec, Anand Rajaraman,, Ullmann, Mining of Massive Data Sets, Cambridge University Press, Open Source free version , ISBN 9781107015357
3. P Bruce, Practical Statistics for Data Scientists, O’Reilly, 2017, iSBN 9789352135653</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Operations and Supply Chain Management</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective□</td></tr>
<tr><td>Offered for</td><td>B.Tech. Smart Manufacturing</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision□</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">——Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• The course aims to provide an in-depth coverage of operations management and supply chain management.
• Students will be exposed to various aspects such as production planning, forecasting, regression analysis, transportation models, topics in supply chain etc</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• The course would equip students with skills required for effective decision making and management</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Operations Management: Introduction, Types of Production Systems, Facility location and layout techniques. Materials Requirement Planning (MRP). (L3)

Production Scheduling -Single machine, Flow shop. Work Study- Method Study- Recording Techniques- Therblig- SIMO chart. Forecasting methods- Qualitative methods, Quantitative models-Time series forecasting models, moving averages, exponential smoothing with trend and seasonal adjustment, multi-item forecasting, Simple and multiple linear regression models (L11)

Network Design in Supply Chain: Introduction to Supply chain, Role of distribution in supply chain –network design in the supply chain –models for facility location and capacity allocation – Impact of uncertainty on network design. Inventory (L10)

Management in Supply Chain: Cycle inventory – multi-echelon inventory – safety stock in the supply chain – safety level estimation, supply uncertainty, data aggregation, replenishment policies, managing safety, inventory in practice – product availability – optimal level, affecting factors, supply chain contracts. (L13)

Transportation in Supply Chain: Design options for Transportation network, trade-offs, Risk management in Transportation. (L5)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. S. L. Davi, K. Philip and S. L. Edith, Designing and Managing the Supply Chain, Tata McGraw-Hill, 2003.
2. R. Panneerselvam, Production and operations management, Prentice-Hall of India,2010</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. A. Ravi Ravindran , Operations Research and Management Science Handbook, 1st Edition., 2007 by CRC Press</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Robotics and Automation</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td>Specialization</td><td>Mechanical Engineering</td><td>Structure (LTPC)</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>To be offered for</td><td>B.Tech. Smart Manufacturing</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Faculty Proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>-</td><td>Submitted for approval</td><td colspan="4">_______ Senate</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To introduce the students to various state of art automation technologies in manufacturing and the role of robots in automation.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, a student will be able to
1. Design robots with application in manufacturing automation.
2. Automate a manufacturing system with various sensors, actuators and controllers.</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="6">Automation Systems-Overview: Overview of mechatronic and automation systems and devices, automated feeding, transfer, retrieval mechanisms and devices, AGVs, FMS workstations, material handling and storage systems, overview of sensors, transducers, control systems and microfluidic devices in automation. (7 L)

Robots in Automation: Robot classification and anatomy, forward and inverse kinematics, DH matrix transformation, Jacobian and differential motion, Trajectory planning, Static and dynamic analysis, Grippers and other hardware, Vision systems, Mobile and parallel robots. (15 L)

Pneumatic Systems: Production, distribution and conditioning of compressed air, system components and graphic representations, design of pneumatic circuits. (7 L)

Hydraulic Systems: Hydraulic systems: flow, pressure and direction control valves, actuators, supporting and control elements, pumps, servo valves and actuators, proportional valves and their applications, design of hydraulic and performance analysis. (7 L)

Controllers: Types, Force feedback, Visitation-assisted robot control, Programming and PLC interfacing, IoT enabling. (7 L)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Anthony Esposito, Fluid power with applications, 7th Edn., 2014, Prentice Hall.
2. M P. Groover, Industrial Robotics: Technology, Programming and Applications, McGraw-Hill, 2nd Edn., 2012, ISBN: 9780070265097.
3. Craig J.J., “Introduction to Robotics: Mechanics and Control ", Prentice Hall, 4th Edn, 2017, ISBN: 978-0201543612.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 4th edition, Pearson India, 2015. ISBN: 9788131732533.
2. HMT Ltd., Mechatronics, Tata–Mcgraw Hill, 2000, ISBN: 9780074636435.
3. Deb, S. R., Robotics technology and flexible automation, Tata McGraw-Hill, 2nd Edn. 2017.
4. Boucher, T. O., Computer automation in manufacturing - an Introduction, Chapman and Hall, 2013.
5. Morris A. Cohen and Uday M. Apte, Manufacturing Automation, McGraw Hill, New York, 1997, ISBN 0-256- 14606-3.</td></tr>
</table>

B.Tech. Smart Manufacturing
Curriculum & Syllabus from 2020 Batch

Course Title	**Robotics and Automation Practice**	Course No	*To be assigned by Academic Cell*			
Specialization	Mechanical Engineering	Structure (LTPC)	0	0	2	1
To be offered for	B.Tech. Smart Manufacturing	Status	Core ■		Elective ☐	
Faculty Proposing the course	Faculty, Department of Mechanical Engineering	Type	New ■		Modification ☐	
Pre-requisite	-	Submitted for approval	_______ Senate			
Learning Objectives	To introduce the students to various state of art automation technologies in manufacturing and the role of robots in automation.					
Learning Outcomes	At the end of the course, a student will be able to 1. Design robots with application in manufacturing automation. 2. Automate a manufacturing system with various sensors, actuators and controllers.					
Contents of the course *(With approximate break up of hours)*	Integration of various sensors, actuators, vision systems and other mechatronic devices in automation Computer based design, simulation and robot analysis Design, development and implementation of pneumatic and hydraulic circuits Programming and integration of PLCs, controllers and IoT devices in automation					
Text Books	1. Anthony Esposito, Fluid power with applications, 7th Edn., 2014, Prentice Hall. 2. M P. Groover, Industrial Robotics: Technology, Programming and Applications, McGraw-Hill, 2nd Edn., 2012, ISBN: 9780070265097. 3. Craig J.J., "Introduction to Robotics: Mechanics and Control ", Prentice Hall, 4th Edn, 2017, ISBN: 978-0201543612.					
Reference Books	1. W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 4th edition, Pearson India, 2015. ISBN: 9788131732533. 2. HMT Ltd., Mechatronics, Tata–Mcgraw Hill, 2000, ISBN: 9780074636435.Deb, S. R., Robotics technology and flexible automation, Tata McGraw-Hill, 2nd Edn. 2017. 3. Boucher, T. O., Computer automation in manufacturing - an Introduction, Chapman and Hall, 2013. 4. Morris A. Cohen and Uday M. Apte, Manufacturing Automation, McGraw Hill, New York, 1997, ISBN 0-256- 14606-3. 5. Ashitava Ghoshal, "Robotics Fundamental Concepts & Analysis", Oxford University Press; 2006, ISBN: 9780195673913 6. K. S. Fu, Robotics: control, sensing, vision and intelligence, Mcgraw-Hill,1987.					

<table>
<tr><td>Course Title</td><td>Quality Engineering</td><td>Course No</td><td colspan="4">To be assigned by Academic Cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech. Smart Manufacturing</td><td>Type</td><td colspan="2">New □</td><td colspan="2">Revision ■</td></tr>
<tr><td>To take effect from</td><td>2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To impart knowledge on inspection, measurement, quality control, validation and certification of products.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, a student will be able to:
Understand various metrology principles and techniques
Identify and select suitable techniques and equipments to inspect and to ensure product quality
Know about various quality control methodologies, standards and certifications</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Basic concepts: Measurement and inspection; Role of metrology in quality assurance; Errors; Length standards; Gauges and comparators; Linear and angular measurements; Fits and tolerances. (7 L+ 8 P)

Measurement Practices: Optical metrology and laser interferometers; Measurement of flatness, straightness and form errors; Surface finish measurements; CMM; Vision applications in Metrology; Nano-measurements. (8 L + 8 P)

Statistical Methodologies: Graphical methods, Statistical control charts, Regression analysis, Analysis of variance, Sampling and acceptance. (10 L + 8 P)

Case studies: Inspection and Validation practices adopted in various industries. (3 L + 4 P)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. T. G. Beckwith, R. D. Marangoni and J. H. Lienhard, Mechanical Measurements, 6th edition, Pearson Higher Education, 2007, ISBN: 0132296071.
2. R. K. Jain, Engineering Metrology, Khanna Publishers, 20th Reprint, 2014, ISBN: 817409153X.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. D. J. Whitehouse, Handbook of surface and nanometrology, 2nd Edition, CRC Press, 2010, ISBN: 9781420082012.
2. G. T. Smith, Industrial Metrology, Springer, 2002, ISBN: 9781852335076.
3. A. M. Badadhe, Metrology and Quality Control, Technical Publications, 2006, ISBN: 8189411861.
4. R. C. Gupta, Statistical Quality Control, 8th edition, Khanna Publishers, 2008, ISBN: 8174091114.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Professional Communication</td><td>Course No</td><td colspan="4">HS3001</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">English</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>1</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Dept. of SH</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>B.Tech.</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• Develop the capability to apply for a job and participate in selection process
• Acquire interview skills
• Gain proficiency in language skills indispensable for a successful professional
• Develop emotional intelligence</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• Prepare résumé and cover letter
• Ready to perform at different levels of the interview process
• Able to use interpersonal skills in challenging situations
• Competent to draft various documents for specific purposes</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Preparing cover letter, résumé, digital profile; video profile; Email etiquette (L2,P4)
• Interview skills, Group discussion and impromptu speech (L2,P6)
• Social communication skills (L4,P6)
  o Conversational English appropriateness, context based speaking in general situations, discussion and associated vocabulary in professional situations)
  o Non-verbal communication – relevance and effective use of paralinguistic features – body language, chronemics, haptics, proxemics
  o Emotional intelligence (EI) and social intelligence at workplace – theoretical perspectives and their application in relevant workplace situations – EI and leadership skills – assessments and best practices in organizations
• Conflict management and communication at workplace (L4,P6)
  o Cross-cultural communication, Argumentation, negotiation, persuasion, decision making, case study of challenging situations
  o Organizing a meeting, working as part of a team, briefing
  o Business presentations – Preparing effective presentations, delivering presentaions and handling questions
• Writing proposals, statement of purpose, research article, agreements, summary Proofreading (L1,P4)
• Training for proficiency assessment (L1,P2)</td></tr>
<tr><td>References</td><td colspan="6">1. Tebeaux, Elizabeth, and Sam Dragga. The Essentials of Technical Communication. OUP, 2018.
2. Sabin, William A. The Gregg Reference Manual: A Manual of Style, Grammar, Usage, and Formatting. McGraw-Hill, 2011, pp 408-421.
3. Raman, Meenakshi and Sangeeta Sharma. Technical Communication: Principles and Practice. OUP, 2015.
4. Caruso, David R. and Peter Salovey. The Emotionally Intelligent Manager: How to Develop and Use the Four Key Emotional Skills of Leadership. John Wiley and Sons, 2004.
5. https://learnenglish.britishcouncil.org/business-english/youre-hired/episode-01
6. https://www.youtube.com/watch?v=HAnw168huqA
7. https://www.youtube.com/watch?v=azrqlQ_SLW8
8. https://owl.purdue.edu/owl/purdue_owl.html
9. Turabian,Kate L. Student's Guide to Writing College Papers. University of Chicago Press, 2010.</td></tr>
<tr><td>Methodology for content delivery</td><td colspan="6">Since students have been introduced to the basics of technical and professional communication in the first semester, this course is designed with the purpose of giving them intense training in professional and academic communication with global competence. Once the concept is introduced, adequate time should be devoted to practice and review.</td></tr>
</table>

ANNEXURE E-IV-C

M.Tech. in ME with specialization in Mechanical Systems Design
Curriculum & Syllabus from 2021 Batch

M.Tech (Mechanical Systems Design) offered by IIITDM Kancheepuram prepares a graduate mechanical engineer to master's in materials and engineering design and covers development of mechanical systems wherein students will be provided with adequate knowledge and training on analytical and experimental methods. The curriculum covers essential topics on the Design, and Core and elective courses are categorized into three levels – foundation, pillar and capstone courses. Foundation courses are designed to provide students with computational and experimental knowledge to solve engineering problems. Pillar courses are designed to provide students with in-depth knowledge and skills in the entire design and development process comprising materials science, manufacturing, mechanics and mechanisms. Certain Pillar and Capstone courses are designed to provide students with project-based learning wherein students apply the knowledge and skills they acquired during the course of their program and provide an engineering design solution. The program requires students to complete one-year long project work wherein students shall work on solving engineering problems relevant to product design and development.

Semester 1					
Category	Course Name	L	T	P	C
PCC	Advanced Numerical Methods	3	1	0	4
PCC	Advanced Mechanics of Materials	3	1	0	4
DSC	Design for Manufacture and Assembly	3	1	0	4
ELC	Elective 1	3	1	0	4
ELC	Elective 2	3	1	0	4
PCC	Advanced Numerical Methods Practice	0	0	3	1.5
PCC	Advanced Mechanics of Materials Practice	0	0	3	1.5
					23.0
Semester 2					
Category	Course Name	L	T	P	C
PCC	Design with Advanced Engineering Materials	3	1	0	4
PCC	Analysis and Synthesis of Robot Mechanisms	3	1	0	4
ELC	Elective 3	3	1	0	4
ELC	Elective 4	3	1	0	4
ELC	Elective 5	3	1	0	4
PCC	Analysis and Synthesis of Robot Mechanisms Practice	0	0	3	1.5
PCC	Advanced Engineering Simulation Practice	0	0	3	1.5
					23.0
Summer					
Category	Course Name	L	T	P	C
PCD	Project I	0	0	20	10
					10.0
Semester 3					
Category	Course Name	L	T	P	C
PCD	Project II	0	0	32	16
					16.0
Semester 4					
Category	Course Name	L	T	P	C
PCD	Project III	0	0	32	16
					16.0

Semester wise Credit Distribution	Credits						
Category	S1	S2	Summer	S3	S4	Total	%
Professional Core Course (PCC)	11	11	0	0	0	22	25.0
Design Course (DSC)	4	0	0	0	0	4	4.5
Elective Course (ELC)	8	12	0	0	0	20	22.7
Professional Career Development (PCD)	0	0	10	16	16	42	47.7
Total	23.0	23.0	10.0	16.0	16.0	88.0	100.0

<table>
<tr><td>Course Title</td><td>Advanced Numerical Methods</td><td>Course No</td><td colspan="4">To be filled by academic cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech . (MSD)</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Mathematics for Engineers</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course provides
1. an introduction to the concepts of Linear Algebra
2. techniques to solve various kinds of equations that students encounter in the field of engineering.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the completion of the course, the student will be able
1. to understand the methods by which physical problems can be solved using computation.
2. to use computation in theoretical analysis and experimental data interpretation.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial)</td><td colspan="6">• Introduction to Linear Algebra: Vector space and subspaces, Tensors, Linear Transformation, system of Linear equation and Matrices, Applications in Engineering (6L +2T)
• Solution of Linear Algebraic equations: Gauss elimination, Gauss-Jordon, LU Decomposition, QR Method, Jacobi and Gauss-Seidel Methods; Eigenvalues and Eigenvectors – Power and inverse power method, physical interpretation of eigenvalues and eigenvectors, Regression based on Least Squares and Principal Component Analysis (8 L+ 3T)
• Solution of Nonlinear Algebraic equations: Bisection method, fixed-point iteration method, Newton-Raphson, Secant method (6 L+ 2T)
• Finite difference formula using Taylor series, Differentiation of Lagrange polynomials, Simpson's rule, Gauss-quadrature rule, Romberg method, multiple integrals (6 L+ 2T)
• Solution for ODE – Euler's method and Stability criterion, second order and fourth order Runge-Kutta methods, system of ODEs and nonlinear ODEs (6 L+ 2T)
• Solution for PDE – Classification of PDEs, Elliptic equations, Parabolic equations (Transient diffusion equation), Hyperbolic equations (wave equation) (5 L+ 2T)
• Numerical Optimization-Line Search method, Steepest Descent method, Conjugate Gradient method, Penalty and Augmented Lagrangian method, Introduction to ANN and GA (5 L+ 1T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. S. P. Venkateshan, Prasanna Swaminathan, Computational Methods in Engineering, Ane Books, 1st edition, 2013, ISBN-13: 978-0-12-416702-5.
2. Steven C. Chapra, Numerical Methods for Engineering, Mc-Graw Hill Education, 7the edition, 2015, ISBN-13: 978-0073397924.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Gilbert Strang, Introduction to Linear Algebra, Wellsley-Cambridge 2009.
2. Joe D Hoffman, Steven Frankel, Numerical Methods for Engineers and Scientists, Second Edition, CRC Press, 2001, ISBN-13: 978-0824704438.
3. Jain, M.K., Iyengar, S.R., and Jain,R.K., `Numerical Methods for Scientific and Engineering Computation', New Age International Pvt. Ltd., 2019, ISBN-13: 978-9387477254..
4. E Kreszig, Advanced Engineering Mathematics, John Wiley, 10th edition, 2015, ISBN-13: 978-8126554232.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Advanced Numerical Methods Practice</td><td>Course No</td><td colspan="4">To be filled by academic cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech. (MSD)</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Programming using C or C++</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course provides an introduction to the numerical methods to solve various kinds of equations relevant to engineering field that students encounter using programming tools like C and C++.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the completion of the course, the student will be able to
1. understand the importance of obtaining approximate solutions to various practical problems
2. solve the application-oriented problems using C codes or C++ codes</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial)</td><td colspan="6">• Exercise on Solution for Linear Algebraic equations: Gauss-Jordon, LU Decomposition, Jacobi and Gauss-Seidel Methods; Eigenvalues and Eigenvectors (9)
• Exercise on Solution of Nonlinear Algebraic equations: Bisection method, fixed-point iteration method, Newton-Raphson, Secant method (6)
• Exercise on Finite difference formulation (6)
• Exercise on Solution for ODE – Euler, second order and fourth order Runge-Kutta methods, system of ODEs and nonlinear ODEs (6)
• Exercise on Solution for PDE – Elliptic equations, Parabolic equations, Hyperbolic equations (6)
• Exercise on Numerical Optimization – Line Search method, Steepest Descent method, Conjugate Gradient method, Introduction to ANN and GA (6)
• Practical engineering problems in structural and thermal systems (3)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. S. P. Venkateshan, Prasanna Swaminathan, Computational Methods in Engineering, Ane Books, 1st edition, 2013, ISBN-13: 978-0-12-416702-5.
2. Steven C. Chapra, Numerical Methods for Engineering, Mc-Graw Hill Education, 7the edition, 2015, ISBN-13: 978-0073397924.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Joe D Hoffman, Steven Frankel, Numerical Methods for Engineers and Scientists, Second Edition, CRC Press, 2001, ISBN-13: 978-0824704438.
2. Jain, M.K., Iyengar, S.R., and Jain,R.K., Numerical Methods for Scientific and Engineering Computation, New Age International Pvt. Ltd., 2019, ISBN-13: 978-9387477254.
3. Jorge Nocedal, Stephen J. Wright, Numerical Optimization, Second Edition, Springer, 2006, ISBN-10: 0-387-30303-0, ISBN-13: 978-0387-30303-1.
4. E Kreszig, Advanced Engineering Mathematics, John Wiley, 10th edition, 2015, ISBN-13: 978-8126554232.</td></tr>
</table>

ANNEXURE E-IV-C

M.Tech. in ME with specialization in Mechanical Systems Design
Curriculum & Syllabus from 2021 Batch

<table>
<tr><td>Course Title</td><td>Advanced Mechanics of Materials</td><td>Course No</td><td colspan="4">To be filled by academic cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech. (MSD)</td><td>Type</td><td colspan="2">New □</td><td colspan="2">Revision ■</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Strength of Materials and Engg Mechanics</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course is intended to give necessary
• understanding of behavior of solid materials in terms of their motion and deformation under the action of static forces.
• analytical and numerical methods to analyze the behavior of various structural members.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the completion of the course, the student will be able to
1. Formulate the behavior of various mechanical structures
2. Perform stress analysis of various products of different shapes made with all kinds of linear elastic materials.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Theories of stress and strain – Principal stresses and strains, equations of equilibrium, strain displacement relations, compatibility conditions, and constitutive relations. (L 9 + T 2)
• Energy methods – elastic strain energy, Theorems of Castigliano, virtual work and stationary potential energy, Applications. (L 6 + T 2)
• Euler-Bernoulli beam bending of asymmetrical sections – bending stresses and deflection. (L 3 + T 1)
• Formulation, Analytical and Finite Difference and Finite element solutions – Beams on elastic foundation, Torsion of prismatic members. (L 6 + T 3)
• Formulation and analytical methods of solution of 2D linear elasticity problems – Airy’s stress function approach for plane stress and plane strain, displacement function approach for axisymmetrically loaded members, temperature effects. (L 12 + T 4)
• Formulation and analytical methods of solution of Plates and shells –Governing equations, Solutions for simple boundary conditions. (L 6 + T 2)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. L. S. Srinath, Advanced Mechanics of Solids, Tata McGraw-Hill, 1st edition, 2009, ISBN: 9780070139886.
2. A. C. Ugural and S. K. Fenster, Advanced Strength and Applied Elasticity, Prentice Hall, 5th edition, 2013, ISBN-13: 978-0-13-707920-9.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. S. P. Timoshenko and J. N. Goodier, Theory of Elasticity, Tata McGraw-Hill, 3rd edition, 2013, ISBN-13: 978-0-07-070122-9.
2. A. P. Boresi and R. J. Schmidt, Advanced Mechanics of Materials, John Wiley & Sons, Inc., 6th edition, 2003, ISBN 978-0-471-43881-6.
3. R. G. Budynas, Advanced strength and Applied Stress Analysis, McGraw-Hill, 2nd edition, 1999, ISBN: 9780070089853.</td></tr>
</table>

M.Tech. in ME with specialization in Mechanical Systems Design
Curriculum & Syllabus from 2021 Batch

<table>
<tr><td>Course Title</td><td>Advanced Mechanics of Materials Practice</td><td>Course No</td><td colspan="4">To be filled by academic cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech. (MSD)</td><td>Type</td><td colspan="2">New □</td><td colspan="2">Revision ■</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Strength of Materials and Engg Mechanics</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course is intended to give necessary
• Numerical formulation to predict stresses, and in-turn life of structures
• Simulation of complex shaped components to predict stresses.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the completion of the course, the student will be able to
1. Formulate the behavior of various structural elements and
2. Predict the life of various products of different shapes made with a wide variety of materials.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Finite difference solutions for torsion of prismatic bars, beams with varying forces and cross section along the span, beams on elastic foundation. (P 9)
• Finite element solutions for axially and transversely loaded members, thin plates or discs with in-plane and lateral forces, long noncircular pipes and dams, solid flywheel, long (infinite) cylinders and brackets (P 21)
• Basic dynamic problems (P 6)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. A. C. Ugural and S. K. Fenster, Advanced Strength and Applied Elasticity, Prentice Hall, 5th edition, 2013, ISBN-13: 978-0-13-707920-9.
2. T. R. Chandrupatla and A. D. Belegundu, Introduction to Finite Elements in Engineering, Pearson, 4th edition, 2011, ISBN: 978-0132162746.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. L. S. Srinath, Advanced Mechanics of Solids, Tata McGraw-Hill, 1st edition, 2009, ISBN: 9780070139886.
2. A. P. Boresi and R. J. Schmidt, Advanced Mechanics of Materials, John Wiley & Sons, Inc., 6th edition, 2003, ISBN 978-0-471-43881-6.
3. R. G. Budynas, Advanced strength and Applied Stress Analysis, McGraw-Hill, 2nd edition, 1999, ISBN: 9780070089853.</td></tr>
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<table>
<tr><td>Course Title</td><td>Design for Manufacture and Assembly</td><td>Course No</td><td colspan="6">To be filled by academic cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td colspan="2">P</td><td colspan="2">C</td></tr>
<tr><td>3</td><td>1</td><td colspan="2">0</td><td colspan="2">4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="3">Elective</td><td>□</td></tr>
<tr><td>Offered for</td><td>M.Tech. (MSD)</td><td>Type</td><td colspan="2">New ■</td><td colspan="3">Revision</td><td>□</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="6" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Basic Materials & Manufacturing Engineering Courses</td></tr>
<tr><td>Learning Objectives</td><td colspan="8">• To provide understanding of interrelationships between design and manufacturing
• To explore implications of early selection of materials, shapes and manufacturing processes in a product development
• To impart knowledge on assembly considerations and assembly cost evaluations</td></tr>
<tr><td>Learning Outcomes</td><td colspan="8">After the completion of the course, students will be able:
1. To understand the importance of considering assembly and manufacturing choices in the early stages of product design
2. To quantitatively estimate the assembly and manufacturing cost of a product.
3. To select an appropriate assembly sequence, material and processing method to reduce the manufacturing complexity and cost of a product</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="8">• Engineering Design: Linear types, Descriptive and prescriptive models, problem statement – objectives, constraints and specifications, Concept generation and evaluation, Embodiment and detailed design, Applications. (L 6 + T 2)
• Selection of Materials: Connection between engineering design and selection of materials, Material performance requirements, Initial screening, Comparing and ranking alternatives, optimal material selection based on shape, size and manufacturing process, Case studies. (L 8 + T 3)
• Process Selection: Review of Manufacturing Processes, Design for Casting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Design for Powder Metallurgy, Design for Polymer Processing, Design for Additive Manufacturing, Case-Studies. (L 15 + T 5)
• Review of Assembly Processes, Design for Welding, Design for Brazing and Soldering, Design for Adhesive Bonding, Design for Joining of Polymers, Design for Heat Treatment, Case-Studies. (L 5 + T 1)
• Design for manual assembly, Design for PCB Manufacturing and assembly, Electrical Connections and Wire harness assembly, Design for Automated and Robotic Assembly, Case studies. (L 8 + T 3)</td></tr>
<tr><td>Essential Reading</td><td colspan="8">1. M. F. Ashby, Materials Selection in Mechanical Design, 5th edition, Elsevier, 2011. ISBN: 9780081005996.
2. M. M. Farag, Materials and Process Selection for Engineering Design, 3rd edition, CRC Press, 2014, ISBN-13: 978-0367438340.
3. P. Dewhurst, W. Knight, G. Boothroyd, Product Design for Manufacture and Assembly, 3rd edition, CRC Press, 2010, ISBN: 9781420089271.
4. L. C. Schmidt, G. Dieter, Engineering Design, 4th edition, McGraw Hill Education India Private Limited, 2013. ISBN: 978-1259064852</td></tr>
<tr><td>Supplementary Reading</td><td colspan="8">1. M. F. Ashby, K. Johnson, Materials and Design: The Art and Science of Material Selection in Product Design, 3rd edition, Butterworth-Heinemann Ltd, 2014. ISBN: 978- 0080982052.
2. M. F. Ashby, Materials and the Environment: Eco-informed Material Choice, 2 nd edition, Butterworth-Heinemann, 2012.
3. G. Boothroyd, Assembly Automation and Product Design, 2nd edition, CRC Press 2005.
4. J. G. Bralla, Design for Manufacturability Handbook, 2nd edition, McGraw-Hill Professional, 1998. ISBN: 978-0070071391.</td></tr>
</table>

ANNEXURE E-IV-C

M.Tech. in ME with specialization in Mechanical Systems Design
Curriculum & Syllabus from 2021 Batch

<table>
<tr><td>Course Title</td><td>Design with Advanced Engineering Materials</td><td>Course No</td><td colspan="4">To be filled by academic cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech. (MSD)</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Basic Materials Engineering Course</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course is proposed to offer
• the connection between engineering design and materials
• an understanding of rate dependent and independent mechanical behavior of various advanced materials
• the constitutive (phenomenological) models and simplified design methods for various advanced materials that are required for design engineers.
• the process of designing advanced/new materials for various products / components</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">After the completion of the course, students will be able:
1. to correlate the methodologies of engineering design and selection of materials and select right kind of material and process
2. to use necessary mathematical (constitutive) models and simplified engineering design methodologies in engineering product / component design</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Engineering design process and role of materials: Connection between engineering design and selection of materials, Time independent and dependent mechanical behavior of materials, Classification of advanced engineering materials based on their properties and applications, Computer aided material and process selection, Applications. (L 15 + T 5)
• Design with rate dependent materials: Deformation mechanisms, Phenomenological models considering viscous effects, Design with polymers, Fatigue and fracture of polymers, Case studies. (L 9 + T 3)
• Design with anisotropic materials: Types of anisotropic materials, Constitutive equations for anisotropic materials and composites, Design with composite materials, Fatigue and fracture of composites, Case studies. (L 12 + T 4)
• Design with high temperature materials: Classification and characteristics of superalloys, Creep and fatigue resistance of super alloys, Design considerations for advanced ceramics, fracture reliability, Case studies. (L 6 + T 2)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. M. F. Ashby, Materials Selection in Mechanical Design, Butterworth Heinemann, 2016, ISBN: 978-0081005996.
2. R. J Crawford, Plastics Engineering, 3rd edition, Butterworth-Heinmann, 2006, ISBN: 978-81-312-0174-9.
3. J. C. Gerdeen and R. A. L. Rorrer, Engineering Design with Polymers and Composites, CRC Press, 2nd edition, 2012, ISBN-13: 978-1-4398-6053-3.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. G. E. Dieter, Engineering Design: Materials and Processing Approach, McGraw-Hill,1999 ISBN-13: 978-0070168961
2. M. M. Farag, Materials and Process Selection for Engineering Design, 3rd edition, CRC Press, 2014, ISBN-13: 978-0367438340
3. R. C. Reed, The Superalloys: Fundamentals and Applications, 1st edition, Cambridge University Press, 2006, ISBN: 9780511541285.
4. D. W. Richerson and W. E. Lee, Modern Ceramic Engineering: Properties, Processing and Use in Design, 4th edition, CRC Press, 2018, ISBN: 9780429488245.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Analysis and Synthesis of RobotMechanisms</td><td>Course No</td><td colspan="4">To be filled by academic cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective ■</td></tr>
<tr><td>Offered for</td><td>M.Tech. (MSD)</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">Senate</td></tr>
<tr><td>Prerequisite</td><td>Kinematics and dynamics</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To impart advanced knowledge in analysis and synthesis of robot mechanisms</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course student will able to:
1. Ability to design and analyze planar and spatial mechanisms
2. Ability to synthesize various mechanisms
3. Ability to design and analyze mechanisms for robotic applications</td></tr>
<tr><td>Course Contents</td><td colspan="6">• Review of Kinematics of Planar Mechanisms: Kinematic pairs, chains and mechanisms, kinematicinversions; Velocity and acceleration of planar mechanisms- graphical and analytical methods; Loop closure equation; Four-bar mechanisms, Grashof criterion. (6 L + 1 T)
• Graphical Synthesis of Planar Mechanisms: Type and number synthesis; Motion, path and function generation, Chebyshev's accuracy points; Two-three-four position synthesis with and without prescribed timing; Synthesis of dwell and Geneva mechanisms. (8 L + 2 T)
• Analytical Synthesis of Planar Mechanisms: Complex algebra representation; Standard form equation; Two and three position analytical synthesis for motion, path and function generation; Introduction to commercially available software for mechanism synthesis. (8 L + 2 T)
• Kinematics and Dynamics of Serial Mechanisms: Robot kinematics-forward/inverse; Denavit- Hartenberg matrix transformation; Differential motion and Jacobian; Dynamics and position control; Path planning; Applications. (12 L+ 3 T)
• Spatial Linkages and Parallel Mechanisms: Rigid body and spatial transformations; Displacement, velocity and acceleration analyses of spatial linkages; Introduction to kinematic analysis of parallelmechanisms. (8 L + 2 T)
• Compliant Robot Mechanisms: Flexibility and deflection; large deflection analysis; Applications. (3 L+ 1 T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. J. J. Uicker, G. R. Pennock and J. E. Shigley, Theory of Machines and Mechanisms, OxfordUniversity Press, 4th edition, 2014, ISBN: 9780199454167
2. R. L. Norton, Design of Machinery-An Introduction to the Synthesis and Analysis ofMechanisms and Machines, McGraw Hill, 6th edition, 2020, ISBN: 9780077421717
3. Craig J.J., "Introduction to Robotics: Mechanics and Control, Prentice Hall, 4 th Edn, 2018, ISBN: 9780133489798</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. A. G. Erdman and G. N. Sandor, Mechanism Design: Analysis and Synthesis: Vol. 1, Pearson,4th edition, 2004, ISBN: 9780130408723.
2. A. G. Erdman and G. N. Sandor, Mechanism Design: Analysis and Synthesis: Vol. 2, Pearson,2005, 4th edition, ISBN: 9780130114372.
3. K. Russell, Q. Shen and R. S. Sodhi, Mechanism Design: Visual and Programmable Approaches,CRC Press, 1st edition, 2014, ISBN: 9781466570177.
4. K. S. Fu, R. C. Gonzalez and C. S. G. Lee, Robotics: Control, Sensing, Vision, Intelligence,McGraw-Hill Education, 1st edition, 2008, ISBN: 9780070265103</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Analysis and Synthesis of RobotMechanisms Practice</td><td>Course No</td><td colspan="4">To be filled by academic cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective ■</td></tr>
<tr><td>Offered for</td><td>M.Tech. (MSD)</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Kinematics and dynamics</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To impart advanced knowledge in analysis and synthesis of robot mechanisms</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course student will able to:
• Ability to design and analyze planar and spatial mechanisms
• Ability to synthesize various mechanisms
• Ability to design and analyze mechanisms for robotic applications</td></tr>
<tr><td>Course Contents</td><td colspan="6">➢ Design, kinematic analysis and synthesis of linkages and mechanisms for various applications using free and paid software such as MechAnalyzer, Linkage 3.0, GIM Mechanism, AR-CAD, CATIA, ADAMS, Autodesk Inventor, Matlab Robotics Tool Box.
➢ Construction of various robot mechanisms using robot kits.
➢ Programming and validation of kinematics and dynamics of robot manipulators.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. J. J. Uicker, G. R. Pennock and J. E. Shigley, Theory of Machines and Mechanisms, Oxford University Press, 4th edition, 2014, ISBN: 9780199454167
2. R. L. Norton, Design of Machinery-An Introduction to the Synthesis and Analysis of Mechanisms and Machines, McGraw Hill, 6th edition, 2020, ISBN: 9780077421717
3. Craig J.J., “Introduction to Robotics: Mechanics and Control, Prentice Hall, 4 th Edn, 2018, ISBN:9780133489798</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">7. A. G. Erdman and G. N. Sandor, Mechanism Design: Analysis and Synthesis: Vol. 1, Pearson, 4th edition, 2004, ISBN: 9780130408723.
8. A. G. Erdman and G. N. Sandor, Mechanism Design: Analysis and Synthesis: Vol. 2, Pearson, 2005, 4th edition, ISBN: 9780130114372.
9. K. Russell, Q. Shen and R. S. Sodhi, Mechanism Design: Visual and Programmable Approaches, CRC Press, 1st edition, 2014, ISBN: 9781466570177.
10. K. S. Fu, R. C. Gonzalez and C. S. G. Lee, Robotics: Control, Sensing, Vision, Intelligence, McGraw-Hill Education, 1st edition, 2008, ISBN: 9780070265103
11. L. W. Tsai, Robot Analysis: The Mechanics of Serial and Parallel Manipulators, Wiley, 1st edition, 2005, ISBN: 9780471325932
12. L. L. Howell, Compliant Mechanisms, John Wiley & Sons, 1st edition, 2002, ISBN:9780471384786.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Advanced Engineering Simulation Practice</td><td>Course No</td><td colspan="4">To be filled by academic cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective ■</td></tr>
<tr><td>Offered for</td><td>M.Tech. (MSD)</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revisio n □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Kinematics and dynamics (For DD only)</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To provide hands-on experience in simulation and analysis of mechanical systems using sophisticated tools.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students will acquire knowledge necessary for product design using computeraided engineering tools.</td></tr>
<tr><td>Course Contents</td><td colspan="6">➢ Application of Finite element method using CAE software.(P 3)
➢ Static and transient structural analysis procedure and application to complex physical components (P 9)
➢ Steady state and transient thermal analysis of mechanical structural systems (P 9)
➢ Analysis procedure and application of contact elements, nonlinearmaterial models and rigid body dynamics. (P 9)
➢ Coupled field finite element analysis of mechanical structural systems. (P 6)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. User manuals of software packages.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. S. Moaveni, Finite Element Analysis: Theory and Application withANSYS, Pearson 2013, ISBN-13: 978-0133840803</td></tr>
</table>

ANNEXURE E-IV-D

M.Tech. in ME with specialization in Smart Manufacturing
Curriculum & Syllabus from 2021 Batch

M.Tech (Smart Manufacturing) is intended to create future masters in manufacturing who are strong in both the current and future innovation in manufacturing, technology, management areas of smart manufacturing. With the foundation courses learnt at the UG level, the pillar courses have a mix containing Manufacturing systems, Automation, networking and data science courses. Further, the electives also permit the student to further gain knowledge in other interdepartmental courses. The program requires students to complete one-year long project work wherein students shall work on real time smart manufacturing systems.

Semester 1					
Category	Course Name	L	T	P	C
PCC	Design for Manufacturing Automation	3	1	0	4
PCC	Manufacturing Systems Engineering	3	1	0	4
DSC	Design for Additive Manufacturing	3	1	0	4
BSC	Probability and Statistics	3	1	0	4
ELC	Elective 1	3	1	0	4
PCC	Design for Manufacturing Automation Practice	0	0	3	1.5
PCC	Manufacturing Systems Engineering Practice	0	0	3	1.5
					23.0
Semester 2					
Category	Course Name	L	T	P	C
PCC	IIoT and Cloud Computing	3	1	0	4
PCC	Data Science	3	0	2	4
ELC	Elective 2	3	1	0	4
ELC	Elective 3	3	1	0	4
ELC	Elective 4	3	1	0	4
PCC	IIoT and Cloud Computing Practice	0	0	3	1.5
PCC	Manufacturing Information Systems Practice	0	0	3	1.5
					23.0
Summer					
Category	Course Name	L	T	P	C
PCD	Project I	0	0	20	10
					10.0
Semester 3					
Category	Course Name	L	T	P	C
PCD	Project II	0	0	32	16
					16.0
Semester 4					
Category	Course Name	L	T	P	C
PCD	Project III	0	0	32	16
					16.0

Semester wise Credit Distribution	Credits						
Category	S1	S2	Summer	S3	S4	Total	%
Professional Core Course (PCC)	11	11	0	0	0	22	25.0
Design Course (DSC)	4	0	0	0	0	4	4.5
Basic Science Course (BSC)	4	0	0	0	0	4	4.5
Elective Course (ELC)	4	12	0	0	0	16	18
Professional Career Development (PCD)	0	0	10	16	16	42	48
Total	23	23	10	16	16	88	100

ANNEXURE E-IV-D

<table>
<tr><td>Course Title</td><td>Design for Manufacturing Automation</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech (SMT)</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To provide knowledge and exposure in integrated design practices of mechatronic systems in manufacturing automation</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course student will be able to:
1. Understand the basic concepts of mechatronic systems in manufacturing automation
2. Design of automation systems using various mechatronic elements
3. Understand the application of SCADA, DCS, PLC, HMI in manufacturing automation
4. Demonstrate integration of various systems and standards in manufacturing automation</td></tr>
<tr><td>Course Contents</td><td colspan="6">Introduction: Manufacturing Automation – evolution, Review of mechatronics systems, Fundamentals of digital electronics, microprocessors, control systems, and applications. Panel design-switch gears and accessories, panel protection, cable harness assembly and busbar selection.
(8 L + 2 T)
Design of Mechatronics System: Mechatronics elements –sensors and actuators, ball screws, solenoids, linear actuators and controllers in manufacturing applications. Motion control-variable frequency drive, remote and local operation, Design of drive control panels, Communication interface, Design and simulation of mechatronic systems. (10 L + 3 T)
PLC & HMI: Fundamentals of PLC and programming languages, Design of alarm and interlocks; Networking of PLC, PLC protection. Introduction of HMI-I/O's, Programming instructions and interface, GUI in HMI.
(8 L + 2 T)
Computer based Industrial Automation: Direct digital control, Distributed control system, SCADA for manufacturing industries, RTUs, Automation networking, Industrial standard communication protocols, Real time testing and runtime application. Communication among HMI, PLC, SCADA, Fault diagnostics / troubleshooting.
(10 L + 3 T)
Industrial Practices and Case Studies: Integration of robotic system, vision system, fluid power systems in manufacturing; Case studies on manufacturing automation and design; Safety considerations, National/International standards.
(8 L+ 2 T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. W. Bolton, Mechatronics, Pearson education Ltd. 7th edition, 2018
2. J. Edward Carryer, M. Ohline and T. Kenny, Introduction to Mechatronic Design, Prentice Hall, 2nd edition, 2011
3. F. Lamb, Advanced PLC Hardware & Programming, Automation Consulting, LLC, 2019.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. D. G. Alciatore and M. B. Histand, Introduction to Mechatronics and Measurement Systems, McGraw-Hill, 4th edition, 2014
2. K. wang, Y. Wang, J. O. Strandhagen, Advanced Manufacturing and Automation VIII, Springer, 1st Edition, 2019.
3. R Mehra, V. Vij, PLCs & SCADA - Theory and Practice, Laxmi Publications, 2nd edition 2017.
4. John W. Webb and Ronald A. Reis, Programmable Logic Controllers: Principles and Applications, Prentice Hall Inc., 5th Edition, 2003</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Design for Manufacturing Automation Practice</td><td>Course No</td><td colspan="4">To be filled by the academic cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech (SMT)</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>July 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To provide knowledge and exposure in integrated design practices of mechatronic systems in manufacturing automation</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course student will be able to:
1. Understand the basic concepts of mechatronic systems and implementation in manufacturing automation
2. Design of automation systems using various mechatronic elements
3. Understand the application of SCADA, DCS, PLC, HMI in manufacturing automation
4. Demonstrate integration of various systems in manufacturing automation</td></tr>
<tr><td>Course Contents</td><td colspan="6">➢ Design and simulation of mechatronic systems for manufacturing applications using CAD packages.
➢ Programming and simulation of various microcontrollers and logic gates using Proteus software/ Tinker CAD.
➢ Control system simulation in MATLAB-Simulink and LabVIEW.
➢ SCADA, PLC & HMI – Programming, simulation and implementation using RSlogix, CODESYS, Rapid SCADA.
➢ Design and implementation of manufacturing automation systems using Tecnomatix and other automation specific software.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">4. W. Bolton, Mechatronics, Pearson education Ltd. 7th edition, 2018
5. J. Edward Carryer, M. Ohline and T. Kenny, Introduction to Mechatronic Design, Prentice Hall, 2nd edition, 2011
6. F. Lamb, Advanced PLC Hardware & Programming, Automation Consulting, LLC, 2019.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">5. D. G. Alciatore and M. B. Histand, Introduction to Mechatronics and Measurement Systems, McGraw-Hill, 4th edition, 2014
6. K. wang, Y. Wang, J. O. Strandhagen, Advanced Manufacturing and Automation VIII, Springer, 1st Edition, 2019.
7. R Mehra, V. Vij, PLCs & SCADA - Theory and Practice, Laxmi Publications, 2nd edition 2017.
8. John W. Webb and Ronald A. Reis, Programmable Logic Controllers: Principles and Applications, Prentice Hall Inc., 5th Edition, 2003
9. T. Bartely, Industrial Automated Systems: Instrumentation and Motion Control, Cengage learning, 2011</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Manufacturing Systems Engineering</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech (SMT)</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To gain a basic understanding of manufacturing systems and its management, including types of systems, current theories of manufacturing management, including lean thinking, JIT and demand driven manufacturing.
• To develop an understanding of the performance measurement of manufacturing systems through metrics and key performance indicators.
• To analyze manufacturing systems in terms of material flow and storage, information flow using event simulation and Queueing Models</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• Students will recognize manufacturing systems, including job shops, flow lines, assembly lines, work cells.
• Students will have a basic understanding of performance measurement and management in modern day manufacturing systems.
• Students will have a basic understanding of current manufacturing control theories, such as lean thinking, agile, responsive systems and JIT.
• Students will be able to develop a simulation model to analyse manufacturing systems to improve performance of assembly lines and job shops.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Introduction to Manufacturing Systems: overview, and components of manufacturing systems. Classification of manufacturing industries (L 6+T 2)
Types of manufacturing Systems: single station cells, Manual Assembly lines, Automated Production lines, Automated Assembly systems, Group technology and cellular manufacturing, Flexible manufacturing cells and systems, Toyota Production System. (L 21+T 7)
Factory Layouts: Types of layouts, systematic layout planning and Design (L 3 + T 1)
Production Scheduling: Scheduling process, priority dispatch rules, Flow shop and Job Shop Scheduling (L 3 + T 1)
Inventory Control: Inventory control policies, Material Requirements Planning (L 3 + T 2)
Queuing models: Notation of queues, Key elements, performance measures, The M/M/1 and M/M/m queue, Queueing Networks (L 3 + T 1)
Simulation of Manufacturing systems: Monte Carlo simulation, System and Environment, Discrete event Simulation (L 3 + T 1)
Intelligent Manufacturing Systems: Introduction to Industry 4.0, Digital twins and The role of Artificial Intelligence in the factory of the future (L 3)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. M. P. Groover, Automation, Production systems and Computer Integrated Manufacturing. 3rd edition, Pearson Education, 2015. ISBN: 978-9332549814.
2. Manufacturing Systems Engineering. Katsundo Hitomi, Taylor and Francis, Second Edition</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. W. J. Hopp, M. L. Spearman, Factory Physics, 3rd edition, Waveland Press, 2011
2. R. Askin and C. Standridge, Modeling and Analysis of Manufacturing Systems, 1st edition, John Wiley, 1992. ISBN: 978-0-471-51418-3
3. S. B. Gershwin, Manufacturing Systems Engineering, 1st edition, Prentice Hall PTR, 1993, ISBN: 9780135606087</td></tr>
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<table>
<tr><td>Course Title</td><td>Manufacturing Systems Engineering Practice</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech (SMT)</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To understand the broad applicability of discrete-event process simulation and queueing models in manufacturing systems
• To analyze manufacturing systems in terms of material flow and storage, information flow using event simulation and Queing Models</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">1. Students will be able to develop a simulation model to analyse different types of manufacturing systems and to improve performance of assembly lines and job shops.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">➢ Solving queuing problems using simulation techniques
➢ Modelling different types of manufacturing systems
➢ Study the effect of variability on performance of different manufacturing system
➢ Performance analysis of manufacturing cells
➢ Simulation of KANBAN control system
➢ Simulation of push pull production system
➢ Optimization of layouts design
➢ Solving reactive scheduling problems.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. M. P. Groover, Automation, Production systems and Computer Integrated Manufacturing. 3rd edition, Pearson Education, 2015. ISBN: 978-9332549814.
2. Manufacturing Systems Engineering. Katsundo Hitomi, Taylor and Francis, Second Edition</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. W. J. Hopp, M. L. Spearman, Factory Physics, 3rd edition, Waveland Press, 2011
2. R. Askin and C. Standridge, Modeling and Analysis of Manufacturing Systems, 1st edition, John Wiley, 1992. ISBN: 978-0-471-51418-3
3. S. B. Gershwin, Manufacturing Systems Engineering, 1st edition, Prentice Hall PTR, 1993, ISBN: 9780135606087</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Design for Additive Manufacturing</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Senthilkumaran, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech (SMT)</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To understand the design constraints and design capabilities unique to the additive manufacturing processes
• To analyse the part design for opportunities in improving its sustainability using computational tools</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">1. Students will be able understand the complexities in design and modify the existing designs suitable for additive manufacturing.
2. Students would be able to apply computational tools to optimize the design for reduced cost and material use.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Introduction to Additive Manufacturing (AM) processes (6 L + 2 T)
• Process planning for additive manufacturing process (8 L + 2 T)
• Principles of design for manufacturing and assembly (DfMA) (4 L + 1 T)
• Constraint approach to design for additive manufacturing: Guidelines and rules for part building (5 L + 1 T)
• Mass customization, part consolidation, functional integration (5 L + 1 T)
• Computational tools for design optimization: Topology optimization and generative design (4 L + 2 T)
• Hierarchical structures and lattice structures (6 L + 1 T)
• Design for hybrid additive manufacturing (2 L + 1 T)
• Industrial case studies (2 L + 1 T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">7. Diegel, Olaf, Axel Nordin, and Damien Motte. A Practical Guide to Design for Additive Manufacturing. Springer Singapore, 2019.
8. Leary, Martin. Design for additive manufacturing. Elsevier, 2019.
9. Page, Tom. Design for additive manufacturing. LAP Lambert Academic Publishing, 2011.
10. Gibson, Ian, David Rosen, Brent Stucker, and Mahyar Khorasani. Additive manufacturing technologies. Vol. 17. New York: Springer, 2014.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Gebhardt, Andreas. "Understanding additive manufacturing." (2011).
2. Chua, Chee Kai, and Kah Fai Leong. 3D Printing and additive manufacturing: Principles and applications of rapid prototyping. 5th Edition, World Scientific Publishing Company, 2017.</td></tr>
</table>

ANNEXURE E-IV-D

<table>
<tr><td>Course Title</td><td>Probability and Statistics</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mathematics</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td></td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech (SMT)</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To impart and/or refresh the knowledge of probabilistic and statistical concepts, tools and techniques.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">1. The student will be comfortable with probabilistic and statistical ideas in engineering applications and will be capable of approaching the issues in a similar spirit wherever necessary.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Introduction to probability – sample spaces and axioms, counting techniques; conditional probability, independence, and Bayes' theorem. (L 9 + T 3)

Discrete and continuous random variables, probability and mass density functions of a few standard discrete and continuous distributions: binomial, Poisson, exponential and normal and their relevance in engineering. Joint distributions, marginal distributions. (L 9 + T 3)

Concepts of mean, variance; Moment generating functions, Markov and Chebychev inequalities; the laws of large numbers and the central limit theorem. (L 9 + T 3)

Purpose and nature of the sampling, point estimation: method of moments and method of maximum likelihood. Confidence Intervals. Linear regression, correlation, covariance. (L 9 + T 3)

Formulation and testing of hypotheses: Type I and Type II Errors. Size and power of a test. Criteria for acceptance of hypothesis: t-test, chi-squared test. Goodness of fit tests. (L 6 + T 2)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">11. D. C. Montgomery and G. C. Runger, Applied Statistics and Probability for Engineers, 6th edition, Wiley India, 2016.
12. R. A. Johnson, Miller and Freund’s Probability and Statistics for Engineers, 8th edition, Pearson, 2015</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. An Introduction to Probability and Statistics by Vijay K. Rohatgi, A. K. Md. Ehsanes Saleh, Wiley, 2nd edition, 2008
2. S. Ross, A First Course in Probability, 9th edition, Pearson 2019</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>IIoT and Cloud Computing</td><td>Course No</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Computer Science and Engg</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech (SMT)</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• This course introduces the concepts of Industrial Internet of Things, and cloud computing.
• The students are exposed to the architectures, and various frameworks in IIoT and cloud computing.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of this course, the students are expected to
1. Understand the existing IoT and Cloud architectures
2. Design an IoT system with cloud infrastructure
3. Implement a prototype of the IoT/cloud system design</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">➢ Introduction, Physical design of IoT, Logical design of IoT, IoT enabling technologies,
Domain specific IoTs (L 4)
➢ IoT design methodology, logical design, Communication APIs, Databases, Networking (L 8)
➢ IoT physical devices (such as Raspberry Pi, pcDuino, Beaglebone black, Cubieboard, Jetson, GoogleCoral, etc.) (L 4)
➢ Introduction to cloud computing: cloud models, cloud service examples, cloud based services & applications (L 6)
➢ Virtualization, load balancing, scalability, deployment, replication, monitoring, SDN,
network function virtualization, MapReduce, identity and access management, SLAs. (L 10)
➢ Cloud service and platforms: Commercial clouds (such as Amazon elastic compute cloud, Google Compute engine, Windows Azure), Storage services, database services, application services, content delivery services, analytics services, Open source private clouds. (L 6)
➢ Case studies: Industrial automation, Cloud for IoT (L 4)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. A. Bahga and V. Madisetti, Internet of Things, A hands-on approach, CreateSpace Inde Publishing Platform, 1st edition, 2014, ISBN: 978-0996025515.
1. A. Bahga and V. Madisetti, Cloud Computing, A hands-on approach, CreateSpace Inde Publishing Platform, 1st edition, 2013, ISBN: 978-1494435141</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. S. Jeschke, C. Brecher, H. Song, and D. B. Rawat, Industrial Internet of Things: Cybermanufacturing Systems, Springer, 1st edition, 2017, ISBN: 978-3319425580.
2. T. Erl, Z. Mahmood, and R. Puttini, Cloud Computing: Concepts, Technology & Architecture, Prentice Hall, 1st edition, 2013, ISBN: 978-0133387520.</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>IIoT and Cloud Computing Practice</td><td>Course No</td><td colspan="4">To be filled by the academic cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Computer Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Computer Science and Engg</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech (SMT)</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• This course introduces the concepts of Industrial Internet of Things, and cloud computing.
• The students are exposed to the architectures, and various frameworks in IIoT and cloud computing.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of this course, the students are expected to
1. Understand the existing IoT and Cloud architectures
2. Design an IoT system with cloud infrastructure
3. Implement a prototype of the IoT/cloud system design</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">➢ Introduction of Hardware Interfaces – Power, USB, UART, Antenna, UICC, GPIO, SPI, I2C,
➢ ADC, PCM, PWM and Analog Audio, Service, Software Interface

➢ Network Design Router Configuration, Port Forwarding, Gateways Interface, DHCP configuration, VPN, Socket Communications, Network security (NMAP)

➢ Logical Design Communication API MQTT, Co-AP, REST, AMQP, HTTP, XMPP, DDS, Web development framework, Cloud Integration, Fog node and Edge node

➢ Deployment, Lightweight Device Management with lightweight Machine to Machine

➢ Advance Practice: SDN, Dockers Container Class Implementation, OpenStack Platform, Database Management (Relational and Non-Relational)

➢ Implementation of smart applications
Cloud computing with IoT for healthcare and industrial automation can be studied</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. D. Boswarthick, O. Elloumi, and O. Hersent, M2M communications: A systems approach, Wiley, 1st edition, 2012, ISBN: 978-1119994756</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. S. Jeschke, C. Brecher, H. Song, and D. B. Rawat, Industrial Internet of Things: Cybermanufacturing Systems, Springer, 1st edition, 2017, ISBN: 978-3319425580.
2. T. Erl, Z. Mahmood, and R. Puttini, Cloud Computing: Concepts, Technology & Architecture, Prentice Hall, 1st edition, 2013, ISBN: 978-0133387520.</td></tr>
</table>

ANNEXURE E-IV-D

M.Tech. in ME with specialization in Smart Manufacturing
Curriculum & Syllabus from 2021 Batch

<table>
<tr><td>Course Title</td><td>Data Science</td><td>Course No</td><td colspan="4">To be filled by the academic cell</td></tr>
<tr><td rowspan="2">Department/
Specialization</td><td rowspan="2">Computer Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Faculty, Department of Computer Science and Engg</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech (SMT)</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td colspan="4" rowspan="2">Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• This course covers the basic concepts of Data Science to help the student to learn, understand and practice data analytics encompassing concepts from descriptive, inferential statistics and predictive techniques and big data concepts.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">1. Ability to identify the characteristics of datasets
2. Ability to select and implement machine learning techniques suitable for the respective application
3. Ability to solve problems associated with big data characteristics such as high dimensionality
4. Ability to integrate machine learning libraries and mathematical and statistical tools</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Introduction to relevant industry applications and analytics – Descriptive Statistics – Data Visualization & Interpretation -Measures of Central Tendency & Dispersion - Basic and advanced plots such as Stem-Leaf Plots, Histograms, Pie charts, Box Plots, Violin Plots etc. – Merits of Demerits & Interpretation (L 10)

Inferential Statistics – Hypothesis Testing - Tests of Significance – Analysis of Variance - Regression – Linear and Logistic (L 8)

Predictive Analytics – Supervised and Unsupervised – Association Rules, Classification, Clustering, Outlier Analysis, Time Series Modeling (L 14)

Big Data Characteristics – Map Reduce – Deduplication, Distributed Storage, Implementation using Hadoop / Pyspark platforms (L 8)

Practice Component: Concepts from Descriptive Statistics, Inferential and Predictive Analytics would be test driven using platforms such as Python, R etc. ML support in these platforms for rule mining and application, classification & clustering algorithms etc. would also be test driven as part of the practice exercises. Modern technologies for big data handling such as Pyspark – support for Map reduce would also be test driven. Applications relevant to the student’s stream of specialization would be explored for exercises / course project as case studies. (P 14 sessions – weekly exercises)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. J Han, M Kamber, Data Mining Concepts & Techniques, Elsevier, 3rd Edition, 2007</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Joel Grus, Data Science from Scratch, Orielly, 2nd Edn, 2019
2. Leskovec, Anand Rajaraman,, Ullmann, Mining of Massive Data Sets, Cambridge University Press, Open Source free version
3. P Bruce, Practical Statistics for Data Scientists, O’Reilly, 2017</td></tr>
</table>

<table>
<tr><td>Course Title</td><td>Manufacturing Information Systems Practice</td><td>Course No</td><td colspan="4">To be filled by the academic cell</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Faculty proposing the course</td><td>Senthilkumaran, Department of Mechanical Engineering</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Offered for</td><td>M.Tech (SMT)</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To study the information systems in different domains of manufacturing
• To model information using modelling languages for better interoperability between systems</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">1. Students will be able understand the role of information systems in collecting, curating and analysing the data from disparate sources of data.
2. Students would be able to apply information modelling principles to different domain information systems.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">➢ Reference architecture study for Industry 4.0 (RAMI)
➢ Information systems in Enterprise domain: Hands-on exercises in ERP, MES, HMI and IoT point solutions
➢ Information systems in value chain domain: Supply chain management and logistics information systems, blockchain exercises
➢ Information systems in lifecycle domain: Product life cycle management (PLM), Product data management and Life cycle inventory information systems
➢ Metrics and KPI modelling
➢ KPI dashboarding and information exchange between information systems</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Gilchrist, Alasdair. Industry 4.0: The Industrial Internet of Things. United States: Apress, 2016.
2. Hernes, Marcin., Jelonek, Dorota., Rot, Artur. Towards Industry 4.0 -- Current Challenges in Information Systems. Germany: Springer International Publishing, 2020.
3. Kumar, Uday., Pascual, Diego Galar., Daponte, Pasquale. Handbook of Industry 4.0 and SMART Systems. United States: CRC Press, 2019.</td></tr>
</table>

ANNEXURE E-IV-E

M.Tech in ME with specialization in AI / Robotics
Curriculum from 2021 Batch

Semester 1					
Category	Course Name	L	T	P	C
PCC	Advanced Data Structures and Algorithms	3	1	0	4
PCC	Modeling and Control of Robot Manipuators	3	1	0	4
DSC	Design for Manufacturing Automation	3	1	0	4
ELC	Elective 1	3	1	0	4
ELC	Elective 2	3	1	0	4
PCC	Modeling and Control of Robot Manipuators Practice	0	0	3	1.5
PCC	Design for Manufacturing Automation Practice	0	0	3	1.5
					23.0
Semester 2					
Category	Course Name	L	T	P	C
PCC	AI and ML for Robotics	3	1	0	4
PCC	Sensors and Actuators for Robots	3	1	0	4
DSC	Design of Robotic Systems	3	1	0	4
ELC	Elective 3	3	1	0	4
ELC	Elective 4	3	1	0	4
PCC	Motion Control of Mobile Robots Practice	0	0	3	1.5
PCC	Sensors and Actuators Practice	0	0	3	1.5
					23.0
Summer					
Category	Course Name	L	T	P	C
PCD	Project Phase I	0	0	20	10
					10.0
Semester 3					
Category	Course Name	L	T	P	C
PCD	Project Phase II	0	0	32	16
					16.0
Semester 4					
Category	Course Name	L	T	P	C
PCD	Project Phase III	0	0	32	16
					16.0

Semester wise Credit Distribution	Credits						
Category	S1	S2	Summer	S3	S4	Total	%
Professional Core Course (PCC)	11	11	0	0	0	22	25.0
Design Course (DSC)	4	4	0	0	0	8	9.1
Professional Career Development (PCD)	0	0	10	16	16	42	47.7
Elective Course (ELC)	8	8	0	0	0	16	18.2
Total	23	23	10	16	16	88	100

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

Introduction of New course

<table>
<tr><td>Course Title</td><td>Engineering Optics</td><td>Course No</td><td colspan="4">PH2000</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Physics</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Dr. Vivek Kumar</td><td>Status</td><td colspan="2">Core □</td><td colspan="2">Elective ■</td></tr>
<tr><td>Offered for</td><td>UG</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>March 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Nil</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce the principles of physical optics and application of the physical concepts to topical engineering domains.
• Understand basic lasing action, study various types of lasers and to have basic idea of fiber optics.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• Interpret the intensity variation of light due to Polarization, interference and diffraction.
• Learn the concept and operating principles of optical instruments.
• State the working principle of lasers and describe its applications.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Module 1: Wave Optics (L17+T8)
• Interference- Introduction to waves, Coherence (Spatial and Temporal), Principle of Superposition, Young's double slit experiment, Interference by wave front division and by amplitude division and examples.
• Diffraction- Fresnel and Fraunhofer diffraction, Fraunhofer diffraction due to double slit. Diffraction grating and its applications.
• Polarization- Introduction, Malus' law, Polarization by reflection and Brewster's law and applications.
Module 2: Laser Basics (L8+T3)
• Laser operation, Absorption, Spontaneous Emission and Stimulated Emission, Population & Inversion, Three- and FourLevel Laser Systems, Laser Characteristics- Types of Lasers: Solid-State Lasers, Gas Lasers, Semiconductor Lasers.
Module 3: Applications (L16+T3)
• Interferometers: Michelson interferometer, Fabry-Perot interferometer, Mach-Zehnder interferometer, Sagnac interferometer.
• Fiber optics: Fermat's principle and Snell's law, optical fiber: principle and construction, acceptance cone, numerical aperture, types of fibers, Applications.</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Eugene Hecht, Optics (5th edition), Pearson (2019).
2. A. Ghatak, Optics (4th edition), Tata Mcgraw Hill (2009).</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. William T. Silfvast, Laser Fundamentals, Cambridge University Press (2004).
2. John Crisp and Barry Elliott, Introduction to Fiber Optics, Elsevier (2005).
3. Warren J. Smith, Modern Optical Engineering, McGraw-Hill (2007).</td></tr>
</table>

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

Introduction of New course

Course Title	**Waves and Vibrations**	Course No	**PH2001**			
Department/ Specialization	Physics	Credits	L	T	P	C
			3	1	0	4
Faculty proposing the course	Dr. Naveen Kumar	Status	Core □	Elective ■		
Offered for	UG	Type	New ■	Revision □		
To take effect from	March 2021	Submitted for approval	44th Senate			
Prerequisite	Nil					
Learning Objectives	• To improve the conceptual, physical and mathematical comprehension of the phenomenon of waves and vibrations • To Implement the understanding of waves and vibrations in real-time applications/devices design					
Learning Outcomes	Students would be able to conceptualize the physical phenomenon of waves/and vibrations for varieties of interdisciplinary product design applications					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• **Module 1:** Sources (electrical/mechanical/oceanic/optical) of waves and vibrations; Importance and applications of vibrations and waves in life; Free, damped, forced oscillations (Mathematical models) (L8+T3) • **Module 2:** Wave equations, Classifications of Waves: transverse, longitudinal, plane, cylindrical, spherical, periodic, aperiodic, sinusoidal, square, triangular, saw tooth waves, polarization, circularly, plane, elliptically polarized waves with mathematical representation and examples/case studies from nature and real-time applications (L10 + T4) • **Module 3:** Superposition of waves, beats, wave packet, phase velocity, group velocity, dispersion, modulation, wave plates, stationary and traveling waves, energy density (L8+T2) • **Module 4:** Energy harvesting techniques along with basic electronic circuitry for product design applications (L8+ T3) • **Module 5:** Wave guiding and fiber Interferometers for smart sensing and measurement applications (L8 +T2)					
Essential Reading	1. Frank S Crawford Jr., Waves: Berkeley Physics Course Volume 3, McGraw Hill, 2008					
Supplementary Reading	1. E. Hecht, Optics, Pearson, 5th edition, 2016 2. Shashank Priya and Daniel J Inman, **Energy Harvesting Technologies, Springer, 2009** 3. Daniele Tosi and Guido Perrone, Fiber-Optic Sensors for Biomedical Applications, Artech House, 2018					

ANNEXURE F

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram

Introduction of New course

Course Title	**Physics of Materials**	Course No	**PH2002**			
Department/ Specialization	Physics	Credits	L	T	P	C
			3	1	0	4
Faculty proposing the course	Dr. Y Ashok Kumar Reddy	Status	Core □	Elective ■		
Offered for	UG	Type	New ■	Revision □		
To take effect from	March 2021	Submitted for approval	44^{th} Senate			
Prerequisite	Nil					
Learning Objectives	• The objective of the course is to provide the insights of various states of material and their properties, nanotechnology, existing energy resources and their applications for next generation Engineers.					
Learning Outcomes	Upon successful completion, students can gain the knowledge to: • Applied Physics concepts towards materials and their applications; • Evaluation and selection of suitable materials for different energy, medical and industrial applications.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• **Physics of Matter:** Atoms in crystals, Atomic bonding, Free electron theory, Band theory, Fermi Level, Energy bands, Conductors, Insulators, Semiconductors, Superconductors, Dielectrics, Magnetic and Plasmonic materials (L12+T3) • **Physics of Nano:** Introduction to nanomaterials, Properties of nanomaterials, Types of nanomaterials, Synthesis of Nanomaterials-Top-down and Bottom-up approaches, Quantum confinement, Quantum well, Wire and Dot, Carbon Nano-tubes (CNTs), Nanotechnology for medical and industrial applications (L14+T4) • **Physics of Energy**: Introduction to energy sources, Solar energy- Solar production and Radiation, Photovoltaic solar cells; Nuclear energy- Nuclear energy processes, Fission and Fusion; Electrochemical energy- Storage and Conversion; Thermal Energy- Conduction, Convection and Radiation; Wind Energy- Turbines and Utility scale wind; Bio energy- Sources and Biomass (L16+T5)					
Essential Reading	1. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, 7^{th} Edition, 2017. 2. Charles P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology, A John Wiley-Interscience publication, 2003. 3. M.N. Avadhanulu, P.G. Kshirsagar, T.V.S. Arun Murthy, A Textbook of Engineering Physics, S. Chand Publishing, 11^{th} Edition, 2018.					
Supplementary Reading	1. Charles Kittel, Introduction to Solid State Physics, 8^{th} Edition, 2004. 2. A.P. Zambare, R.B. Bhise, A.B. Bhise, V.D. Kulkarni, H.R. Kulkarni, Physics of Nanomaterials, Nirali Prakashan, 2019. 3. Robert L. Jaffe, Washington Taylor, The Physics of Energy, Cambridge University Press, 2018.					

ANNEXURE F

INDIANINSTITUTE OF INFORMATION TECHNOLOGY
DESIGN AND MANUFACTURING (IIITDM) KANCHEEPURAM

INTRODUCTION OF NEW COURSE

Course Title	**An introduction to Cryptography**	Course No	MAT503			
Specialization	CSE/ECE/MEC/PHY/MAT	Structure (LTPC)	3	0	0	3
To be offered for	UG/PG	Status	Core ☐		Elective ■	
Faculty Proposing the course	M. Subramani	Type	New ■		Modification ☐	
Date of DAC		Members Present in DAC				
		External Member:				
Pre-requisite	Engineering Mathematics	Submitted for approval	44th Senate			
Learning Objectives	This course will be an introduction to cryptography and cryptanalysis.					
Learning Outcomes	Will be able to implement various cryptosystems and digital signature schemes, and understand their basic decryption and security pitfalls, including for RSA and El Gamal public key systems.					
Contents of the course *(With approximate break-up of hours)*	Modular arithmetic, Euclidean algorithm and its generalizations, quadratic residues laws, primality testing, integer factorization, finite fields [10] Introduction to simple cryptosystems, cryptanalysis, Public key cryptography, Hash function, RSA cryptosystem, Pseudo primes, Pollard’s p-1 method, the Rho method [10] The ElGamal cryptosystem, Diffee-Hellman key exchange system, discrete logarithm problem- Shank’s algorithm, The Pollard Rho algorithm, The Pohlig-Hellman Algorithm, ElGamal systems, The ElGamal signature scheme [10] Introduction Elliptic curve, Elliptic curve cryptography, Elliptic curve primality test, Elliptic curve factorization [12]					
Text Books	1. Cryptography : theory and practice, Stinson, Douglas R, Paterson, Maura B, Fourth edition, CRC Press, Taylor & Francis Group, 2018.					
Reference Books	1. An introduction to Mathematical cryptography, Jeffery Hoffstein, Jill Pipher, J.H. Silverman, First edition, Springer, 2008. 2. A course in Number Theory and Cryptography, Neal Koblitz, Second edition, Springer, 1994.					

ANNEXURE F

Introduction of New course

<table>
<tr><td>Course Title</td><td>Materials Design for Sensor Systems</td><td>Course No</td><td colspan="4">PHY5XX</td></tr>
<tr><td rowspan="2">Department/ Specialization</td><td rowspan="2">Mechanical & Electronic Materials and Design Engineering</td><td rowspan="2">Credits</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Faculty proposing the course</td><td>Dr. Y. Ashok Kumar Reddy</td><td>Status</td><td colspan="2">Core □</td><td colspan="2">Elective ■</td></tr>
<tr><td>Offered for</td><td>UG and PG/DD</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Revision □</td></tr>
<tr><td>To take effect from</td><td>June 2021</td><td rowspan="2">Submitted for approval</td><td rowspan="2" colspan="4">44th Senate</td></tr>
<tr><td>Prerequisite</td><td>Consent of Teacher (COT)</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To study the materials design perspectives for device fabrication
• To understand the concepts of Photodetectors and Infrared Sensors for energy/defence applications</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• This course aims to learn the advanced design and fabrication techniques of the devices
• It can be mainly useful for UG and PG/DD students towards making the Photodetectors and Infrared Sensors for bio-medical, energy and defence applications</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">I. Material Properties, Device Fabrication Techniques and Issues:
Material properties − Structural, Optical, and Electrical properties
Advanced techniques for materials design − Physical and Chemical approaches
Device fabrication methods – Lithography and Etching
Fabrication related issues – Residual stress, Micro cracks, and Surface oxidation
(L12+T3 h)
II. Photodetectors:
Introduction to photodetectors & Architectures – M-S-M, Heterojunction, Bi-layers
Materials selection and fabrication of devices – M-S-M, M-I-S, Photo-multiplier tubes; Figures of merit − Responsivity, Detectivity, External quantum efficiency
Photodetectors for next generation – Energy, Bio-medical imaging and Defence areas (L14+T4 h)
III. Infrared (IR) Sensors:
Type of IR detectors − Photon (cooled) detectors, Thermal (un-cooled) detectors
Metal and Superconductor based materials (Ti, Pt, YBaCuO), Semiconductor based materials (a-Si, VO_x, TiO_x); Fabrication and design of IR image sensor device
Testing of IR sensors performance − Resistivity, Temperature Co-efficient of resistance (TCR), noise, Responsivity, and Detectivity
Future trends of IR sensor materials − Military-night vision, Civil-security and surveillance, Gas detection and Imaging (L16+T5 h)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Photodetectors: Materials, Devices and Applications, A. Ahmadivand, J.E. Bowers et al., B. Nabet (eds.), Woodhead Publishing, 1st ed., 2015.
2. Infrared detectors, Antoni Rogalski, CRC Press Taylor and Francis group, 2nd ed., 2010.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Materials Science of Thin Films: Deposition and Structure, Milton Ohring, D. Gall, S.P. Baker, Academic Press Inc, 3rd ed., 2014.
2. Photodetectors: Devices, Circuits, and Applications, S. Donati, Prentice Hall PTR, 2011.
3. Fundamentals of Infrared Detector Materials, M.A. Kinch, SPIE Press book, USA, 2007.</td></tr>
</table>

ANNEXURE F

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY
DESIGN AND MANUFACTURING (IIITDM) KANCHEEPURAM

INTRODUCTION OF NEW COURSE

Course Title	**Optical Fiber Sensors**	Course No	ELE558			
Specialization	ECE	Structure (LTPC)	3	0	0	3
To be offered for	UG/PG	Status	Core ☐		Elective ■	
Faculty Proposing the course	Dr. Srijith K	Type	New ■		Modification ☐	
Date of DAC		Members Present in DAC				
		External Members:	Prof. Balaji Srinivasan, IITM Dr. Arup Lal Chakraborty, IITGN			
Pre-requisite		Submitted for approval	44^{th} Senate			
Learning Objectives	Fiber Optic Sensors is intended to be a graduate level course that introduces the different types of fiber-optic sensing technologies and their applications in metrology, navigation, structural health monitoring and healthcare.					
Learning Outcomes	At the end of the course, the learners are expected to do the following: • To identify an appropriate fiber-optic sensing technique for a given problem • To understand the capabilities and performance limits of a given sensing system • To design the sensor system for a given application • To analyze the performance parameters of a given sensor system					
Contents of the course *(With approximate break-up of hours)*	Motivation for fiber optic sensors-Review of wave propagation in optical fibers – Optical receiver design - Noise in optical receivers (6) Sensor metrics: dynamic range, accuracy, precision, resolution, cross-sensitivity (2) Intensity modulated sensors: Typical system configurations - SNR improvement through averaging, filtering and lock-in techniques - Evanescent wave sensing, Gas sensing using Absorption Spectroscopy (7) Interferometric sensors: Typical system configurations - phase stabilization issues, coherence issues, rotation sensing using Sagnac interferometers and micro-ring resonators, Displacement/vibration sensing using Fabry-Perot resonators (7) Polarimetric Sensors – Faraday Effect - Current sensors – Highly birefringent PM fibers (2) Wavelength modulated sensors: Fiber Bragg gratings - Principles and characteristics - Interrogation techniques - Multiplexing FBG sensors - Structural health monitoring applications - Long period gratings - Biochemical sensing (9) Distributed fiber optic sensors: OTDR concept - SNR vs bandwidth tradeoff - dynamic range vs spatial resolution tradeoff - Distributed sensors based on Raman, Brillouin and Rayleigh scattering (9)					
Text Book	Francis T.S. Yu, Shizhou Yin, Paul B. Ruffin, “Fiber Optic Sensors”, 2/e, CRC Press, 2017.					
Reference Books	1. Ginu Rajan, “Optical Fiber Sensors: Advanced Techniques and Applications”, 1/e, CRC Press, 2015. 2. Z Fang, Ken K Chin, R Qu and H Cai, “Fundamentals of Optical Fiber Sensors”, 1/e, Wiley Publications, 2012. 3. John Dakin and Brain Culshaw, “Optical Fiber Sensors”, Artech House, 1/e, 1997. 4. A Othonos and K Kalli, “Fiber Bragg Gratings: Fundamentals and Applications in Telecommunications and Sensing”, Artech House, 1/e, 1999. 5. K T V Grattan and B T Meggitt, “Optical Fiber Sensing Technology: Fundamentals”, Springer US, 1/e, 2000					

Category wise data of admission

B Tech

The opening and closing ranks of B. Tech students for the year 2020-21 is given below:

Branch	OP	EWS	OBC	SC	ST	PD
	Opening – Closing Rank					
Computer Science and Engineering	8686 - 17727	18114 - 21656	20659 - 27716	39725 - 102213	127878 - 159253	250431 – 341494 (OP) 455451 (EWS) 676681 – 714211 (OBC) 704133 (SC)
Electronics and Communication Engineering	18955 - 27835	28045 - 32137	29392 - 40630	107985 - 142108	162101 - 197795	553719 – 604729 (OP) 696135 (EWS) 727587 (OBC)
Mechanical Engineering	19914 - 44183	45402 - 52501	44412 - 56171	120446 - 152607	152525 - 203318	565854 (OP) 987400 (OBC)
Smart Manufacturing	24066 - 50030	53862 - 61223	56868 - 69513	162947 - 190072	221125 - 228380	610160 (OP)

Category wise Distribution of B. Tech students for the year 2020-21 is given below:

Branch	DASA	GEN-EWS	GEN-EWS(PwD)	OBC-NCL	OBC-NCL(PwD)	Open	Open(PwD)	SC	SC(PwD)	ST	Grand Total
CS20B1	3	11	1	30	2	46	2	16	1	9	121
EC20B1	3	11	1	31	1	44	3	18		9	121
ME20B1		7		21	1	30	1	12		6	78
ME20B2		4		11		15	1	5		2	38
Grand Total	**6**	**33**	**2**	**93**	**4**	**135**	**7**	**51**	**1**	**26**	**358**

State wise distribution of B. Tech students through JoSAA is given below:

State	No .of Students
ANDAMAN & NICOBAR ISLANDS (UT)	1
ANDHRA PRADESH	124
BIHAR	6
DELHI (NCT)	1
GUJARAT	2
HARYANA	4
JHARKHAND	2
KARNATAKA	18
KERALA	6
MADHYA PRADESH	4
MAHARASTRA	18
ODISHA	1
PUDUCHERRY (UT)	1
RAJASTHAN	13
TAMIL NADU	30
TELANGANA	103
UTTAR PRADESH	16
UTTARAKHAND	1
WEST BENGAL	1
Grand Total	**352**

M. Tech

M Tech - 2020 Admissions - CCMT based on GATE Score

Branch	Min Score	Max Score
CDS	356	523
EDS	389	523
MDS	352	569
SMT	370	495

IIITDM Kancheepuram
19.02.2021

General Guidelines: Admission, Performance and Time line for Ph.D Scholars

(A) Students Under Regular HTRA

1. Faculty members are permitted to have normally two HTRA students. To attract good quality and interested students, faculty members may display their research caliber prominently in the web page and along with the advertisement copy. Occasion of Research Scholars' Day and other events may be utilized for this purpose. Faculty members can conduct outreach program regularly on recent research trends to attract potential candidates. In addition, faculty, with requisite permission, may encourage the prospective candidates to work with them in their research area prior to their application for the HTRA position. However, the selection of candidates is subject to fulfillment of norms of the institute.

2. Only the candidates having excellent academic record throughout their career (career first class) and having aptitude/attitude towards research and development may be selected. GATE score candidates may be given preference.

3. Students may be admitted prior to commencement of odd and even semester so as to commence their course work in January or July academic session.

4. In a week, research scholars should spend at least 40 hours in R&D, 8 hours of TA duty assigned by the department/supervisor. Research Scholars are expected to carry out their TA work diligently. TA duty assignment avoided during coursework as per as practicable.

5. Based on the recommendation of Doctoral Committee (DC), the scholars shall take 4 courses in his area of research in addition to the mandatory Research Methodology course. B.Tech. students pursuing Ph.D. will be assigned 24 credits of course works (Theory + Practice).

6. After successful completion of course work and the minimum CGPA requirement of 7.5, the scholar is permitted to attend comprehensive examination.

7. Scholars registered in School of Inter Disciplinary Design and Innovation may opt for one of the following as the comprehensive examination:
    (a) Conventional comprehensive examination which has two parts, the written part followed by the oral examination.
    (b) Written part in one paper corresponding to their basic degree followed by a rigorous oral examination as recommended by the DC, School of Design and approved by the Dean Academics.

8. Scholars are expected to complete their research work in a time bound manner which will be monitored by DC. The tentative schedule is as under:

(a) Completion of course work (6 months to one year)
(b) comprehensive examination (6 months to 18 months)
(c) literature review (initial review required for identification of the problem statement/objectives/scope to be completed within one year). At the time of second DC, the scholars are to submit their research proposal along with tentative yearly roadmap.
(d) Scholars should try to present their work in Tier I / Tier II conferences in the respective fields from the 2nd year.
(e) The scholars are required to have at least 2 SCI papers published/accepted in reputed journals of their area of research prior to their synopsis meeting.

9. Scholars will be supported by the Institute to present papers in their research area to disseminate their output and to collaborate with other research scholars and experts. Maximum amount of **Rs. one lakh** during the entire period of research which may be utilized to:
   (a) attend workshops/tutorials in the first one year
   (b) present papers in peer reviewed society conducted conferences in India/abroad
   (c) present paper once in ONE Tier- I conference abroad
   (d) Membership to Professional bodies like IEEE, ASME, ACM which avails automatic subscription to reputed Journals

10. Scholars who submit the thesis within 3.5 years or 4 years shall be rewarded as follows:
   (a) Monthly stipend equivalent to last drawn amount will be issued as Pre-Doctoral Fellowship for a period of 6 months.
   (b) If the scholars are ready to continue working anticipating more papers, the above Pre-Doctoral Fellowship may be extended beyond six months based on the approval by the Director. However, the cumulative period is limited to 5 years.
   (c) A certificate of Appreciation signed by the Director will be issued for early completion of quality research work.

11. Scholars will be paid fellowship on monthly basis in line with guidelines of the Government and on the basis of the monthly performance report from the supervisor

12. DC will meet once in every six months to evaluate the progress of the research work.

13. Research scholar need to register for 20 credits in each semester as per following credits break up: Research Credit: 16, Seminar and Technical writing: 02, TA Performance: 02. Whenever the student is doing course work, the research credits will be reduced by course credits and TA work will not be assigned during the period.

14. During the time of submission, student need to deposit a thesis processing fee of Rs. 10,000/=.

15. Student need to submit a technical report for the work carried out during the semester period and present the same before the DC. The performance of the students will be evaluated on the basis of 25:75 weightage assigned to Supervisor and DC.

16. If the progress/performance of the student is not satisfactory, the guide may refer the matter to the DC and the DC should be convened within a month, even if the request comes out of the normal schedule. If the DC considers the concern raised by the guide is in order, the scholar will be issued a warning and a period of six months to improve the performance. If the candidate fails to improve the research output even after six months, the DC may recommend cancellation of PhD studentship for the candidate. Dean Academics will report the issue to the Director and the decision of the Director will be final in this regard.

17. HTRA Scholars can take break for maximum period of one year on health ground/family issues and fellowship shall not be paid during the break period. Studentship will be terminated, automatically, in case of break beyond period of one year. As the projects are to be completed in a time bound manner, no break in period id permitted in case of JRF.

18. Any request for grant of RKA scheme for regular HTRA scholar will be considered only after completion of 3 years which is further subject to publication of at least two SCI papers in reputed journals and the scholar is in writing stage of his thesis. Further students have to pay the tuition fee during the period of RKA scheme till he submits his/her thesis.

19. Change of supervisor is strictly prohibited and in no case change of supervisor will be entertained. In case of no compatibility with supervisor and student and/or interest in research area, need to be reported within 6 months of enrollment. In that case the studentship will be terminated by listening to the incompatibility.

20. Performance of the project scholar shall be reviewed by the PI as well as by the duly constituted DC. DC will meet in every six months to evaluate the progress of the research work. If the progress/performance of the student is not satisfactory, the matter will be placed before the DC and if considered in order, a warning will be issued by the DC. If the subsequent performance is not satisfactory as determined by the DC, the DC will recommend for termination of the student from Ph.D. program without further correspondence. The evaluation in this regard is preferable in the early stage of the enrollment to save student’s time as well as public money.

21. Institute provides accommodation in the hostel and all other facilities to research scholars. Hence no HRA and overhead expenses are to be paid to any HTRA scholars. If he/she so desires can stay outside of his own.

22. A faculty member with a sponsored project or multiple projects having total value of Rs.50 lakhs (one or sum of two) and above at any instant with a project student in each, is eligible to take one additional HTRA scholar subject to total research scholars count is **five.**

23. A faculty member is eligible to take an HTRA scholar, only when his number of students drawing institute fellowship is reduced to one.

(B) JRF/SRF/Project students

1. The recruitment of JRF/SRF working for **sponsored research projects** will be made through SRIC Cell separately. Projects with duration two years and more, the JRF/SRF will be given an opportunity to enroll for Ph.D. program of the Institute which may be clearly reflected in the advertisement. In that case, the candidate must fulfil the norms of Ph. D. enrollment criteria. The PI must also ensure that a similar level test is conducted prior to the interview.

2. The Ph.D. problem must be in line with the research project and the JRF/SRF should be prepared to take additional effort for Ph.D. work as well as to mitigate the project objectives. They should abide by the rules and regulations of sponsoring agency and also the institute.

3. If recruited in the middle of the semester he/she will start the course work in the next semester

4. JRF/SRF will receive their monthly salary/stipend from project funds based on performance report from PI till completion of project period. No TA work will be given to project scholars during the course of their project period.

5. JRF/SRF shall draw the same fellowship amount as specified during the advertisement even though there would have been an enhancement to regular HTRA students as per Govt. order. The enhancement will not be made to JRF/SRF stipend unless a written order is produced by the PI from the sponsoring agencies. The perks like HRA, overhead will be admissible to JRF/SRF if the project has a clear provision in the project.

6. The project scholars will be supported by institute fellowship after the successful completion of their project period. However, this is extended normally for a period of **one year** and grant of fellowship for further period **one year** is subject to performance of the student and recommendation of the DC and approval of the Director in this regard. However, the total stipend period (Project + Institute) will not exceed 4 years in any case.

7. As soon as the student is allowed to draw Institute fellowship after completion of the project, he will be given TA duty as like HTRA scholars and all other regulations, terms, and conditions of HTRA scholars will be applicable to him. The total institute scholar count will be increased by one for the faculty.

8. Conversion of project JRF/SRF into regular HTRA fellowship is not permitted under any circumstances even in case of faculty having no student under HTRA.

ANNEXURE I

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, DESIGN AND MANUFACTURING KANCHEEPURAM

ACADEMIC CALENDAR – EVEN SEMESTER – Jan–May 2021

2017,18,19 B Tech; 2016,17,18,19 DD; 2019,20 M Tech

	January 2021			February 2021			March 2021			April 2021			May 2021			June 2021		
	Date		Days	Date		Days	Date		Days	Date		Days	Date		Days	Date		Days
Sat													1					
Sun													2					
Mon				1		1	1	Last Date to Apply For Make-up Exam Quiz I	1				3	End Semester Exam				
Tue				2		2	2	Last Date to Announce Quiz I Results	2				4	End Semester Exam		1	Fee Payment Portal to Open	
Wed				3	DD Comprehensive Exam/Viva	3	3	Class Committee	3				5	UG/DD/PG Final Project Review		2	Call for Supplementary open	
Thu				4	DD Comprehensive Exam/Viva	4	4	Class Committee	4	1		1	6	UG/DD/PG Final Project Review		3		
Fri	1	Semester Enrolment		5	DD Comprehensive Exam/Viva	5	5	Class Committee	5	2	Good Friday		7	UG/DD/PG Final Project Review		4		
Sat	2			6	GATE 2021		6			3			8			5		
Sun	3			7	GATE 2021		7			4			9			6		
Mon	4	Commencement of classes	1	8		6	8	Portal to close for Mid Semester Feedback	6	5	Last Date to Apply For Make-up Exam Quiz II	2	10	Final Year Internship Starts		7	Jul-Nov 2021 Registration Open	
Tue	5		2	9		7	9		7	6	Last Date to Announce Quiz II Results	3	11	Project Report Uploading in Portal to open Supplementary Exam		8		
Wed	6		3	10	DD Comprehensive Exam/Viva	8	10	Call for Supplementary open	8	7		4	12	Supplementary Exam		9		
Thu	7		4	11	DD Comprehensive Exam/Viva	9	11		9	8		5	13	Supplementary Exam Project Report Uploading in Portal to close		10		
Fri	8		5	12	DD Comprehensive Exam/Viva	10	12		10	9	Jul-Nov 2021 Pre-Registration Close	6	14	Id-Ul-Fitr		11	Call for Supplementary close	
Sat	9			13	GATE 2021		13			10			15			12		
Sun	10			14	GATE 2021		14			11			16			13		
Mon	11	Last date for enrolment with fine/ Orientation Programme for PhD Scholars	6	15		11	15	Friday's Timetable	11	12	Portal to open for End Semester Feedback	7	17	Last date for submission of Grades Supplementary Exam		14	Jul-Nov 2021 Registration Close	
Tue	12		7	16		12	16		12	13		8	18	Supplementary Exam		15		
Wed	13		8	17	Quiz I/UG/DD/PG 1st project Review		17		13	14		9	19	Supplementary Exam		16		
Thu	14	Pongal		18	Quiz I/UG/DD/PG 1st project Review		18		14	15		10	20	Supplementary Exam		17		
Fri	15		9	19	Quiz I/UG/DD/PG 1st project Review		19	Call for Supplementary close	15	16		11	21	Declaration of Results		18		
Sat	16			20			20			17			22			19		
Sun	17			21			21			18			23			20		
Mon	18		10	22		13	22	Quiz II/UG/DD/PG 2nd project Review		19		12	24			21		
Tue	19	Last date to apply for change of electives	11	23		14	23	Quiz II/UG/DD/PG 2nd project Review		20		13	25			22		
Wed	20	Class Committee	12	24		15	24	Quiz II/UG/DD/PG 2nd project Review		21	Portal to close for End Semester Feedback	14	26	Buddha Purnima Vesak		23		
Thu	21	Class Committee	13	25		16	25		16	22	Compilation of Attendance	15	27			24		
Fri	22	Class Committee	14	26	Portal to open for Mid Semester Feedback	17	26		17	23	End Semester Exam		28			25	Last date to update "I" Grade of Jan-May 2021	
Sat	23			27	Research Scholars' Day		27			24			29			26		
Sun	24			28			28			25	Mahavir Jayanti		30			27		
Mon	25		15				29		18	26	End Semester Exam		31	Last date for submission of Supplementary Grades		28		
Tue	26	Republic Day					30	Jul-Nov 2021 Pre-Registration Open	19	27	End Semester Exam					29		
Wed	27		16				31		20	28	End Semester Exam					30	Fee Payment Portal to Close	
Thu	28		17							29	End Semester Exam							
Fri	29	Last date to update "I" Grade of Jul-Nov 2020	18							30	End Semester Exam							
Sat	30																	
Sun	31																	

Month	Mon	Tue	Wed	Thu	Fri	Total
January	4	3	4	3	4	**18**
February	4	4	3	3	3	**17**
March	3	4	4	4	5	**20**
April	3	3	3	4	2	**15**
May	-	-	-	-	-	**-**
Total	**14**	**14**	**14**	**14**	**14**	**70**

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, DESIGN AND MANUFACTURING KANCHEEPURAM

ACADEMIC CALENDAR – ODD SEMESTER – Jul–Nov 2021

ALL B Tech, DD, M Tech Batches

	July 2021			August 2021			September 2021			October 2021			November 2021			December 2021		
	Date		Days	Date		Days	Date		Days	Date		Days	Date		Days	Date		Days
Sat																		
Sun				1														
Mon				2		1							1	**UG/DD First Project Review**	1			
Tue				3		2							2	Jan-May 2022 Fee Payment portal open	2			
Wed				4	**Last date for enrolment with fine**	3	1	**Quiz I**					3	**Portal to open for End Semester Feedback**	3	1	**UG/DD/PG Final Project Review**	
Thu	1	**Fee Payment with fine Portal Open**		5		4	2	**Quiz I**					4	**Diwali/Deepavali**		2		
Fri	2			6	**Last date for submission of Supplementary Grades**	5	3	**Quiz I**		1	**Call for Supplementary open**	1	5		4	3		
Sat	3			7			4			2	**Mahatma Gandhi Jayanti**		6			4		
Sun	4			8			5			3			7			5		
Mon	5			9	**Last date to apply for change of electives**	6	6		1	4	**Quiz II/PG Mid-Sem Project Review**		8	**Thursday's Timetable**	5	6		
Tue	6			10	**PG Summer Project Review**	7	7		2	5	**Quiz II/PG Mid-Sem Project Review**		9		6	7		
Wed	7			11	**PG Summer Project Review/ Class Committee**	8	8	**Last Date to Apply for Make-up Exam Quiz I**	3	6	**Quiz II/PG Mid-Sem Project Review**		10		7	8		
Thu	8			12	**Class Committee**	9	9		4	7		2	11		8	9	Jan-May 2022 Fee Payment Portal Close	
Fri	9			13	**Class Committee**	10	10	**Ganesh Chaturthi**		8		3	12		9	10	Jan-May 2022 Fee Payment with fine Portal Open	
Sat	10			14			11			9			13			11		
Sun	11	**Fee Payment with fine Portal Close**		15	**Independence Day**		12			10			14			12		
Mon	12			16		11	13	**Last Date to Announce Quiz I Results**	5	11	**Reporting date for final years after Internship**	4	15	**Portal to close for End Semester Feedback**	10	13		
Tue	13			17		12	14	**Friday's Timetable**	6	12	Jan-May 2022 Pre-Registration Open	5	16	**Compilation of Attendance**	11	14	**Last date for submission of Grades**	
Wed	14	**Supplementary Exam**		18		13	15	**Class Committee**	7	13	**Call for Supplementary close**	6	17	**End Semester Exam**		15		
Thu	15	**Supplementary Exam**		19	**Muharram**		16	**Class Committee**	8	14	**Mahanavami**		18	**End Semester Exam**		16	**Declaration of Results**	
Fri	16	**Supplementary Exam**		20		14	17	**Class Committee Portal to open for Mid Semester Feedback**	9	15	**Dussehra**		19	**Guru Nanak's Birthday**		17	Jan-May 2022 Registration Open	
Sat	17			21			18			16			20			18		
Sun	18			22			19			17			21			19		
Mon	19	**Supplementary Exam**		23	**Thursday's Timetable**	15	20		10	18		7	22	**End Semester Exam**		20	Jan-May 2022 Fee with fine Portal Close	
Tue	20	**Supplementary Exam**		24		16	21		11	19	**Milad un-Nabi-Id-e-Milad***		23	**End Semester Exam**		21		
Wed	21	**Id-Ul-Zuha (Bakrid)**		25		17	22		12	20	UG/DD Internship Review/ Last Date to Apply for Make-up Exam Quiz II	8	24	**End Semester Exam**		22	**Supplementary Exam**	
Thu	22	**Supplementary Exam**		26		18	23		13	21	UG/DD Internship Review/ Last Date to Announce Quiz II Results	9	25	**End Semester Exam**		23	**Supplementary Exam**	
Fri	23	**Supplementary Exam**		27		19	24		14	22	UG/DD Internship Review Jan-May 2022 Pre-Registration Close	10	26	**End Semester Exam**		24	Jan-May 2022 Registration Close **Supplementary Exam**	
Sat	24	**Convocation**		28			25			23			27			25	**Christmas Day**	
Sun	25			29			26			24			28			26		
Mon	26	**Semester Enrolment & Commencement of classes Orientation Programme for 2021 UG/PG/PhD**	1	30		20	27	**Portal to close for Mid Semester Feedback**	15	25		11	29	**UG/DD/PG Final Project Review**		27	**Supplementary Exam**	
Tue	27		2	31		21	28		16	26		12	30	**UG/DD/PG Final Project Review**		28	**Supplementary Exam**	
Wed	28		3				29		17	27		13				29	**Supplementary Exam**	
Thu	29		4				30		18	28	**UG/DD First Project Review**	14				30	**Supplementary Exam**	
Fri	30		5							29	**UG/DD First Project Review**	15				31	**Supplementary Exam**	
Sat	31									30								
Sun										31								

Month	Mon	Tue	Wed	Thu	Fri	Total
July	1	1	1	1	1	**5**
August	4	5	4	4	4	**21**
September	4	3	4	4	3	**18**
October	3	2	3	3	4	**15**
November	2	3	2	2	2	**11**
December	-	-	-	-	-	**-**
Total	**14**	**14**	**14**	**14**	**14**	**70**

ANNEXURE I

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, DESIGN AND MANUFACTURING KANCHEEPURAM

ACADEMIC CALENDAR FOR B TECH 2020 BATCH

Semester 1

	November 2020			December 2020			January 2021			February 2021			March 2021		
	Date		Days	Date		Days	Date		Days	Date		Days	Date		Days
Sat															
Sun	1														
Mon	2									1	Opening of Pre-Registration for Semester 2	1	1	End Semester	
Tue	3			1	Commencement of Classes	1				2		2	2	End Semester	
Wed	4			2		2				3	Class Committee	3	3	End Semester	
Thu	5			3		3				4	Class Committee	4	4	End Semester	
Fri	6			4		4	1		1	5	Class Committee	5	5	End Semester	
Sat	7			5	Monday's Timetable	5	2	Tuesday's Timetable	2	6	Monday's Timetable	6	6		
Sun	8			6			3			7			7		
Mon	9			7		6	4		3	8		7	8	End Semester	
Tue	10			8		7	5		4	9		8	9	End Semester	
Wed	11			9		8	6		5	10		9	10		
Thu	12			10		9	7		6	11		10	11		
Fri	13			11		10	8		7	12		11	12		
Sat	14			12	Tuesday's Timetable	11	9	Thursday's Timetable	8	13	Wednesday's Timetable	12	13		
Sun	15			13			10			14			14		
Mon	16			14	Class Committee	12	11		9	15	Closing of Pre-Registration for Semester 2	13	15	Closing of Semester 2 Fee payment window	
Tue	17			15	Class Committee	13	12	Mid Semester Exam		16	Opening of Semester 2 Fee payment window	14	16		
Wed	18			16	Class Committee	14	13	Mid Semester Exam		17		15	17	Last date for submission of Grades	
Thu	19			17		15	14	Pongal		18		16	18	Registration Portal to open for Semester 2	
Fri	20			18		16	15	Mid Semester Exam		19		17	19		
Sat	21			19	Wednesday's Timetable	17	16	Mid Semester Exam		20	Thursday's Timetable	18	20		
Sun	22			20			17			21			21		
Mon	23			21		18	18		10	22		19	22	Declaration of Semester 1 Results	
Tue	24			22		19	19		11	23		20	23		
Wed	25			23		20	20		12	24		21	24		
Thu	26			24		21	21		13	25		22	25	Registration Portal to close for Semester 2	
Fri	27	Orientation Programme		25	Christmas Day		22		14	26		23	26		
Sat	28	Orientation Programme		26	Friday's Timetable	22	23	Friday's Timetable	15	27	Friday's Timetable Compilation of Attendance	24	27		
Sun	29			27			24			28			28		
Mon	30	Guru Nanak's Birthday		28		23	25	Last date to apply for Makeup of Mid Semester Exam	16				29	Commencement of Classes/ Enrolment For Semester 2	
Tue				29		24	26	Republic Day					30		
Wed				30		25	27		17				31		
Thu				31		26	28		18						
Fri							29	Last date to announce Mid Semester Exam Marks	19						
Sat							30	Tuesday's Timetable	20						
Sun							31								

Month	Mon	Tue	Wed	Thu	Fri	Total
December	5	6	6	5	4	**26**
January	4	4	3	4	5	**20**
February	5	4	5	5	5	**24**
March	-	-	-	-	-	-
Total	**14**	**14**	**14**	**14**	**14**	**70**

ANNEXURE I

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, DESIGN AND MANUFACTURING KANCHEEPURAM

ACADEMIC CALENDAR FOR B TECH 2020 BATCH

Semester 2

	March 2021			April 2021			May 2021			June 2021			July 2021		
	Date		Days	Date		Days	Date		Days	Date		Days	Date		Days
Sat							1	Friday's Timetable	1						
Sun							2								
Mon	1						3		2						
Tue	2						4		3	1	Quiz II				
Wed	3						5		4	2	Quiz II				
Thu	4			1		1	6		5	3		1	1	End Semester	
Fri	5			2	Good Friday		7		6	4	Opening of Pre-Registration for Semester 3	2	2	End Semester	
Sat	6			3	Friday's Timetable	2	8	Wednesday's Timetable	7	5	Tuesday's Timetable	3	3		
Sun	7			4			9			6			4		
Mon	8			5		3	10	Last date to apply for Makeup Quiz I	8	7		4	5	End Semester	
Tue	9			6		4	11	Last date to announce Quiz I Marks	9	8		5	6	End Semester	
Wed	10			7		5	12		10	9		6	7	End Semester	
Thu	11			8		6	13		11	10		7	8	End Semester	
Fri	12			9	Last date for enrolment with fine	7	14	Id-Ul-Fitr		11	Last date to apply for Makeup Quiz II	8	9		
Sat	13			10	Wednesday's Timetable	8	15	Friday's Timetable	12	12	Wednesday's Timetable	9	10		
Sun	14			11			16			13			11		
Mon	15			12		9	17		13	14	Last date to announce Quiz II Marks	10	12		
Tue	16			13	Class Committee	10	18	Class Committee	14	15	Closing of Pre-Registration for Semester 3	11	13		
Wed	17			14	Class Committee	11	19	Class Committee	15	16	Opening of Semester 3 Fee payment window	12	14		
Thu	18			15	Class Committee	12	20	Class Committee	16	17		13	15	Closing of Semester 3 Fee payment window	
Fri	19			16		13	21		17	18		14	16	Last Date for submission of Grades	
Sat	20			17	Thursday's Timetable	14	22	Thursday's Timetable	**18**	**19**	Friday's Timetable	15	17		
Sun	21			18			23			20			18		
Mon	22			19		15	24		19	21		16	19	Declaration of Semester 2 Results	
Tue	23			20		16	25		20	22		17	20	Opening of Registration for Semester 3	
Wed	24			21		17	26	Buddha Purnima Vesak		23		18	21	Id-Ul-Zuha (Bakrid)	
Thu	25			22		18	27		21	24		19	22		
Fri	26			23		19	28		22	25		20	23		
Sat	27			24	Wednesday's Timetable	20	29	Monday's Timetable	23	26	Tuesday's Timetable	21	24	Closing of Registration for Semester 3	
Sun	28			25	Mahavir Jayanti		30			27			25		
Mon	29	Commencement of Classes / Enrolment	1	26		21	31	Quiz II		28	Compilation of Attendance	22	26	Commencement of Classes/ Enrolment For Semester 3	
Tue	30		2	27		22				29			27		
Wed	31		3	28	Quiz I					30	End Semester		28		
Thu				29	Quiz I								29		
Fri				30	Quiz I								30		
Sat													31		
Sun															

Month	Mon	Tue	Wed	Thu	Fri	Total
March	1	1	1	-	-	**3**
April	4	4	5	5	4	**22**
May	5	4	4	5	5	**23**
June	4	5	4	4	5	**22**
July	-	-	-	-	-	**-**
Total	**14**	**14**	**14**	**14**	**14**	**70**

Dr. Jyotismita Mishra

Ph.D., NIT Rourkela

22 March 1988

Chennai
India

+91 9348685714
+91 8895961488 (WhatsApp)

www.linkedin.com/in/jyotismita-mishra-219a3361/

jyotismita.mishra22@gmail.com
jmishra@ieee.org

About me

Jyotismita is looking for an exposure to share and learn new technical ideas with society and to implement the best skill within for the organization and being an integral part of the work culture of the organization and evolve into a creative, smart working professional. Jyotismita displays great curiosity and attempts to fit his experiences into a clear understanding of the engineering and technology.

Technical Skills

MATLAB-SIMULINK

dSpace Digital controller

MULTISIM

OPAL-RT

Arduino

Python

(*)[The skill scale is from 0 (Fundamental Awareness) to 6 (Expert).]

Objective

Looking for an exposure to share and learn new technical ideas with society and to implement the best skill within for the organization and being an integral part of the work culture of the organization and evolve into a creative, smart working professional.

Education

Professional

2013-2019 Ph.D. in Electrical Engineering — National Institute of Technology, Rourkela
Design and Development of a Wind-Solar-Battery Hybrid Autonomous System

2010-2012 M. Engg — Birla Institute of Technology, Mesra
Majoring in Electrical & Electronics Engineering with 84%. (with Distinction)
Masters Thesis: Mi-controller Based Three Phase Boost Inverter for Hybrid Electric Vehicle.

2005-2009 B. Tech — BPUT, Odisha
Majoring in Electrical Enginnering with 6.96 CGPA

Publications

Journals :

1. J. Mishra, M. Pattnaik and S. Samanta "Drift Free Perturb and Observe MPPT Algorithm with Improved Performance for SEIG based Stand-alone Wind Energy Generation System," *IEEE Transaction on Power Electronics*, vol. 35, no. 6, pp. 5842-5849, 2019.
2. D. Verma, J. Mishra, and M. Pattnaik "Output voltage based adaptive step size MPPT controller with improved dynamics for stand-alone photovoltaic system," *Journal of Renewable and Sustainable Energy-AIP*, vol. 10, no. 4, pp. 043505 - 1-13, 2018.
3. J. Mishra, S. Das, D. Kumar and M. Pattnaik, "A Novel Auto-tuned Adaptive Frequency and Adaptive Step-size Inc MPPT Algorithm for Photovoltaic System", *International Transactions on Electrical Energy Systems* (Wiley), 2021, e12813
4. J. Mishra and M. Pattnaik S. Samanta "Optimum Modes of Operation for a Wind-Battery Hybrid Autonomous System: An Efficient Power Management Scheme" , *IEEE Trans. on Power Electronics*. (Review Received)
5. J. Mishra, M. Pattnaik and S. Samanta, "Performance Study of DC Motor based Wind Turbine Emulator for Stand-alone Wind Generation System ", *Energy System-Springer*(Under Review)

Conferences :

1. J. Mishra, M. Pattnaik and S. Samanta "Performance Evaluation of a Self-excited Induction Generator for Stand-alone Wind Energy Conversion System" , *IEEE Power, Communication and Information Technology Conference (PCITC)*, 2015
2. J. Mishra, M. Pattnaik and S. Samanta, "Speed Sensorless MPPT Control of Stand-alone SEIG Based Wind-Battery Hybrid System", *6th IEEE International Conference on Computer Applications In Electrical Engineering-Recent Advances (CERA)*, 2017
3. J. Mishra, M. Pattnaik and S. Samanta, "Power Management Scheme for a Wind-Photovoltaic Hybrid Autonomous System with Battery Storage", *4th IEEE Southern Power Electronics Conference,(SPEC)*, 2018
4. J. Mishra, M. Pattnaik and S. Samanta, "Load Voltage based MPPT Algorithm for a Stand-alone Wind Generation System", *15th IEEE INDICON*, 2018
5. J. Mishra, D. Kumar, S. Das and M. Pattnaik, "Performance Comparision of P&O and INC MPPT Algorithm for a Stand-alone PV System", *IEEE Innovations in Power and Advanced Computing Technologies (i-PACT) 2019*

ANNEXURE J

Dr. Jyotismita Mishra

Ph.D., NIT Rourkela

Software Skills

Origin

MS Visio

Latex

MS Office

Windows

(*)[The skill scale is from 0 (Fundamental Awareness) to 6 (Expert).]

Strengths

Diligence
Punctuality
Adaptability
Patience
Quick Learner

Subjects Strength

Renewable Energy systems
Power Electronics
Electrical Mahines
power electronics and drives
Mahines Analysis
Control System

Languages Known

English

Hindi

Odia

(*)[The skill scale is from 0 (Fundamental Awareness) to 6 (Expert).]

Book Chapters

1. J. Mishra, and M. Pattnaik, “Design and Analysis of DC-DC Buck Converter with Drift-free MPPT Algorithm for a SEIG based Wind Energy Generation System", *Springer Nature - DC-DC Converters for Future Renewable energy system*, 2021 (Accepted-In Press)

Awards

2013 Ph.D. Fellowship award by MHRD, Govt. of India

2018 IEEE Southern Power Electronics Conference (SPEC), NTU, Singapore (from SPEC Student Travel Grant)

Experience

June 2012- July 2013 — Assistant Professor — Kalinga Institute of Industrial Technology, Bhubaneswar, Odisha
With the Dept. of Electrical Engineering

July 2010- July 2012 — Teaching Assistant — Birla Institute of Technology, Mesra
With the Dept. of Electrical and Electronics Engineering

July 2013- July 2017 — Teaching Assistant — National Institute of Technology Rourkela
With the Dept. of Electrical Engineering

Other Informations

Frequent reviewer of IEEE Journal of Photo-voltaic.

Presentations

2018 IEEE SPEC, NTU, Singapore
2018 IEEE INDICON, Coimbatore, India
2017 IEEE CERA, IIT Roorkee, India
2015 IEEE PCITC, ITER, Bhubaneswar, India

References

1. Prof. Monalisa Pattnaik
Assistant Professor, Dept. of Electrical Engineering
National Institute of technology, Rourkela, India
mail: pattnaikm@nitrkl.ac.in, Ph: +91-8895381976
2. Prof. Prof. Pravat K. Ray
Associate Professor, Dept. of Electrical Engineering
National Institute of technology, Rourkela, India
mail: rayp@nitrkl.ac.in, Ph: 0661-2462412
3. Prof. Bansidhar Majhi
Director, Indian Institute o Information Technology Design and Manufacturing, Kancheepuram
mail: director@iiitdm.ac.in, Ph: +91 44 2747 6302