Curriculum for B.Tech

Design Engineering

For the Academic Year 2025

(Approved in Senate 60)

Indian Institute of Information Technology Design and Manufacturing, Kancheepuram

Chennai-600 127

B. Tech – Design Engineering

Semester 1					
Category	**Course Name**	**L**	**T**	**P**	**C**
BSC	Calculus	3	1	0	4
BSC	Physics for Engineers	3	0	2	4
BEC	Basic Electrical Engineering	3	1	0	4
ITC	Problem Solving and Programming	3	0	2	4
DSC	Concepts in Engineering Design	2	0	2	3
BEC	Engineering Skills Practice	0	0	2	1
HMC	Effective Language and Communication Skills	1	0	2	2
HMC	NSO/NCC/SSG/NSS/YOGA	0	0	2	P/F
					22.0
Semester 2					
Category	**Course Name**	**L**	**T**	**P**	**C**
BSC	Differential Equations	3	1	0	4
ITC	Data Structures and Algorithms	3	0	2	4
PCC	Materials for Design Engineers	3	0	0	3
PCC	Electronics for Designers	3	0	2	4
DSC	Form Design and CAD Modeling	2	0	2	3
DSC	Biology for Design	2	0	2	3
HMC	Earth, Environment and Design	1	0	0	P/F
					21.0
Semester 3					
Category	**Course Name**	**L**	**T**	**P**	**C**
SEC	Linear Algebra	3	0	0	3
ITC	Introduction to AI with Python	2	0	2	3
PCC	Mechanics and Mechanisms	3	0	2	4
PCC	Instrumentation and Control systems	3	0	2	4
DSC	Sociology of Design	2	0	2	3
DSC	Human Centered Design	2	0	2	3
DSC	Techno-asthetics in Product Detailing	2	0	2	3
HMC	Indian Constitution, Essence of Indian Traditional Knowledge	1	0	0	P/F
					23.0
Semester 4					
Category	**Course Name**	**L**	**T**	**P**	**C**
SEC	Probability and Statistics	3	0	0	3
PCC	Design of Engineering Components	3	0	2	4
PCC	Fluids and thermodynamics	2	0	2	3
PCC	Embedded systems for product development	2	0	2	3
PCC	Manufacturing Technology	3	0	2	4
DSC	Data Driven Design	2	0	2	3
DSC	Systems Thinking for Design	2	0	2	3
HMC	Human Values and Stress Management	1	0	0	P / F
					23.0

Semester 5					
Category	**Course Name**	**L**	**T**	**P**	**C**
PCC	Cyber Physical Systems	3	0	2	4
PCC	Advanced Manufacturing	3	0	2	4
DSC	Generative Design	2	0	2	3
DSC	Smart Product Design	2	0	2	3
DSC	Entrepreneurship and Venture Creation	3	1	0	4
PEC	Program Elective 1	3	1	0	4
HMC	Professional Ethics and Organizational Behaviour	1	0	0	P/F
					22.0
Semester 6					
Category	**Course Name**	**L**	**T**	**P**	**C**
SEC	Numerical and Computational Methods	3	0	0	3
DSC	Simulation Driven Design	2	0	2	3
DSC	Ergonomics and Usability	2	0	2	3
DSC	Product and Innovation Management	3	1	0	4
PEC	Program Elective 2	3	1	0	4
ELC	Free/Open Elective 1	3	0	0	3
HMC	Professional Communication	1	0	2	2
HMC	Intellectual Property Rights	1	0	0	P/F
					22.0
	Summer				
PCD	**Summer Internship MID MAY to MID JULY**				**P/F**
Semester 7					
Category	**Course Name**	**L**	**T**	**P**	**C**
PEC	Program Elective 3	3	0	0	3
ELC	Free/Open Elective 2	3	0	0	3
ELC	Free/Open Elective 3	3	0	0	3
ELC	Free/Open Elective 4	3	0	0	3
ELC	Free/Open Elective 5	3	0	0	3
PCD	Comprehensive Exam				P/F
HMC	Invited Expert Lectures*	0	0	0	P/F
	*** 10 Expert lectures to be attended from Sem 1 to Sem 7**				**15.0**
Semester 8					
Category	**Course Name**	**L**	**T**	**P**	**C**
PCD	B.Tech. Project (BTP)	0	0	18	**9**

Semester wise Credit Distribution	Credits									
Category	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**Total**	**%**
Basic Science Course (BSC)	8	4	0	0	0	0	0	0	12	8
Science Elective Course (SEC)	0	0	3	3	0	3	0	0	9	6
Basic Engineering Course (BEC)	5	0	0	0	0	0	0	0	5	3
IT Skill Course (ITC)	4	4	3	0	0	0	0	0	11	7
Program Core Course (PCC)	0	7	8	14	8	0	0	0	37	24
Program Elective Course (PEC)	0	0	0	0	4	4	3	0	11	7
Elective Course (ELC)	0	0	0	0	0	3	12	0	15	10
Humanities and Management Course (HMC)	2	0	0	0	0	2	0	0	4	3
Professional Career Development (PCD)	0	0	0	0	0	0	0	9	9	6
Design Course (DSC)	3	6	9	6	10	10	0	0	44	28
Total	22	21	23	23	22	22	15	9	157	100
	22	**43**	**66**	**89**	**111**	**133**	**148**	**157**	**157**	

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COURSE FORMAT

Course Code		Course Name	Calculus			
Offered by the Department	SH-Mathematics	Structure (LTPC)	3	1	0	4
To be offered for	B Tech	Course type	Core			
Pre-requisite	NIL	Approved In	Senate 61			
Learning Objectives	The course will introduce the students to basic concepts in Calculus, such as convergence, differentiation & integration, and their applications.					
Contents of the Course	➢ Limit and Continuity of functions defined on intervals, Intermediate Value Theorem, Differentiability, Rolle's Theorem, Mean Value Theorem, and Taylor's Formula (5L+2P) ➢ Sequences and series (7L+2P) ➢ Definite integral as the limit of sum, Mean value theorem, Fundamental theorem of integral calculus, and its applications (9L+3P) ➢ Functions of several variables, Limit and Continuity, Geometric representation of partial and total derivatives, Derivatives of composite functions (8L+3P) ➢ Directional derivatives, Gradient, Lagrange multipliers, Optimization problems (7L+2P) ➢ Multiple integrals: Evaluation of line and surface integrals (6L+2P)					
Essential Reading	1. Thomas G B. and Finney R. L., Calculus, Pearson Education, 2007					
Supplementary Reading	1. Piskunov N., Differential and Integral Calculus, Vol. I & II, Mir Publishers, 1981 2. Kreyszig E., Advanced Engineering Mathematics, Wiley Eastern, 2007. 3. Hass J., Weir M. D., Giordano F. R., Thomas Calculus, 11th Edition, Pearson.					

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COURSE FORMAT

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Physics for Engineers</td></tr>
<tr><td>Dept./ Specialization</td><td>SH -Physics</td><td>Structure (LTPC)</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>To be offered for</td><td>B. Tech. and DD</td><td>Status</td><td colspan="2">Core ☑</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Faculty Proposing the course</td><td>SH - Physics</td><td>Type</td><td colspan="2">New ☑</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>None</td><td colspan="2">Submitted for approval</td><td colspan="3">Senate-61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To learn about
• Transformation of three dimensional coordinate systems for scalar and vector fields
• Concepts of gradient, divergence and curl in the context of scalar and vector fields.
• Theories of electrostatics, magnetostatics, magnetism with hands on experience experiments.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the student should be able to
• Visualize the three dimensional coordinates transformation of vectors and curved surfaces
• Describe physical meaning of gradient, divergence and curl for practical purposes
• Explain knowledge of electrostatics, magnetostatics and magnetism</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">• Vectors-an introduction; Unit vectors in Cartesian, spherical, and cylindrical polar co-ordinates; Transformation of coordinate systems, line, surface, and volume integrals, Concept of scalar and vector fields; Gradient of a scalar field; Directional derivative, Equipotential surfaces, Conservative vector fields and their potential functions-gravitational and electrostatic examples. (9L)
• Flux, divergence of a vector, Gauss’s theorem, Continuity equation; Curl–rotational and irrational vector fields, Stoke’s theorem. Conservation principles for matter, energy, and electrical charge, physical applications in gravitation and electrostatics. Irrotational versus rotational vector fields. (8L)
• Electrostatics: Electrostatic potential and field due to discrete and continuous charge distributions, boundary condition, Energy for a charge distribution, Conductors and capacitors, Laplace’s equation Image problem, Dielectric polarization, Electric displacement vector, Dielectric susceptibility, Energy in dielectric systems. (12L)
• Magneto statics: Lorentz force law, Bio-Savart's law and Ampere's law in magneto statics, Divergence and curl of B, Magnetic induction due to configurations of current-carrying conductors, Magnetization and bound currents, Energy density in a magnetic field, Magnetic permeability and susceptibility, Boundary conditions. (13 L)
Practice components will cover the experiments on electrostatics and magneto statics viz. Electrostatic field, dielectric polarization, Electric Permittivity, capacitance, electric conductivity, Biot Savart law, Magnetic field, Magnetic permeability, Helmholtz Coil, Magnetization, Hysteresis, Faraday’s law etc. (28 P)</td></tr>
<tr><td>Text Book</td><td colspan="6">1. David J. Griffiths, Introduction to Electrodynamics, 4th Edition, Pearson, 2015, ISBN – 13: 978-9332550445
2. Bhag Singh Guru, Huseyin R. Hiziroglu, Electromagnetic field Theory, 2nd Edition, Cambridge University Press, 2009; ISBN-13 : 978-0521116022</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. W. H. Hayt, J. A. Buck and M. Jaleel Akhtar, Engineering Electromagnetics, McGraw Hill (India) Education Pvt. Ltd, Special Indian Edition 2020.
2. G. B. Arfken, H. J. Weber and F. E. Harris, Mathematical Methods for Physicists, Academic Press, 7th Edition, 2013, ISBN-13: 978-9381269558</td></tr>
</table>

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Basic Electrical Engineering</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</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 rowspan="2">To be offered for</td><td rowspan="2">B.Tech & DD (All Branches)</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective</td></tr>
<tr><td>Status</td><td colspan="2">New</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">● To impart foundational knowledge on the construction, operation, and analysis of basic electrical and electronic circuits.
● To develop the ability to systematically analyze DC and AC circuits for practical engineering applications.
● To introduce students to fundamental electrical machines and their relevance in industrial and consumer contexts.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students will be able to
• Represent and interpret basic electrical systems using standard technical conventions.
• Analyze and solve linear electric circuits (both DC and AC) with single or multiple power sources in the time domain.
• Understand the fundamentals of electronic components and circuits.
• Understand the construction, operation, and applications of electrical machines commonly used in industry.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Basics of Electricity: Systems of units - charge and current, voltage, power and energy, electricity tariff, circuit elements - sources and passive elements (R,L,C), Overview of power system (4L+1T)

DC Circuits: Basic laws and circuit analysis - Ohm’s law, Kirchhoff’s laws, voltage and current division, Wye-Delta transformations, Nodal and Mesh analysis with independent sources (6L+3T).

Circuit theorems (with independent sources) - Linearity property, Superposition, source transformation, Thevenin’s theorem, Norton’s theorem, maximum power transfer theorem (5L+3T)

AC Circuits: Sinusoids and phasors – phasor relationships, Impedance and Admittance; sinusoidal steady-state analysis – Nodal and mess analysis, theorems; AC power analysis- Instantaneous and average power, RMS, apparent and PF, complex power (10L+4T)

Electrical Machines: Transformers – principle of operation, types, EMF equation, equivalent circuit, Losses and efficiency calculation, Dot convention (4L+1T)

DC Machines - principle of operation, emf and torque equation, types, characteristics and speed control of DC motors (4L+1T).

AC Induction Machines- operating principles, equivalent circuits, torque-speed characteristics, speed control, efficiency (4L+1T)

Electronic Circuits: Operational Amplifiers - Ideal op-amp, inverting and noninverting amplifier, Applications of Op-Amp (2L+1T)</td></tr>
</table>

	Diodes - V-I characteristics and their applications (2L)
Text Books	1. Alexander C. and Sadiku M. N. O., Fundamentals of Electric Circuits, 7th Edition, Tata McGraw-Hill, New Delhi, ISBN: 9781260226409, 2013. 2. A.E. Fitzgerald and Charles Kingsley, 'Electric Machinery', Tata McGraw-Hill Education Publications, 6th Edition, 2002.
Reference Books	1. Hughes, 'Electrical and Electronic Technology', Pearson Education India, 10th Edition, 2010. 2. W. H. Hayt and T. E. Kimmerley, Engineering Circuit Analysis, 9th Edition, TMH, ISBN: 9780073545516, 2019. 3. Joseph. A. Edminister, 'Electric Circuits - Schaum's Outline Series', McGraw-Hill Publications, 6th Edition, 2003.

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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Problem Solving and Programming</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">CSE</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>0</td><td>2</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech, DD</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td>--</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The course focuses on problem solving skills / techniques. Students shall be exposed to data representations, base conversions, arithmetic in fixed and floating point representations. Sequence, selection, iterative statements and various other programming constructs in C,Python shall be discussed with case studies. The practice component of this course shall equip the students to test drive the theory concepts using appropriate case studies.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• The teaching and assessment shall ensure that given a computational problem, students can use computers as a tool to solve the problem.
• Developing pseudo codes and programs using various programming constructs are expected out of the students.
• Students will be able to develop simple applications using the various programming constructs.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Evolution of Computing Machines - Number Representation - Fixed & Floating Point - Base Conversions: Binary, Decimal, Octal, Hexa-decimal number systems and conversions. Introduction to algorithms and flow chart, Data types in C – Input and output statements – Formatted input/output – Phases of program development –Applications involving sequence statements (8L)
Operators - Arithmetic, logical, relational, shift, unary operators – Precedence and Associativity - Selection Statements: IF-ELSE, SWITCH-CASE - Programs involving sequence & selection - GOTO statements - break statement - Nested IF (6 L)
Repetition Statements - FOR, WHILE, DO WHILE - Programs involving sequence, selection & repetition - continue statement - Nested loops - Introduction to Arrays and Strings - Array manipulation - string manipulation -string operations - multi-dimensional arrays (10 L)
Functions in C – Function declaration, definition – scope -storage class-Built-in and user defined functions –Recursive functions (5 L)
Introduction to Pointers, Pointer Arithmetic, Dynamic Memory Allocation – Basic data structures using pointers, Structures and File processing, Command Line Arguments (6 L)
Introduction to Python programming: basic programming constructs, selection (IF), Looping Statements, Functions and Recursion - Examples. (7 L)
Practice Component: Introduction to text editors - basic text processing - case studies involving office software - doc and ppt creation, Introduction to Linux commands - file/directory creation - copy, move, pdf creation, zip commands -Applications using sequence statements - input/output statements - arithmetic with precedence and associativity. Case studies involving selection and repetition statements – arrays, functions, strings, recursion. Case studies involving pointers, dynamic memory allocation, structures, file processing (28P)
Note: 30% of the practice component to be done using Python</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Deitel P J and Deitel H M, C How to Program, Prentice Hall, 9th Edition, 2022, 978-0137398355.
2. Deitel P J and Deitel H M, Python for Programmers, Pearson Education, 2019, 978-0135224335.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Kernighan, Ritchie D, The C Programming Language, Prentice Hall, 2nd Edition, 2015, 978-9332549449
2. Byron S. Gottfried, Programming with C, TMH Publishers, 4th Edition, 2018, 978-9353160272
3. Donald E. Knuth, The Art of Computer Programming, 3rd Edition,2022, 978-0137935109.
4. Yashavant Kanetkar, Understanding Pointers in C& C++, BPB Publications, 5th Edition, 2019, 978-9388176378.</td></tr>
</table>

Course Code		Course Title	Concepts in Engineering Design			
Dept./Faculty proposing the course	SIDI	Structure (LTPC)	L	T	P	C
			2	0	2	3
To be offered for	B Tech/DD	Type	Core ☑		Elective ☐	
		Status	New ☑		Modification ☐	
Pre-requisite	None	Submitted for approval			Senate 61	
Learning Objectives	• To understand the engineering design process, product development cycles, and market influences on design decisions. • To transform customer needs into technical specifications using QFD and competitive benchmarking. • To assess design alternatives using structured decision frameworks.					
Learning Outcomes	• Students will formulate engineering problems by translating customer requirements into technical specifications, generate and evaluate innovative design concepts using creative thinking methodologies.					
Contents of the course *(With approximate break-up of hours for L/T/P)*	• **Introduction** - Importance of engineering design- types of design- the design process- total life cycle- regulatory and social issues-product design- types of products- phases of product development process- product and process cycles-organization for product development-markets and marketing-technological innovation (5L+5P) • **Problem definition & need identification** - Identifying customer needs- gathering information- classifying customer requirements- establishing engineering characteristics- competitive benchmarking- quality function deployment- product design specification (6L+6P) • **Conceptual design** - Creativity in design- creativity and problem solving- creative thinking methods- conceptual decomposition- morphological methods-TRIZ (Theory of Inventive Problem Solving)- Decision making and concept selection-decision theories-concept screening and concept scoring (6L+6P) • **Embodiment design** - Product architecture- steps in developing product architecture-configuration design-industrial design- human factors design- prototyping and testing (6L+6P) • **Product Economics and related issues** - Risk, reliability and safety- failure mode & effects analysis- concept of total quality- robust design- economic decision making- time value of money-profitability of investment- cost estimation-design to cost (5L+5P)					
Text Books	1. George E.Dieter & Linda C.Schmidt, Engineering Design, McGraw-Hill International Edition 5, 2013, ISBN-10 : 9355322259, ISBN-13 : 978-9355322258 2. Anita Goyal, Karl T Ulrich, Steven D Eppinger, Product Design and Development , Tata McGraw-Hill Education, 4th Edition, 2009, ISBN-10: 0070146799, ISBN-13: 978-0070146792					
Reference Books	1. Kevin Otto, Kristin Wood, Product Design, Pearson Education, Indian Reprint, 2004, ISBN-10: 0130212717, ISBN-13: 978-0130212719 2. Yousef Haik, T.M.M. Shahin, Engineering Design Process, Cengage Learning, 2nd Edition Reprint, 2010, ISBN-10: 0495668141, ISBN-13: 978-0495668145 3. Clive L. Dym, Patrick Little, Engineering Design: A Project-based Introduction, John Wiley & Sons, 3rd Edition, 2009, ISBN-10: 0470225963, ISBN-13: 978-0470225967					

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COURSE FORMAT

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Engineering Skill Practice</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Structure (LTPC)</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 rowspan="2">To be offered for</td><td rowspan="2">All UG & DD</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td>NIL</td><td colspan="2">Submitted for approval</td><td colspan="3">Senate 61</td></tr>
<tr><td>Learning 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>Learning Outcomes</td><td colspan="6">At the end of the course, the students will be able to choose suitable process/method among the mechanical, electrical, electronics, and communication engineering concepts that can full fill the functional outcomes of the parts/prototypes/products.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</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, Arc Welding, 3D Printing. (10P)

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. (6P)

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

Dismantle and assembly of PC. Installing OS and disk management. (4P).</td></tr>
<tr><td>Text Books</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>Reference Books</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>

Course Code		Course Name	Effective Language and Communication skills			
Offered by Department	SH-English	Structure(LTPC)	1	0	2	2
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate 61			
Learning Objectives	• Hone LSRW and practice critical thinking • Enable students to speak and write grammatically acceptable sentences • Train students in technical communication • Cultivate interest to learn language and to build the confidence to communicate in English • Develop an interest in updating their language skills through continuous learning • Connecting personal growth with improvement in their proficiency in English					
Learning Outcomes	• Able to communicate effectively with grammatically acceptable constructions and appropriate words in formal and informal situations • Can extract information effectively and able to think critically • Able to present technical content confidently					
Course Contents(with approximatebreakup of hours forlecture/ tutorial/ be donepractice)	• Introduction: Language, effective communication, ethics and aesthetics of communication (L1) • Phonetics – sounds, pronunciation of words, stress, intonation, listening, Varieties of English (L3, P4) • Sentence structure, concord, punctuation, stylistic errors, common errors (L3, P4) • Reading and comprehension (L2, P5) ➢ Different types of reading, analyzing the organization of the text ➢ Critical thinking- thesis statement, argument, hypothesis, order, reason, evidence, consistency,tautology, conclusion • Exercises for vocabulary enrichment (for daily practice) • Speaking (L2, P5) ➢ Barriers to effective communication, technical presentation and presentation skills, self-introduction, ➢ Requests, enquiry, suggestion in formal and informal situations, reporting an event, grouppresentation – debate • Writing (L3, P8) ➢ Writing formal letters, email, résumé, ➢ Data interpretation, reports, product description/requirements/ technical instructions, recordingobservations ➢ The language of content strategy - voice and tone strategy - the language of localization_ textanalysis tools ➢ Plagiarism – the importance of documentation, different methods of note-taking ➢ Essays/story/ book & movie reviews/writing for social media/blogging/ journaling • Life lessons through stories and activities (P2)					
Essential & Supplementary Reading	1. Tebeaux, Elizabeth, and Sam Dragga. *The Essentials of Technical Communication* OUP, 2018. 2. Rizvi, M Ashraf. *Effective Technical Communication*. McGraw-Hill, 2017 3. Hancock, Mark. *English Pronunciation in Use: Intermediate Self-study and Classroom Use*.CUP,2012. 4. Cottrell, Stella. *Critical Thinking Skills: Developing Effective Argument and Analysis*. Palgrave,2005. 5. Gower, Roger. *Grammar in Practice*. CUP, 2005. 6. Paterson, Ken. *Oxford Living Grammar*. OUP, 2014. 7. Sabin, William A. *The Gregg Reference Manual:A Manual of Style, Grammar, Usage, andFormatting.* McGraw-Hill, 2011. 8. Fitikides, T. J. *Common Mistakes in English*. London: Orient Longman, 1984.					

Leech, Geoffrey and Jan Svartvik. A Communicative Grammar of English. Routledge, 2013.
9. Astley, Peter and Lewis Lansford. *Oxford English for Careers: Engineering*. OUP, 2013.
10. Savage, Alice and Patricia Mayer. *Effective Academic Writing*. OUP, 2013
11. Harari, Yuval Noah. *Sapiens: A Brief History of Humankind*. Vintage, 2014.
12. https://www.ted.com/
13. https://www.bbc.co.uk/learningenglish/features/pronunciation/tims-pronunciation-workshop-ep-13
14. https://learnenglish.britishcouncil.org/skills/listening
15. https://www.nationalgeographic.com/podcasts/overheard
16. https://www.youtube.com/user/NatureVideoChannel
17. https://www.youtube.com/watch?v=Aj-EnsvU5Q0&list=PLcetZ6gSk969oGvAI0e4_PgVnlGbm64bp
18. https://www.merriam-webster.com/word-of-the-day
19. https://www.newyorker.com/tag/book-reviews

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY
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COURSE FORMAT

Course Code		Course Name	Differential Equations			
Offered by the Department	SH-Mathematics	Structure (LTPC)	3	1	0	4
To be offered for	B.Tech	Course Type	Core			
Pre-requisite	NIL	Approved In	Senate 61			
Learning 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 +3P) ➢ Power series solution of ordinary differential equations, Singular Points, Frobenius series solutions, Bessel and Legendre differential equations, Properties of Bessel functions and Legendre Polynomials (12L+4P) ➢ Fourier series (6L+2P) ➢ Laplace transforms: Elementary properties of Laplace transforms, inversion by partial fractions, convolution theorem, and its applications to ordinary differential equations (6L+2P) ➢ Introduction to partial differential equations, wave equation, heat equation, and diffusion equation (8L+3P)					
Essential Readings	1. Simmons G. F., Differential Equations, Tata McGraw-Hill, 2003. 2. Kreyszig E., Advanced Engineering Mathematics, Wiley, 2007.					
Supplementary Reading	1. William E. Boyce and R. C. Diprima, Elementary Differential Equations and Boundary Value Problems, John Wiley, 8th Edition, 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					

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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Data Structures and Algorithms</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">CSE</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>0</td><td>2</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech, DD</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td>--</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">Given a computational problem, the focus is on design and implementation of algorithms using suitable data structures. The notion of time and space complexity, design of efficient algorithms and data structures shall also be explored. The course also focuses on exploring role of data structure for solving problems efficiently.</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>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">ADT- Review of elementary data structures – List, Stack, Queue- 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, Master theorem (5L)
Analysis of sorting/searching algorithms - Incremental Design - insertion sort, decremental Design - Celebrity problem - Divide and Conquer- quicksort ,merge 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.) (5L)
Dictionary ADT: Binary search trees, balanced binary search trees - AVL Trees. (5L)
Hashing - collisions, open and closed hashing, properties of good hash functions. Priority queue ADT: Binary heaps with application (5L)
Data Structures in Python – Strings, Lists, Tuples, Dictionary – Examples (5L)
Graphs: Representations (Matrix and Adjacency List),basic traversal such as BFS, DFS with complexity, spanning tree (5L)
Practice Component: Elementary Data Structures, Implementation of case studies involving algorithms and data structures using C, 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 (28P)
Note: 30% of the practice component to be done using Python</td></tr>
<tr><td>Text Books</td><td colspan="6">1. M.A. Weiss,Data Structures and Algorithm Analysis in C,Pearson,2nd edition,2002, 978-8131714744.
2. Deitel P J and Deitel H M, Python for Programmers, Pearson Education, 2019, 978-0135224335.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Introduction to Algorithms, Prentice Hall of India, 4th Edition, 2022, 978-0262046305.
2. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Pearson, 3rd edition, 2017, 978-9332585485.
3. Horowitz, Sahni and Anderson-Freed, Fundamentals of Data Structures in C, Silicon Press, 2nd Edition, 2008, 978-8173716058
4. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python, 1st edition, 2013, 978-1118290279.</td></tr>
</table>

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Materials for Design Engineers</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</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>0</td><td>0</td><td>3</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech/ DD</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective</td></tr>
<tr><td>Status</td><td colspan="2">New ■</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>None</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• Understand the classification, properties, and roles of materials (metals, ceramics, polymers, composites) in mechanical design.
• Analyze material properties (mechanical, thermal, electrical, magnetic, optical) for specific design applications.
• Evaluate materials using material property charts and indices for optimal selection in design processes.
• Apply Ashby charts and material selection methodologies to optimize stiffness, strength, and cost in design.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• To identify suitable materials for design applications based on their mechanical, thermal, and electrical properties.
• To assess material performance using property charts and indices for lightweight and cost-effective design solutions.
• To select appropriate materials for specific applications by applying Ashby charts and
• To demonstrate the ability to optimize material choices for stiffness, strength, and torsional performance in design problems.</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">• Introduction - Materials in Design, Four aspects of mechanical design, Four main factors in material selection, Material selection in Design process, A generic Mechanical system, Types of Design Problems, Classification of Materials (10L)
• Material Properties - (20L)
Mechanical properties:Mechanical properties of metals, ceramics, polymers and composites at room temperature; stress-strain response (elastic, anelastic and plastic deformation). Electronic properties: free electron theory, Fermi energy, density of states, elements of band theory, semiconductors, Hall effect, dielectric behaviour, piezo- and ferro-electric behaviour.
Magnetic properties: Origin of magnetism in materials, para-, dia-, ferro- and ferri-magnetism.
Thermal properties: Specific heat, heat conduction, thermal diffusivity, thermal expansion, and thermoelectricity.
Optical properties: Refractive index, absorption and transmission of electromagnetic radiation.
• Types of materials - Polymers, Plastics, Elastomers, Ferrous Alloys such as steel and aluminium, Ceramics, Composites and Wood. (8L)
• Materials selection processes - Material property charts, Modulus vs Density, Strength vs Density, Strength vs cost, Process of Material selection (8L)
• Materials indices - Design for lightweight optimizing stiffness and strength (examples such as tie-rod, beam), Design for lightweight optimizing torsional stiffness and strength (example like shaft design), Looking up the chart (modulus vs density, strength vs density etc), Material selection using Ashby charts and models. (10L)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Ashby, M.F. (2024), Materials Selection in Mechanical Design, 6th edition, Elsevier, ISBN:9780443160295
2. William D. Callister and David G Rethwisch (2018), Material Science and Engineering, Wiley, 10th Edition, ISBN:9781119321590</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Gordon, M. Joseph (2002); Industrial design of plastics products, ISBN:9780471231516
2. Karana, Elvin, Owain Pedgley, and Valentina Rognoli, eds. (2013), Materials Experience: fundamentals of materials and design. Butterworth-Heinemann, ISBN:9780080993591
3. Maleque, Md Abdul, and Mohd Sapuan Salit (2013); Materials selection and design. Springer, Singapore, ISBN:9789814560375</td></tr>
</table>

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Electronics for Designers</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</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>0</td><td>2</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech/DD</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective</td></tr>
<tr><td>Status</td><td colspan="2">New ■</td><td colspan="2">Modification □</td></tr>
<tr><td>Pre-requisite</td><td>None</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce basic principles of electronics, including circuit elements, signals, and systems, relevant to design applications
• To enable students to analyze simple electronic circuits using mathematical tools and simulation techniques
• To equip students with the ability to design basic electronic circuits for real-world applications using standard components
• To provide hands-on exposure to electronic components and measurement tools, connecting theoretical knowledge to practical implementation.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• Explain the properties and applications of passive and active electronic components in design.
• Evaluate DC and AC circuits using Ohm's Law, Kirchhoff's Laws, and simulation tools.
• Create functional electronic circuits, such as rectifiers and amplifiers, meeting design specifications.
• Demonstrate proficiency in using measurement tools to test and apply circuits in practical scenarios like signal conditioning.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">• Introduction to Basic Electronics - Overview of electronics in design: Scope and applications, Passive components: Resistors, Capacitors, Inductors - properties and uses, Active components: Diodes and Transistors - characteristics and applications (6L+4P)
• Circuit Fundamentals and Analysis - Basic circuit concepts: Voltage, Current, Power, and Energy, DC circuits: Ohm's Law, Kirchhoff's Laws, Series and Parallel circuits, AC circuits: sinusoidal signals, impedance, and phasors (7L+5P)
• Design of Electronic Circuits - Circuit design: Specifications and constraints, Diode-based circuits: Rectifiers and Clippers, Transistor as a switch and amplifier: Biasing and small-signal models,Simulation tools: Basics of SPICE and other similar softwares (10L+6P)
• Measurement and Applications - Measuring instruments: Multimeter, Oscilloscope, Function Generator, Practical applications: Filters, Oscillators, and Signal Conditioning and Case study: Electronics in product design (e.g., sensors in wearables) (11L+7P)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Boylestad, R. L., & Nashelsky, L. - Electronic Devices and Circuit Theory, 11th Edition, Pearson Education, 2012, ISBN: 9780132622264.
2. Sedra, A. S., & Smith, K. C. - Microelectronic Circuits, 7th Edition, Oxford University Press, 2014, ISBN: 9780199339136.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Millman, J., & Halkias, C. C. - Integrated Electronics: Analog and Digital Circuits and Systems, 2nd Edition, McGraw-Hill, 2010.
2. Horowitz, P., & Hill, W. - The Art of Electronics, 3rd Edition, Cambridge University Press, 2015.
3. Malvino, A. P., & Bates, D. J. - Electronic Principles, 8th Edition, McGraw-Hill Education, 2015.
4. Floyd, T. L. - Fundamentals of Analog and Digital Electronics, 9th Edition, Pearson Education, 2012.
5. Tocci, R. J., Widmer, N. S., & Moss, G. L. - Digital Systems: Principles and Applications, 12th Edition, Pearson, 2016.</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Form Design and CAD Modelling</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</td><td rowspan="2">Structure (LTPC)</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 rowspan="2">To be offered for</td><td rowspan="2">B.Tech/ DD</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ■</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>Concepts in Engineering Design</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">● Understand the principles of natural and man-made forms, including abstraction and visual relationships.
● Apply 2D and 3D form design techniques to create innovative sketches and models.
● Analyze 3D forms through visual analysis, symmetry, and proportion for product design.
● Create product forms and CAD models with creativity, incorporating form factors and aesthetic expression.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">● Demonstrate the ability to sketch and model 2D/3D forms inspired by natural and man-made principles.
● Evaluate 3D forms for balance, symmetry, and proportion using visual analysis techniques.
● Design product forms that integrate aesthetic expression and functional form factors effectively.
● Produce CAD models with accurate part modeling, assembly, and bio-inspired design elements.</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">● Nature and Form - Form inspiration from nature, natural forms observation, laws in natural forms, natural form principles, concept of abstraction (5L+5P)

● 2D/3D form and visual analysis - Aspects of form, designing a form, representational forms, serial planes, wall structures, prisms, cylinders, polyhedral structures, triangular planes, linear layers, and interlinking lines, Basic visual points, positive and negative volumes, propositions, 3-D primary geometric forms, Axis, axial movements, forces, curves, relationships, joined forms, intersectional forms, transitional forms, evolution of forms, foam modelling, clay modelling; 3D special matrix, organisational framework, symmetry and asymmetry, balance, orientation, and overall proportion (9L+9P)

● Form for 3-D products - Form in the context of products, form design methods, form factors for product design, product appearance, expression in product forms (7L+7P)

● CAD modelling - Introduction to the tool interface, lines, curves, views, planes, isometric, orthographic, dimensions, part modelling, protrusion, revolve, sweep, surfaces, assembly, bill of materials, bio sketches modelling (7L+7P)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Hannah, Gail Greet. Elements of design: Rowena Reed Kostellow and the structure of visual relationships. Princeton Architectural Press, 2002. ISBN: 1568983298
2. Ocvirk, O.G., Stinson, R.E., Wigg, P.R., Bone, R.O., and Cayton, D.L. (2002). Art Fundamentals: Theory and Practice, McGraw-Hill, USA. ISBN 10:0073379271</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Macnab, Maggie. Design by nature: Using universal forms and principles in design. New Riders, 2011. ISBN 10: 0321747763
2. Ian Stroud, Hildegrade Nagy, Solid Modelling and CAD systems: How to Survive a CAD systems, Springer Publications, 2016. ISBN 13:978-1447169024
3. Elam, Kimberly, 'Geometry of Design', Studies in Proportion and Composition, Princeton Architectural Press, 2001. ISBN 10: 1568982496</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Biology for Design</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</td><td rowspan="2">Structure (LTPC)</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 rowspan="2">To be offered for</td><td rowspan="2">B.Tech/DD</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective</td></tr>
<tr><td>Status</td><td colspan="2">New ■</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>None</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">● To understand the structure and function of human biological systems and their relevance to design.
● To analyze sensory systems to enhance user interaction in product design.
● To apply biomimetic principles from natural energy and structural systems to create sustainable designs.
● To evaluate biological processes for inspiration in developing efficient and human-centered products.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">● Explain biological systems and their application in engineering sustainable product designs.
● Assess human sensory systems to improve user experience in technology interactions.
● Design products inspired by natural energy and structural systems for efficiency and sustainability.
● Demonstrate the ability to apply biomimetic principles to create structurally optimized, human-centered designs.</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">● Introduction to Biology and Life Systems - Overview of biology and its importance for designers, key biological concepts: taxonomy, structure and function of cells, levels of biological organization, and systems, Basic cellular processes: respiration, photosynthesis, and cell division, and Biomimetic design inspired by cellular structures. (5L+5P)

● Human Anatomy in Design - Overview of the human body and its systems: circulatory, respiratory, digestive, nervous, and musculoskeletal systems. Structure and types of muscles, basic principles of human movement. Anatomical models for interactive body mapping to explore the functions of key organs and systems in the body. (6L+6P)

● Physiology of Sensory Systems - Vision, Hearing, Touch, Taste, and Smell: Understanding how sensory systems influence design, particularly in product interaction and user experience. Visual perception experiment, biofeedback devices, and electrophysiology of sensory systems (5L+5P)

● Energy, Structure, and Materials in Nature - Energy systems in biology: metabolism, energy storage, and energy transfer. Designing sustainable products inspired by biological energy flow, Structural systems in nature: bones, shells, exoskeletons, and plant fibers, Structural optimization: Design of natural structures for strength and energy conservation. (5L+5P)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Campbell, Neil A., Jane B. Reece, Lisa A. Urry, Michael Lee Cain, Steven Alexander Wasserman, Peter V. Minorsky, and Robert B. Jackson. Biology: a global approach. New York, NY: Pearson, 2018.
2. Alberts, Bruce, Rebecca Heald, Alexander Johnson, David Morgan, Martin Raff, Keith Roberts, and Peter Walter. Molecular biology of the cell, WW Norton & Company, 2022.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Marieb, Elaine Nicpon, and Katja Hoehn. Human anatomy & physiology. Pearson education, 2007.
2. Ashby, Michael F. Materials and the environment: eco-informed material choice. Elsevier, 2012.
3. Netter, Frank H. Atlas of Human Anatomy, Professional Edition E-Book: Digital eBook. Elsevier health sciences, 2014.
4. Pocock, Gillian, Christopher D. Richards, and David A. Richards. Human physiology. Oxford university press, 2018.</td></tr>
</table>

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Introduction to AI with Python</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">Computer Science and Engineering</td><td rowspan="2">Structure (LTPC)</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 rowspan="2">To be offered for</td><td rowspan="2">Common to All B.Tech, DD</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ■</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>--</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• The course focuses on imparting knowledge about the principles of search and logic with practical examples.
• To develop a basic understanding of problem solving, knowledge representation, reasoning and learning methods of AI.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• The student will gain knowledge about space search and search algorithms, logic based knowledge representation, and the shortcomings in in reasoning methods.
• Ability to decide on the suitable representation for a domain model.
• Ability to choose appropriate algorithms for AI reasoning in that domain</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Overview of Python and AI: Data types, Control Structures in Python, Philosophy of AI,Need, Use of Agents, Intelligent Agents – Rationality, Structure and Environments. (L5)

Search Strategies: Uniformed Search-BFS, DFS, Iterative Deepening DFS,Informed Search – Best First, A* Search, Iterative Deepening A*, Depth First Branch Bound, Heuristic Functions, Local Search- Hill Climbing and Simulated Annealing, Limitations, Random walk/Restart (L10)

Adversarial Search and Constraint Satisfaction Problem :Min Max Algorithm, Alpha Beta pruning, Backtracking for CSP, Arc Consistency (L5)

Logic in AI: Knowledge Based Agents, Propositional logic, agent for wumpus world, Knowledge base, First order logic, Syntax& Semantics, Propositional vs. First-Order Inference, Forward Chaining, Backward Chaining, Resolution Refutation Systems (L8)

Practice Sessions:
All assignments would be implemented using Python packages for AI such as Tensorflow, Pytorch, Scikit learn, Tokenizers,Pytholog, etc. Solving Problems By Search: BFS,DFS, Iterative Deepening DFS, N-Queens problem, TSP, Local Search- N Puzzle problem using Hill Climbing, Game Playing Strategies: Alpha Beta Pruning,Tic tac toe game, CSP-Map Coloring Problem, Uncertainity in AI: Conditional Independence, Bayesian Networks, Applications of AI in respective engineering domain. [P28]</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. S Russell & P Norvig, Artificial Intelligence – A Modern Approach, Pearson, 3rd Edition, 2010, ISBN 9789332543515.
2. Nils J Nilsson, "Artificial Intelligence: A New Synthesis", Morgan Kaufmann Publications, 2000.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill, 2013, ISBN 9783827370891
2. P Norvig, Paradigms of AI Programming, Morgan Kauffmann, 1991, ISBN 9781558601918
3. Dean, Allen & Aloimonos, AI Theory & Practice, Addison Wesley, 1995, ISBN 9780805325478</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Mechanics and Mechanisms</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</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>0</td><td>2</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech/DD</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective</td></tr>
<tr><td>Status</td><td colspan="2">New ■</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>None</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">● To understand the principles of mechanisms, kinematics, and material deformation in product design.
● To analyze structural elements under various loading conditions using kinematic and stress-strain methods.
● To apply vibration and bending theories to evaluate mechanical behavior in design applications.
● To evaluate stresses, strains, and deflections in deformable bodies for robust product design.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">● Explain the interaction of kinematic pairs, mechanisms, and degrees of freedom in planar systems.
● Calculate velocity, acceleration, and vibration characteristics for planar mechanisms and SDOF systems.
● Assess shear forces, bending moments, and stresses using diagrams and Mohr's circle.
● Design structural components considering bending, buckling, and torsion for mechanical stability.</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">● Introduction- General concepts, Introduction of Simple mechanism, Different types of Kinematics pair, Grublers rule for degree of freedom, Grashof's Criterion and Inversions of 3R-P, 2R-2P chains (6L+3P).
● Kinematic Analysis -Concepts of vectorial analysis, Velocity and Acceleration Analysis of planar mechanisms, Cams and its classification, Cams with uniform acceleration and retardation, SHM, Cylcloidal motion, oscillating followers (7L+5P).
● Vibrations- Vibration analysis of SDOF systems, Natural, damped forced vibrations, Based-excited vibrations, transmissibility ratio (4L+3P).
● Axial Forces, Shearing Forces and Bending Moments - Plotting shearing force, bending moment and axial force diagrams for determinate structures (beams and frames), Relationship between loads, shear forces, bending moment (5L+3P)
● Stress and Strain analysis- Deformable bodies, internal forces, stress, strain, Hooke's law, stress strain diagram, Principal stresses and principal planes, Maximum shear stress and corresponding plane, Mohr's circle (5L+3P)
● Theory of bending, buckling and torsion - pure bending, Small deflection theory, Bending stress, Flexural formula, differential equation of deflected shape, Introduction to deflection, theory of columns, Euler's formula, Derivation of torsion formulas,Torsional moments and stresses in shaft (7L+5P)</td></tr>
<tr><td>Text Books</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. Ghosh and A. K. Mallik, Theory of Mechanism and Machines, Affiliated East–West Press Private Ltd., 2009.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. F.P.Beer, E.R.Johnston, J.T.Dewolf and D.F.Mazurek, Statics and Mechanics of Materials, McGrawHill, 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.</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Instrumentation and Control systems</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</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>0</td><td>2</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech/DD</td><td>Type</td><td colspan="2">Core ☐</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ☐</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>None</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">● To understand fundamental principles of instrumentation and control,
● To select and integrate appropriate sensors and actuators for physical products,
● To design and implement control systems for real-world applications,
● To develop and test data acquisition systems for measurement and monitoring,
● To analyze and optimize feedback control strategies and to ensure reliability and precision in instrumentation-based product development.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the student should demonstrate qualities of immersion in
● A task related to choice of the sensor, transducing mechanisms, and data acquisition methods,
● To build the sensory systems.
● Further, they expected to be thorough with planning and realization of electronic instruments.</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">Introduction to instrumentation and control in product development, Key components: Sensors, actuators, controllers, and user interfaces, Importance of precision, accuracy, and calibration. (5L+3P)

Classification of sensors: Contact vs. non-contact, active vs. passive, analog vs. digital, Measurement of physical parameters: Temperature, pressure, displacement, flow, force, etc, Signal conditioning, amplification, and filtering. (7L+5P)

Introduction to Data Acquisition Systems (DAQs), ADC/DAC conversion, sampling rates, and resolution. (5L+3P)

Types of actuators: Pneumatic, hydraulic, electric, and piezoelectric, Motor control techniques: DC motors, stepper motors, and servo motors, Feedback mechanisms for precise motion control. (7L+5P)

Open-loop vs. closed-loop control systems, PID control: Tuning methods and real-world implementation, Advanced control strategies: Model Predictive Control (MPC), Adaptive Control, and AI-based control. (7L+5P)

Instrumentation reliability and failure analysis, Safety regulations and compliance standards (ISO, IEC, ANSI), Case studies in medical, automotive, and industrial control systems. (5L+3P)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Ogata, K. (2010). Modern Control Engineering. United Kingdom: Prentice Hall.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Bentley, J. P. (2005). Principles of Measurement Systems. United Kingdom: Pearson Prentice Hall.
2. Instrumentation Reference Book. (2009). Netherlands: Butterworth-Heinemann.</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Sociology of Design</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</td><td rowspan="2">Structure (LTPC)</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 rowspan="2">To be offered for</td><td rowspan="2">B.Tech/DD</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective</td></tr>
<tr><td>Status</td><td colspan="2">New ■</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>None</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">● To understand design as a social process within socio-technical systems and its impact on users and organizations.
● To analyze social factors and sociological theories to critically assess design problem situations.
● To apply semiotic and sociological tools to interpret signs, emotions, and interactions in design contexts.
● To evaluate paradoxes in design problems to reframe them for innovative solutions.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">● Identify key social factors that influence the process of design, both about users and teams.
● Apply sociological theories to inquire into problem situations critically,
● Pay attention to paradoxes and frame and reframe problems in different ways.
● Exhibit behaviors of presence, gesture-response and improvisation.</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">Learning to experience the socio-material world [6L+6P]
● A series of design activities to be done in groups of varying sizes

Understanding signs and meaning construction [4L+4P]
● Introduction to signs and semiotic analysis of posters and advertisements

Understanding the Sociological perspectives [10L+10P]
● Introduction to sociological imagination & critical thinking
● Learning about Functionalism, Conflict Theory, Interactionism through a movie
● Developing rich pictures; Gigamapping to capture human emotions & perspectives
● Interactionism, Interaction Rituals, design and innovation

Technology, Design and Society - [6L+6P]
● Values, culture, methods of engineers / designers and how they shape the quality of lives
● Case studies on history of technology and design and Actor Network Theory
● Discover your passion and domain of interest & network to identify partners</td></tr>
<tr><td>Text Books</td><td colspan="6">1. John J Macionis and Reema Bhatia (2018), Sociology, Pearson Education, 17th edition, ISBN: 9789353066383
2. 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</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Louis L Bucciarelli (1994), Designing engineers, MIT Press, Cambridge, MA, ISBN: 9780262522120
2. Dominique Vinck (ed.) (2009), Everyday engineering: An ethnography of design and innovation, MIT Press, Cambridge, MA, ISBN: 9780262512640
3. Robin Williams (2014), The non-designers design book: Design and typographic principles for the visual novice, 4th edition, ISBN: 9780133966152
4. Ross Knox Bassett (2016), The technological Indian, Harvard University Press, ISBN: 9780674504714</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Human Centred Design</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</td><td rowspan="2">Structure (LTPC)</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 rowspan="2">To be offered for</td><td rowspan="2">B.Tech/DD</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective</td></tr>
<tr><td>Status</td><td colspan="2">New ■</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>None</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">● To understand human-centered design principles and their role in addressing user needs.
● To apply qualitative and quantitative research methods to gather user requirements.
● To analyze user research data to create actionable design insights and requirements.
● To evaluate design effectiveness through usability testing and heuristic evaluations.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">By the end of this course, students will be able to:
● Apply user research methods such as ethnography, contextual inquiry, interviews, surveys
● Analyze and synthesize research findings into personas, journey maps, and user scenarios
● Conduct usability testing and heuristic evaluations to assess design effectiveness
● Develop and communicate design requirements based on real-world user data.</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">Introduction to Human-Centered Design [4L+4P]
Principles and benefits of HCD, Observing people and things; Empathy in User Research, Ethical considerations in user research
Understanding User Needs [4L+4P]
What are user requirements, and why do they matter?, Research planning: defining goals, scope, and methods, Qualitative vs. Quantitative Research, Understanding stakeholder needs & business objectives
Qualitative Research Methods [6L+6P]
Ethnography, Field Observations & Contextual Inquiry, User Interviews: Planning, conducting, and analyzing responses, Focus Groups: Pros, cons, and facilitation techniques, Affinity Diagramming for Research Synthesis
Quantitative Research Methods [6L+6P]
Survey Design: Writing unbiased, effective questions, Analyzing user behavior through heatmaps & analytics, A/B Testing Basics, Data visualization techniques
Organizing & Analyzing Research Data [6L+6P]
Stakeholder analysis (Needs, Alterables, Constraints), Creating Personas & User Archetypes, Mapping User Journeys & Experience Maps, Empathy Mapping & Mental Models, Extracting insights from user research, Writing actionable User Requirements & Use Cases, Prioritizing requirements: Kano Models, Stakeholder Communication and research storytelling</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Keri Smith (2008), How to be an Explorer of the World: Portable Life Museum, Penguin Group, ISBN: 9780399534607
2. Norman, Don (2013). The Design of Everyday Things. Revised and expanded. Basic Books. ISBN 9780465050659.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Norman, Donald A. (2005). Emotional Design: Why We Love (or Hate) Everyday Things. Basic Books. ISBN 0465051367
2. Elizabeth Goodman, Mike Kuniavsky, and Andrea Moed (2012), Observing the User Experience, Morgan Kaufman, Second edition, ISBN 978-0-12-384869-7
3. Steve Portigal (2015), Interviewing Users: How to Uncover Compelling Insights, Second edition.</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Techno-aesthetics in product detailing</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</td><td rowspan="2">Structure (LTPC)</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 rowspan="2">To be offered for</td><td rowspan="2">B.Tech/DD</td><td>Type</td><td colspan="2">Core ▬</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ▬</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>Form Design and CAD Modelling</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">● To develop abilities to design product details that assemble the forms and subforms of the Product,
● To develop an understanding of the importance of ‘product details ‘for effective manufacturability, maintenance, and repairs of a product and
● To develop an understanding of the importance of aesthetically integrated functional details of the product as a visual feature.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the student is able to
● Aesthetically integrate the product components and technical features of products,
● To analyse, comprehend, and integrate ergonomic principles and visual semantics of the product components and technical features of products
● To apply ergonomic principles and visual semantics to develop efficient and user-friendly techno-aesthetic products.</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">Introduction to Techno Aesthetic Details & Strategy for Aesthetics (12L) - Definition of Techno-Aesthetic Detailing: Merging engineering with aesthetic intent, Elements of Aesthetics: Form, colour, texture, proportion, symmetry, balance, and contrast, Human Perception & Product Aesthetics: Gestalt principles, cognitive psychology, Aesthetic Strategies in Product Design: Brand identity, emotional design, UX aesthetics, Case Studies: Apple, Tesla, Braun, IKEA, Philips - product aesthetics & design language.

Technical Requirement of the Product (16L) - Material & Manufacturing Constraints in Aesthetic Design - Metals, polymers, ceramics, composites–impact on form and aesthetics, CNC, 3D Printing, Injection Molding, Sheet Metal–aesthetic influence, Surface finishes, coatings, and textures, Tolerance, Fit & Finish Considerations - GD&T, Assembly constraints, Seamless joints.

Product Mockup Development (28P) - Sketching & CAD for Aesthetic Detailing - Sketching techniques for visualizing form, CAD surface modelling (Alias, Rhino, SolidWorks Surfacing), Physical Mockup Development - Prototyping methods: Foam, Clay, 3D Printing, Painting, Texturing & Finishing Techniques, User Testing & Aesthetic Feedback
- Heuristic evaluation, A/B testing aesthetics, user preference analysis.</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Gabbay, D.M., Thagard, P., Woods, J. and Meijers, A.W., 2009. Philosophy of technology and engineering sciences. Elsevier. ISBN-13: 978-0444516671. ISBN-10: 0444516670</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Pye, D., 2008. The nature and aesthetics of design. The Herbert Press Limited. ISBN-13: 978-0713652864. ISBN-10: 0713652861
2. Lefteri, Chris. "Making It: Manufacturing Techniques for Product Design, 2007." Continuum. ISBN-13: 978-1856695060. ISBN-10: 1856695069
3. Norman Donald, A., 2013. The design of everyday things. MIT Press. ISBN-13: 978-0262525671. ISBN-10: 0262525674</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Design of Engineering Components</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
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<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech/DD</td><td>Type</td><td colspan="2">Core ▬</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ▬</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>Mechanics and Mechanisms</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course is to understand the concepts and procedure for
● Designing engineering components
● Using various failure theories and loading conditions.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students will be able to
● Understand the fundamentals Engineering components design,
● Develop skills in design of Joints, Gears, Clutches and Bearings.
● To analyse fatigue for different applications.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Introduction - Review of fundamental principles and theories, uncertainties in design equations and Factor of safety. Application of theories of failure to design, Design based on strength and stiffness, stress concentrations, Design of solid and hollow shafts, keys and couplings (6L+4P)

Design of joints - Threaded fasteners such as bolted joints, Knuckle joints, Cotter joints, welded joints (butt, filler and parallel transverse fillet welds) riveted and bonded joints (6L+4P)

Gears- Geometry of tooth profiles, Law of gearing, Involute profile, interference, spur, helical, spiral and worm gears, simple, compound gear trains. Epicyclic gear trains (7L+5P)

Fatigue- Introduction to design for fatigue strength. Endurance and modifying factors. Surface strength. Review of design procedure of fatigue failure with application to the design of shafts, gears, bolts and springs subjected to fatigue loading (7L+5P)

Design of Clutches and Bearings - Sliding contact and rolling contact bearings, hydrodynamic journal bearings (7L+5P)</td></tr>
<tr><td>Text Books</td><td colspan="6">1.M. F. Spotts,T.E. Shoup, L.E. Hornberger, S.R. Jayaram and C.V. Venkatesh, (2016), Design of Machine elements, ISBN: 9788177584219.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. R.G. Budynas and J.K. Nisbett, Shigley's Mechanical Engineering Design, McGraw-Hill Education, 10th Edition, 2017
2. V Bhandari, Design of Machine Elements, McGraw-Hill Education, 4th Edition, 2017.
3. Robert L. Norton, Machine Design, Pearson Education, 5th Edition, 2018</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Fluids and thermodynamics</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</td><td rowspan="2">Structure (LTPC)</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 rowspan="2">To be offered for</td><td rowspan="2">B.Tech/DD</td><td>Type</td><td colspan="2">Core ☑</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ☑</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>None</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course aims offers the following learning objectives:
To know the fluid properties and fluid conservation laws;
To apply fluid mechanics principles to practical problems such as pipe flows, converging and diverging channels, mini and micro flows;
Enable students to learn the basic concepts of thermodynamics to perform exergy and entropy for different thermal applications;
To prepare students to carry out numerical/experimental multiphysics investigation in later stages of the graduation;</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students will be able to
Understand the fundamentals of fluids and thermodynamics,
Develop skills in deriving and solving mathematical equations for conservation, fluid mechanics and thermos-fluids.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Basic fluid and thermodynamic concepts (4L+4P)
Continuum approach, Knudsen number, microscopic viewpoints of the fluid, Eulerian and Lagrangian flow field descriptions. Thermodynamic systems (control mass vs control volume), energy, work, heat transfer. Transport properties (fluid viscosity, thermal conductivity, and diffusivity). Equilibrium states, extensive/intensive thermodynamic properties and paths.
Conservation equations (10L+10P)
Derivation and application of mass conservation in integral and differential forms and material derivatives. Reynolds transport theorem, conservation of linear momentum derivation, Bernoulli equation. First law of thermodynamics- control mass and volume analysis (integral and differential forms), (Example: energy conversion devices, constant volume and constant pressure heating). Second law of thermodynamics- reversible and irreversible processes, entropy generation, Gibbs equation, Bejan number (Be).
Fluid mechanics and fluid measurements (5L+5P)
Definition and properties of Fluids, ideal and real fluid units, systems of measurement. Fluid properties: density, specific weight, specific volume, specific gravity, viscosity, compressibility, surface tension and capillarity, vapour pressure and cavitation. Venturimeter, Orifice meter, Flow through orifices and notches, Loss of head due to friction in pipes, Discharge measurements in pipes.
Thermo-fluidics system design (8L+8P)
Fluid channel configurations, control of residence time, parallel channels, manifold and header design, hotspots, flow induced hotspot</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Munson, Young, Okiishi & Huebsch, Fundamentals of Fluid Mechanics, John Wiley and Sons Inc, 6th Edition 2009 (or earlier editions)</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Moran, M.J., Shapiro, H.N., D. D. Boettner & Bailey, M. B., Fundamentals of Engineering Thermodynamics, John Wiley and Sons Inc, 7th Edition 2011 Wiley
2. Fluid Mechanics by F.M. White, Tata Mcgraw Hill, 7th edition, 2011.
3. Fluid Mechanics by R.W. Fox and A.T. McDonald, Wiley, 10th edition, 2021</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Embedded Systems for Product Development</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</td><td rowspan="2">Structure (LTPC)</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 rowspan="2">To be offered for</td><td rowspan="2">B.Tech/DD</td><td>Type</td><td colspan="2">Core ☑</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ☑</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>Basic electronics Instrumentation and control systems</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">Understand the fundamentals of embedded systems architecture, Integrate sensors, actuators, and real-time control in product design.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">By the end of this course, students will: Design and implement embedded solutions for physical products. Develop firmware using low-level and high-level programming techniques. Implement wireless and wired communication protocols. Optimize embedded systems for power efficiency and performance.</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">Definition and applications in physical product development - Key components: Microcontrollers, processors, sensors, and actuators. System constraints: Power, memory, and real-time processing. (2L+2P)
Microcontroller selection and architecture (ARM, AVR, RISC-V, etc.) - Circuit design and PCB layout considerations. Power management and energy efficiency in embedded systems. (2L+2P)
Introduction to embedded C and C++ - Low-level programming: Interrupts, timers, and peripheral interfacing. Firmware development best practices. (4L+4P)
Concept of real-time constraints - RTOS vs. Bare-metal programming. Task scheduling, memory management, and inter-process communication. (4L+4P)
Cyber security challenges in embedded devices - Secure boot and firmware updates. Fault tolerance and system robustness. (2L+2P)
Power-saving techniques (sleep modes, dynamic power scaling) - Embedded AI and edge computing. Case studies on power-efficient product design. (5L+5P)
Applications of Embedded systems - automotive, healthcare, consumer electronics, and industrial automation, Emerging trends in embedded product development. Ethical and regulatory considerations. (4L+4P)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Lee, E. A., Seshia, S. A. (2016). Introduction to Embedded Systems, Second Edition: A Cyber-Physical Systems Approach. United Kingdom: MIT Press.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Embedded Systems. (2005). India: Pearson Education.
2. Edwards, L. A. R. W., Edwards, L. (2003). Embedded System Design on a Shoestring: Achieving High Performance with a Limited budget. Netherlands: Newnes.</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Manufacturing Technology</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</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>0</td><td>2</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech/DD</td><td>Type</td><td colspan="2">Core ☑</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ☑</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>None</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The objective of this foundation course is to help students to: (i) Develop a professional knowledge of materials transformation methods, (ii) Considerations and decisions that go into manufacturing process selection for a given machine component, (iii) Perform hands-on exercises in the product realization laboratory.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end the course, the student should
● Have gained a knowledge of a wide range of manufacturing processes
● Identify & prescribe a manufacturing processes for a given machine component
● Use basic machines and hand tools to manufacture simple parts from metal and/or plastic to reasonable tolerances
Analyze and apply a broad range of modern manufacturing techniques utilized in industry</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">Fundamentals of conventional manufacturing: (18L+12P)
● Properties of Materials including Metals, Ceramics & Wood
● Metal shaping, forming, joining, sheet metal and casting processes
Select and compare processing capabilities (6L+4P) - Select different manufacturing processes based upon material, shape, mechanical properties, and number to be produced, achievable tolerances, cost and environmental impacts
Microstructure and heat treatment (4L+2P) - Microstructures and mechanical behavior based upon solidification theory and microstructure, development through heat treatments
Manufacture of plastic components (6L+4P) - Plastics processing - Injection moulding, compression moulding, Extrusion, thermoforming and bonding.</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Mikell P. Groover, John Wiley & Sons, 2010</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Manufacturing Processes for Engineering Materials, Serope Kalpakjian and Steven Schmid, Pearson Education, 2018
2. Introduction to Manufacturing Processes by Schey J, McGraw-Hill Education, 1999</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Data Driven Design</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</td><td rowspan="2">Structure (LTPC)</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 rowspan="2">To be offered for</td><td rowspan="2">B.Tech/DD</td><td>Type</td><td colspan="2">Core ☑</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ☑</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>Introduction to AI with Python</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">● To understand the fundamental principles of data-driven design,
● To develop proficiency in data acquisition, cleaning, and pre-processing techniques,
● To create interactive data visualizations for design communication and
● To implement data-driven design methodologies in real-world case studies.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">On successful completion of the course, the student will be able to
● Perform exploratory data analysis to identify patterns and relationships in datasets,
● Apply data cleaning techniques to handle missing values, outliers, and noise,
● Generate interactive visualizations that effectively communicate design insights and develop data-driven design solutions using machine learning and statistical methods.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Foundations of Data-Driven Design (8L+8P)
● Basic data acquisition methods
● The role of data in design
Data Processing and Analysis (10L+10P)
● Data cleaning, missing data handling, and pre-processing
● Data analysis techniques
● Statistical analysis for design decision-making
Data Visualization and Design Implementation (10L+10P)
● Visualization techniques in Python and MATLAB
● Interactive visualization tools and methods
Application of data-driven approaches to real design problems –Generative Design</td></tr>
<tr><td>Text Books</td><td colspan="6">1. McKinney, Wes. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter. O'Reilly Media, Inc., 2022 (3rd Edition), ISBN-10: 109810403X; ISBN-13: 978-1098104030

2. Kirk, Andy. Data Visualisation: A Handbook for Data Driven Design. SAGE Publications, 2019 (2nd Edition), ISBN-10: 1526468921; ISBN-13: 978-1526468925</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Forrester, Alexander, Andras Sobester, and Andy Keane. Engineering Design via Surrogate Modelling: A Practical Guide. John Wiley & Sons, 2008, ISBN-10: 0470060689; ISBN-13: 978-0470060681

2. Pratap, Rudra. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers. Oxford University Press, Inc., 2009 (6th Edition), ISBN-13: 978-0199731244

3. Géron, Aurélien. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow. O'Reilly Media, Inc., 2022 (3rd Edition), ISBN-13: 978-1098125974

4. Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016, ISBN-13: 978-0262035613</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Systems Thinking for Design</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</td><td rowspan="2">Structure (LTPC)</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 rowspan="2">To be offered for</td><td rowspan="2">B.Tech/DD</td><td>Type</td><td colspan="2">Core ☐</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ☐</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>None</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">● This course introduces students to systems thinking and sets an interdisciplinary foundation for complex problem-solving, emphasizing the fuzzy front end of product design.
● It covers fundamental principles, methodologies, and tools for modelling complex systems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students will be able to
● Understand the fundamentals of systems thinking and its role in design,
● Develop skills in systems modeling using qualitative and quantitative approaches
● Apply systems thinking to real-world engineering and design challenges</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Introduction to Systems Thinking [4L+4P]
● Definition and importance of systems thinking
● Characteristics of systems (open vs. closed, static vs. dynamic)
● Design challenges in complex systems
● Historical evolution of systems thinking

System Components and Relationships [6L+6P]
● System boundaries and environments
● Elements and interdependencies
● Hierarchy and Networks in complex systems
● Feedback loops (positive and negative)
● Emergent properties and unintended consequences

Methods and Tools for Diagnosis & Design [12L+12P]
● Complex Network analysis
● Interpretive structural modelling
● Causal Loop Dynamics & System archetypes
● Design Structure Matrix
Systems Modeling (SysML) Language [4L+4P]
● Introduction to SysML methods
● Translate a requirement into SysML models</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Andrew P. Sage and James E. Armstrong Jr. (2000), Introduction to Systems Engineering, Wiley, ISBN: 9780471027669

2. Nigel Cross (2008), Engineering Design Methods: Strategies for product design, 4th Ed, John Wiley Sons, ISBN: 9780470519264</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Ulrich Karl, Eppinger Steven and Goyal Anita (2009), Product design and development, 4th edition, TMH, ISBN: 9780070146792

2. Dan Norman (2010); Living with complexity, MIT Press, ISBN: 9780262014861

3. Stanford Friedenthal et al. (2014), A practical guide to SysML: The systems modeling language, 3rd Ed, ISBN:9780128008003</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Cyber Physical Systems</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</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>0</td><td>2</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">UG & DD (Semester 5)</td><td>Type</td><td colspan="2">Core ☑</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ☑</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>Basic Electronics
Instrumentation and controls
Embedded systems</td><td colspan="3">Submitted for approval</td><td>Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">By the end of this course, students will be able to Understand the fundamentals of Cyber-Physical Systems and their role in product development, Apply system modeling and simulation techniques for CPS, Design embedded and networked control systems for physical products, Integrate sensors, actuators, and real-time computing for CPS applications, Develop secure and scalable architectures for IoT-based physical systems and Implement data-driven decision-making and AI/ML techniques in CPS.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end the course, the student should able to build a cyber-physical system as per the context with all design decisions and gain the idea about challenges involved in realizing the CPS</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">Introduction to Cyber-Physical Systems (CPS) - Definition and characteristics of CPS. Applications in physical product development (smart products, industrial automation, IoT, etc.), Key components: Sensors, actuators, communication networks, and computing elements. (4L+4P)
Mathematical modelling of CPS, Simulation tools and techniques MATLAB/Simulink, Modelica, etc.) (8L+8P)
Sensor integration and data acquisition, Actuator technologies and control strategies, Feedback control design for CPS. (8L+8P)
Communication protocols (MQTT, CoAP, OPC UA, etc.), Wireless technologies for CPS (Bluetooth, Zigbee, LoRa, 5G), Edge vs. Cloud computing in CPS architectures. (6L+6P)
Case studies of CPS in automotive, healthcare, manufacturing, and consumer electronics, Emerging trends in CPS-enabled product design, Ethical and regulatory considerations. (4L+4P)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Cyber-Physical Systems, By Raj Rajkumar, Dionisio de Niz, Mark Klein · 2016.
2. Cyber-Physical Systems: A Model-Based Approach, By Walid M. Taha, Abd-Elhamid M. Taha, Johan Thunberg · 2020.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. A Practical Introduction to Human-in-the-Loop Cyber-Physical Systems, By David Nunes, Jorge Sa Silva, Fernando Boavida · 2018
2. Abiri Jahromi, A and Kundur, D (2020) Fundamentals of Cyber-Physical Systems. In: Anumba, CJ and Roofigari-Esfahan, N, (eds.) Cyber-Physical Systems in the Built Environment. Springer ISBN 978-3-030-41559-4 https://doi.org/10.1007/978-3-030-41560-0_1
3. Cyber-Physical Systems: A Foundation for the Future" by Lee & Seshia
4. Cyber-physical Systems Radhakisan Baheti and Helen Gill</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Advanced Manufacturing</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</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>0</td><td>2</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech/DD</td><td>Type</td><td colspan="2">Core ▬</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ▬</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>None</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The objective of this course is to help students to develop a professional knowledge of modern subtractive manufacturing processes, understand the need for unconventional and additive manufacturing methods and perform hands-on exercises in the Product Realization Laboratory</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the student should have gained a knowledge of modern manufacturing processes, sound understanding of different 3D printing technologies and unconventional machining methods and understand how different manufacturing processes affect the final form, fit of a component.</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">Subtractive machining processes: (12L+8P) - Metal cutting theory, turning, thread cutting, automatic lathes, shaping, drilling, reaming, boring, tapping, milling, gear hobbing and finishing of gears.
Abrasive processes and broaching (3L+1P) - Abrasive processes, cylindrical grinding, surface grinding, centreless grinding, internal and external grinding, and broaching.
Powder metallurgy (3L+1P) - Metal powder production, powder compaction, sintering, design and process capabilities, forming, shaping and machining of ceramics, processing of elastomers, metal matrix composites and ceramic-matrix composite.
Unconventional machining processes and semiconductor fabrication (6L+4P) - Water jet machining, ultrasonic machining, Electric Discharge Machining (EDM), Laser Beam Machining and drilling (LBM), Plasma Arc Machining (PAM), Electron Beam Machining (EBM), Chemical and Electrochemical machining (CHM and ECM), processing semiconductors.
Rapid prototyping (9L+5P) - Design for Additive Manufacturing, SLA-Photo curable materials, Powder Bed Fusion –SLS, Fused deposition modelling, Sheet Lamination Process, Thermal bonding and beam deposition processes
CNC machines (3L+1P) - Numeric Control (NC) machine tools, CNC types, CNC programming fundamentals</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Mikell P. Groover, John Wiley & Sons, 2010
2. Manufacturing Processes for Engineering Materials, Serope Kalpakjian and Steven Schmid, Pearson Education, 2018</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Introduction to Manufacturing Processes by Schey J, McGraw-Hill Education, 1999
2. Benedict, Gary F. Nontraditional manufacturing processes. CRC press, 2017
3. McGeough, Joseph A. Advanced methods of machining. Springer Science & Business Media, 1988
4. Chua, Chee Kai, Kah Fai Leong, and Chu Sing Lim. Rapid prototyping: principles and applications.</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Generative Design</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</td><td rowspan="2">Structure (LTPC)</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 rowspan="2">To be offered for</td><td rowspan="2">B.Tech/DD</td><td>Type</td><td colspan="2">Core ☐</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ☐</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>Form Design and CAD Modeling</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The objective of this foundation program is to help students coming from different backgrounds to:
• To introduce students to computational design methodologies for engineering optimization
• To develop proficiency in industry-standard generative design software and tools
• To teach fundamental principles of topology optimization and its applications
To prepare students for implementing generative design in real-world engineering contexts</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">On successful completion of the course, the student will be able to:
• Explain key principles and algorithms in generative design and topology optimization
• Execute generative design studies using industry-standard software
• Evaluate design outcomes based on performance criteria and factor of safety
Create design solutions optimized for specific manufacturing methods, including additive manufacturing</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Foundations of Generative Design (8L+8P) - Introduction to generative design principles and historical evolution, Parametric design fundamentals using Grasshopper, Mathematical foundations of topology optimization and algorithms

Tools and Techniques (10L+10P) - Introduction to Grasshopper and Fusion 360 generative design workflow, FEA and structural analysis with factor of safety evaluation, Advanced optimization algorithms including genetic and machine learning approaches, Design for additive manufacturing with focus on cellular/ lattice structures

Generative Design Applications and Advanced Topics (10L+10P) - Architectural applications of generative design including structural systems and facades, Generative design integration with product development lifecycle, Lightweight structures for aerospace, mechanical, civil, biomedical and architectural designs</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Tedeschi, Arturo, and Davide Lombardi, The algorithms-aided design (AAD), Informed Architecture: Computational Strategies in Architectural Design, 2018, ISBN: 978-88-95315-30-0.
2. Hartmut Bohnacker, Benedikt Gross, Julia Laub, Claudius Lazzeroni and Marie Frohling, Generative design: visualize, program, and create with processing. Princeton Architectural Press, 2012, ISBN: 978-1-61689-077-3.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Haftka, Raphael T., and Zafer Gürdal. Elements of structural optimization, Vol. 11. Springer Science & Business Media, 2012, ISBN: 978-94-010-5550-5.
2. Bendsoe, Martin Philip, and Ole Sigmund, Topology optimization: theory, methods, and applications, Springer Science & Business Media, 2013, ISBN: 978-3-540-42992-0.</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Smart Product Design</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</td><td rowspan="2">Structure (LTPC)</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 rowspan="2">To be offered for</td><td rowspan="2">B.Tech/DD</td><td>Type</td><td colspan="2">Core ☑</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ☑</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>Systems thinking for design</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">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</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students will:
• Identify and define the right type of intelligent behaviour for a chosen product concept
• Design high-level functional and component (structural) architecture for intelligent behaviour using appropriate metaphor and analogy
Evaluate and select the right AI technique for the proposed functional and component architecture and vice versa</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">Introduction to intelligence behavior (6L+6P) - Definition of intelligence, Dimensions of intelligence, Levels of intelligence
Architecture for intelligent behavior (10L+10P) - 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)
Selection of appropriate AI Techniques (12L+12P) - 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.</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Donald A Norman (2007), The design of future things, Basic Books, New York</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Dario Floreano and Claudio Mattiussi (2008), Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, MIT Press
2. Michael Negnevitsky (2005), Artificial Intelligence: A Guide to Intelligent Systems, Second Edition, Addison Wesley</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Entrepreneurship and Venture Creation</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</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 rowspan="2">To be offered for</td><td rowspan="2">B.Tech/DD</td><td>Type</td><td colspan="2">Core ☑</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ☑</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>None</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The course aims to introduce students to entrepreneurial thinking, business model innovation, and value creation.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students will: (i) Understand entrepreneurship as a mindset and its role in economic and social value creation, (ii) Identify and evaluate business opportunities through market research and innovation techniques, (iii) Develop a viable business model using frameworks like the Business Model Canvas (BMC), (iv) Analyze different funding options, including bootstrapping, venture capital, and crowdfunding, (v) Understand the fundamentals of scaling and sustaining a startup and (vi) Develop and pitch a real-world startup concept.</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">Introduction to Entrepreneurship [4L+4P] - What is Entrepreneurship vs management? Myths vs. Reality, Types of entrepreneurs: Startup, Small Business, Social, Corporate, Types of firms / legal entities, The Entrepreneurial Mindset: Creativity, Risk-taking, and Resilience, Case Study: Success Stories of Famous Entrepreneurs.
Opportunity Identification & Market Research [8L+8P] - Competition analysis, Recognizing unsolved problems and market gaps, Market research techniques: Surveys, Focus Groups, Competitive Analysis, Customer Discovery & Validation.
Business Models and Value Proposition [8L+8P] - Understanding Value Creation: Economic, Social, and Sustainable Value, Business Model Innovation: Business Model Canvas (BMC), Customer Segments & Unique Value Proposition (UVP).
Entrepreneurial Finance & Funding Strategies [4L+4P] - Understanding startup costs & financial projections, Funding sources: Bootstrapping, Angel Investors, Venture Capital, Crowdfunding, Pitch Deck Development & storytelling.
Scaling & Sustaining a Business [4L+4P] - Scaling strategies: Product-Market Fit & Expansion Models, Legal & Operational Considerations (Business registration, patents, etc.), Entrepreneurial leadership & team building, Final Deliverable: Comprehensive Startup Business Plan & Pitch Presentation.</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Porter, M (1988), Competitive Advantage: Creating & sustaining superior performance, The Free Press, ISBN: 9780684841465
2. Eric Ries (2011), The Lean Startup, Portfolio Penguin, ISBN:9780307887894</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. University of Delhi (2013), Foundation course: Business, Entrepreneurship and Management, Pearson, ISBN: 9789332520059
2. KSV Menon and Garima Malik (2016), Funding options for startups, NotionPress, ISBN: 9788175110991
3. Thiel, Peter, 1967- and Blake 1986- Masters, Zero to One: Notes On Startups, or How to Build the Future. Books on Tape, 2014.
4. Osterwalder, Alexander, and Yves Pigneur. 2010. Business Model Generation. Chichester, England: John Wiley & Sons</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Simulation Driven Design</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</td><td rowspan="2">Structure (LTPC)</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 rowspan="2">To be offered for</td><td rowspan="2">B.Tech/DD</td><td>Type</td><td colspan="2">Core ☑</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ☑</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="2">Submitted for approval</td><td colspan="3">Senate 61</td></tr>
<tr><td>Learning 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>Learning 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 for L/T/P)</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 (2L+2P)
● Dynamic response –impact and crashworthiness (2L+2P)
● Product optimization in terms of product size, shape and material, Structural Optimization (2L+2P)
● Non-linear stress analysis (2L+2P)
● Manufacturing simulations including casting and deep drawing, welding, additive manufacturing (2L+2P)
● System Modelling and Control Systems (2L+2P)
● Composite Analysis & Optimization (2L+2P)
● Design of Experiment (DoE) Studies (2L+2P)
● Electromagnetic simulation (2L+2P)
● Fundamentals of CFD, MATLAB, Simulink, ADAMS, etc(10L+10P)</td></tr>
<tr><td>Text Books</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</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. NAFEMS (1992), A finite element primer, Bookcraft Ltd.
2. Paul Jacob and Lee Goulding (2002), An explicit finite element primer, NAFEMS Ltd., ISBN:9781874376453
3. A.A. Becker (2001), Understanding Non-linear finite element analysis, NAFEMS Ltd., ISBN:9781874376354</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Ergonomics and Usability</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</td><td rowspan="2">Structure (LTPC)</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 rowspan="2">To be offered for</td><td rowspan="2">B.Tech/DD</td><td>Type</td><td colspan="2">Core ☑</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ☑</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>None</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The objective of this course is to: (i) To develop an understanding of the science of work and human relationships, (ii) To integrate scientific methodology for design products, processes, and services more efficiently, with comfort and utilitarian and (iii) To develop an understanding of the physical and cognitive aspects of comfort, efficiency, utility, and safety in human-machine interface, processes, and services.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the student should be able to apply anthropometric and ergonomic data in product design, to analyze and improve human-system interaction using cognitive ergonomics principles, to conduct usability evaluations and recommend design improvements and to develop inclusive and user-friendly products based on real-world usability.</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">Physical Ergonomics (10L) - Introduction to Ergonomics, definition, scope, and importance of physical ergonomics in design, Human Capabilities, Human biomechanics, anthropometrics, Posture, Ergonomics Equipment and Measuring procedures, Ergonomics risk, Ergonomic guidelines for workstation, product, and equipment design, Virtual Ergonomics & Digital Human Modelling.
Cognitive Ergonomics (10L) - Cognitive Load & Human Perception, Information processing model (input, cognition, response), Attention, memory, and mental workload in design, Human-computer interaction (HCI) & Interface Design - Visual perception & Gestalt principles, Affordances, mental models, and error prevention, Decision-Making & Human Error, Errors in human-system interaction (slips vs. mistakes), Cognitive Ergonomics in Safety-Critical Systems - Aviation, healthcare, automotive case studies.
Usability & User Experience (8L+28P) - Usability Principles & Evaluation Methods - Nielsen's Usability Heuristics, Usability testing techniques, Usability metrics: Effectiveness, efficiency, satisfaction, WCAG (Web Content Accessibility Guidelines), Wireframing & prototyping (Figma, Axure, Adobe XD), Ergonomics and Usability evaluation of an existing product & redesign proposal.</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Stanton, N.A., Salmon, P.M., Rafferty, L.A., Walker, G.H., Baber, C. and Jenkins, D.P., 2017. Human factors methods: a practical guide for engineering and design. CRC Press. ISBN-13: 978-1472408150. ISBN-10: 1472408152
2. Shneiderman, B. and Plaisant, C., 2010. Designing the user interface: strategies for effective human-computer interaction. Pearson Education India. ISBN-13: 978-0321537355. ISBN-10: 0321537351</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Tilley, A.R., 2001. The measure of man and woman: human factors in design. John Wiley & Sons. ISBN: 9780471099550. ISBN-10: 0471099554
2. Norman, D., 2000. Donald A. Norman. The Design of Everyday Things. ISBN-13: 978-0465050659. ISBN-10: 0465050654
3. Wickens, C.D., Gordon, S.E., Liu, Y. and Lee, J., 2004. An introduction to human factors engineering (Vol. 2, p. 587). Upper Saddle River, NJ: Pearson Prentice Hall. ISBN-13: 978-0131837362. ISBN-10: 0131837362</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Product and Innovation Management</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</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 rowspan="2">To be offered for</td><td rowspan="2">B.Tech/DD</td><td>Type</td><td colspan="2">Core ☑</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ☑</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>None</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The course provides an introduction to product and innovation management in an organizational context</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students should be able to
● Understand product management fundamentals, including lifecycle, strategy, and positioning.
● Conduct market research to identify user needs and market opportunities.
● Develop and evaluate new product concepts using business feasibility analysis.
Understand how to commercialize and launch products successfully.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Introduction to Product and Innovation Management [6L+2T] - What is Product Management? Roles & Responsibilities, Difference between Product Management and Project Management, Types of Innovation: Incremental, Disruptive, Sustaining, Radical, Case studies: Innovative vs. Failed Products.
Product Lifecycle and Strategy [9L+3T]- Product Lifecycle Stages: Introduction, Growth, Maturity, Decline, Product Portfolio Management (BCG Matrix), Competitive positioning & value proposition, Go-To-Market Strategy.
Innovation Frameworks [9L+3T] - Lean Startup Methodology, Blue Ocean Strategy, Open Innovation & Crowdsourcing, IPR strategy.
Pricing, Branding, and Business Models [9L+3T] - Pricing Strategies: Cost-based, Value-based, Competitive, Business models: Subscription, Freemium, Marketplace, Direct Sales, Branding & Positioning strategies, Case studies on successful product branding.
Commercialization & Product Launch [6L+2T] - Go-To-Market (GTM) Strategy Development, Product launch planning & execution, Measuring product success: KPIs & metrics, Post-launch product management & updates.</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Steven Haines (2014), Product manager's desk reference, 2nd Edition, McGraw Hill
2. Jakki J Mohr, SanjitSengupta (2011), Marketing of High-Technology Products and Innovations, 2nd Edition, Pearson Education</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. John Stark (2011), Product Lifecycle Management: 21st Century Paradigm for Product Realisation, Springer
2. Joe Tidd and John Bessant (2009), Managing Innovation: Integrating Technological, Market and Organizational Change, Wiley
3. Paul Trott (2011), Innovation Management and New Product Development, 5/E, Pearson
4. Burgelman R. Christensen C., Maidique M., Wheelwright S. 2007, Strategic Management of Technology and Innovation. McGraw Hill
5. Marty Cagan (2018), Inspired: How to Create Products Customers Love, ISBN ISBN: 978-1-119-38750-3
6. Eric Ries (2011), The Lean Startup, Portfolio Penguin, ISBN:9780307887894</td></tr>
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