Curriculum and Syllabus for Dual Degree

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

From The Academic Year 2023
(Approved in Senate 51)

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

Semester 1								
S.No	Course Code	Course Name		Category	L	T	P	C
1	MA1000	Calculus		BSC	3	1	0	4
2	PH1000	Engineering Electromagnetics		BSC	3	0	0	3
3	EC1000	Electrical Circuits for Engineers		BEC	3	1	0	4
4	CS1000	Problem Solving and Programming		BEC	3	0	0	3
5	ME1000	Materials for Engineers		BEC	3	0	0	3
6	DS1000	Foundation for Engineering and Product Design		DSC	1	2	0	3
7	PH1001	Engineering Electromagnetics Practice		BSC	0	0	3	1.5
8	CS1001	Problem Solving and Programming Practice		BEC	0	0	3	1.5
9	HS1000	Effective Language and Communication Skills		HSC	1	0	2	2
	NC1000	NSO Semester 1						
	NC1002	NCC Semester 1	Any one					
10	NC1004	SSG Semester 1		NC	0	0	2	0
								25

Semester 2								
S.No	Courses Code	Course Name		Category	L	T	P	C
1	MA1001	Differential Equations		BSC	3	1	0	4
2		Science Elective Course 1		SEC	3	1	0	4
3	ME1001	Engineering Graphics		BEC	2	0	4	4
4	CS1004	Data Structures and Algorithms		ITC	3	0	0	3
5	DS1001	Sociology of Design		DSC	1	2	0	3
6	ID1000	Design and Manufacturing Lab		ITC	0	0	2	1
7	CS1005	Discrete Structures for Computer Science		PCC	3	1	0	4
8	CS1006	Data Structures and Algorithms Practice		ITC	0	0	4	2
	NC1001	NSO Semester 2						
	NC1003	NCC Semester 2	Any one					
9	NC1005	SSG Semester 2		NC	0	0	2	0
10	NC1008	Earth, Environment and Design		NC	1	0	0	0
								25

Semester 3							
S.No	Course Code	Course Name	Category	L	T	P	C
1		Science Elective Course 2	SEC	3	1	0	4
2	DS2000	Systems Thinking for Design	DSC	1	2	0	3
3	CS2000	Object Oriented Programming	PCC	2	0	4	4
4	CS2001	Digital System Design	PCC	3	1	0	4
5	CS2002	Design and Analysis of Algorithms	PCC	3	1	0	4
6	CS2003	Digital System Design practice	PCC	0	0	4	2
7	CS2004	Design and Analysis of Algorithms practice	PCC	0	0	4	2
8	NC2000	Indian Constitution, Essence of Indian Traditional Knowledge	NC	1	0	0	0
							23

Semester 4							
S.No	Course Code	Course Name	Category	L	T	P	C
1		Science Elective Course 3	SEC	3	1	0	4
2	DS2001	Smart Product Design	DSC	1	2	0	3
3	CS2007	Computer Organization and Architecture	PCC	3	1	0	4
4	CS2008	Database Systems	PCC	3	1	0	4
5	CS2009	Theory of Computation	PCC	3	1	0	4
6	CS2010	Computer Organization and Architecture practice	PCC	0	0	4	2
7	CS2011	Database Systems practice	PCC	0	0	4	2
8	NC2001	Human Values and Stress Management	NC	1	0	0	0
							23
Semester 5							
S.No	Courses Code	Course Name	Category	L	T	P	C
1	CS3006	Introduction to Data Science for Engineers	ITC	3	0	2	4
2	DS3000	Entrepreneurship and Management Functions	DSC	1	2	0	3
3	CS3000	Operating Systems	PCC	3	1	0	4
4	CS3001	Computer Networks	PCC	3	1	0	4
5	CS3002	Compiler Design	PCC	3	1	0	4
6	CS3003	Operating Systems practice	PCC	0	0	4	2
7	CS3004	Computers Networks practice	PCC	0	0	4	2
8	CS3005	Compiler Design Practice	PCC	0	0	4	2
9	NC3000	Professional Ethics and Organizational Behavior	NC	1	0	0	0
							25
Semester 6							
S.No	Courses Code	Course Name	Category	L	T	P	C
1	DS3001	Prototyping and Testing	DSC	1	2	0	3
2		Professional Elective Course 1	PEC	3	1	0	4
3		Professional Elective Course 2	PEC	3	1	0	4
4		Professional Elective Course 3	PEC	3	1	0	4
5		Free Elective Course 1	ELC	3	1	0	4
6		Free Elective Course 2	ELC	3	1	0	4
7	HS3000	Professional Communication	HSC	1	0	2	2
8	NC3001	Intellectual Property Rights	NC	1	0	0	0
							25

Semester 7							
S.No	Courses Code	Course Name	Category	L	T	P	C
1	CS5010	Analytics and Systems of Big Data	PCC	3	0	2	4
2	CS5011	Information Security	PCC	3	1	0	4
3	CS5012	Interactive Computer Graphics	PCC	3	0	2	4
4		Professional Elective Course 4	PEC	3	1	0	4
5		Free Elective Course 3	ELC	3	1	0	4
6		Free Elective Course 4	ELC	3	1	0	4
							24
Semester 8							
S.No	Courses Code	Course Name	Category	L	T	P	C
1	CS5013	High Performance Computing	PCC	3	0	2	4
2	CS5014	Software Engineering and Testing	PCC	3	1	0	4
3	CS5015	Human Computer Interaction	PCC	3	0	2	4
4		Free Elective Course 5	ELC	3	1	0	4
5		Professional Elective Course 5	PEC	3	1	0	4
6		Professional Elective Course 6	PEC	3	1	0	4
							24
Semester 9							
S.No	Courses Code	Course Name	Category	L	T	P	c
1	CS6003	DD-CS- Project Phase I (May – July)(Internship)	PCD	0	0	8	4
2	CS6004	DD-CS-Project Phase II (Aug – Nov)	PCD	0	0	12	6
							10
Semester 10							
S.No	Courses Code	Course Name	Category	L	T	P	C
1	CS6005	DD-CS-Project Phase III (Dec – May)	PCD	0	0	20	10
							10

$ All NC courses are Pass/Fail courses for which the letter grade H/L shall be awarded.

1. Professional Elective Course is an elective course offered or prescribed by the parent department. Free Elective Course is an elective course offered by any department, including the parent department. For example: - A ME student, based on his/her choice, can register the elective course offered by ME department or CSE department as free elective course.
2. 3 Months internship is mandatory, however, the curriculum offers the flexibility to carry out 3-12 Months internship with the approval of the parent department. To satisfy the minimum credit requirement, students opting for long term internship (More than 3 months) are expected to advance a few elective courses and credit a few courses from NPTEL. In line with the guidelines approved by the Senate (Senate 46-07), a B.Tech/DD student can earn a maximum of 9 credits from NPTEL Courses. For all successfully completed NPTEL Courses, the letter grade "H" (Pass) will be awarded and credits of such courses will not be accounted for CGPA calculation.

Semester wise Credit Distribution

Category	Semester											
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	Total	%
Basic Science Course (BSC)	8.5	4	0	0	0	0	0	0	0	0	12.5	5.8
Science Elective Course (SEC)	0	4	4	4	0	0	0	0	0	0	12	5.6
Basic Engineering Course (BEC)	11.5	4	0	0	0	0	0	0	0	0	15.5	7.2
Design Course (DSC)	3	3	3	3	3	3	0	0	0	0	18	8.4
IT Skill Course (ITC)	0	6	0	0	4	0	0	0	0	0	10	4.7
Professional Core Course (PCC)	0	4	16	16	18	0	12	4	0	0	70	32.7
Professional Elective Course (PEC)	0	0	0	0	0	12	4	16	0	0	32	15
Elective Course (ELC)	0	0	0	0	0	8	8	4	0	0	20	9.3
Humanities and Social Science Course (HSC)	2	0	0	0	0	2	0	0	0	0	4	1.9
Professional Career Development (PCD)	0	0	0	0	0	0	0	0	10	10	20	9.3
Total	25	25	23	23	25	25	24	24	10	10	214	100
	25.0	50.0	73.0	96.0	121.0	146.0	170.0	194.0	204.0	214.0	214.0	

Course Name	Calculus	Course Code	MA1000			
Offered by Department	SH -Mathematics	Structure (LTPC)	3	1	0	4
To be offered for	B.Tech	Course type	Core			
Pre-requisite	NIL	Approved In	Senate-43			
Learning Objectives	The course will introduce the student to basic concepts in Calculus such as convergence, differentiation & integration and its applications.					
Contents of the course	• Limit and Continuity of functions defined on intervals, Intermediate Value Theorem, Differentiability, Rolle's Theorem, Mean Value Theorem, Taylor's Formula (5) • Sequences and series (7) • Definite integral as the limit of sum – Mean value theorem – Fundamental theorem of integral calculus and its applications (9) • Functions of several variables – Limit and Continuity, Geometric representation of partial and total increments Partial derivatives – Derivatives of composite functions (8) • Directional derivatives – Gradient, Lagrange multipliers – Optimization problems (7) • Multiple integrals – Evaluation of line and surface integrals (6)					
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. J Hass, M D Weir, F R Giordano, Thomas Calculus, 11th Edition, Pearson.					

Course Name	Engineering Electromagnetics	Course Code	PH1000			
Offered by Department	SH -Physics	Structure(LTPC)	3	0	0	3
To be offered for	B. Tech	Course Type	Core			
Pre-requisite	NIL	Approved In	Senate-43			
Learning Objectives	The objective of this course is to give an idea how the electromagnetic wave behaves. This also provides an understanding of theories of electrostatics, magnetism and electrodynamics with their applications. It will enhance the problem solving capacity of the student.					
Contents of the course	• Vectors - an introduction; Unit vectors in spherical and cylindricalpolarco-ordinates;Conceptofvectorfields;Gradientofascalarfield; flux, divergence of a vector, Gauss's theorem,Continuityequation;Curl– rotationalandirrationalvectorfields,Stoke'stheorem. (12) • 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 di-electric systems. (10) • 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. (10) • Electrodynamics: • Electro motive force ,Time-varying fields, Faraday's law of electro-magnetic induction, • Self and mutual inductance, displacement current, Maxwell's equations in free space. Boundary condition, propagation in linear medium. Plane electro-magnetic waves—reflection and refraction, electromagnetic energy density, Pointing Vector.(10)					
Essential Reading	1.W.H.Hayt andJ.A.Buck,EngineeringElectromagnetics,TataMcGrawHillEducationPvt.Ltd, 2006.					
Supplementary Reading	1. W. H. Hayt, J. A.Buck and M.Jaleel Akhtar,Engineering Electromagnetics,McGraw Hill (India) Education Pvt. Ltd, Special Indian Edition 2020. 2. Purcell. E.M, Electricityand Magnetism BerkleyPhysics Course, V2, Tata McGraw Hill, 2008. 3. Feynman.R.P,Leighton.R.B,Sands.M,TheFeynmanLecturesonPhysics,Narosa Publishing House, Vol. II, 2008. Hill, 2008. 4. G.B.Arfken,H.J.WeberandF.E.Harris,MathematicalMethodsforPhysicists, Academic Press, 2013					

Course Name	ElectricalCircuitsforEngineers	Course Code	EC1000			
Offered by Department	ElectronicsandCommunication Engineering	Structure(LTPC)	3	1	0	4
To be offered for	B.Tech	B. Tech	Core			
Pre-requisite	NIL	Approved In	Senate-43			
Learning Objectives	Thiscourseaimstoequipthestudentswithabasicunderstandingofelectricalcircuitsandmachinesforspecifictypesofapplications. Thiscoursealsoequipsstudentswithanabilitytounderstandbasicsofanalogandigitalelectronics.					
LearningOutcomes	Thestudentsshalldevelopanintuitiveunderstandingofthecircuitanalysis,basicconceptsofelectricalmachines,andelectronicdevicesandcircuitsandbeabletoapplytheminproductdesignanddevelopment					
Contentsofthecourse *(Withapproximatebreak-upofhours)*	Elementsinelectricalcircuits:R,L,C,voltageandcurrentsources,Ohm'slaw,Kirchoff'sLaws**(4)** Networkanalysis:Nodalandmeshanalysiswithonlyindependentsources**(4)** Networktheorems:Superposition,Thevenin's&Norton's,Maximumpowertransfertheorems**(4)** DCcircuits:ResponseofRC,RLandRLCcircuits**(6)** ACcircuits:ACsignalmeasures,Phasoranalysisofsingle-phaseACcircuits,ThreephaseACcircuits**(6)** Machines:Transformers,DCgenerator,DCmotor,ACinductionmachines**(8)** Diodes:V-Icharacteristics,applications-rectifiers,clippers,clampers**(2)** Op-amps:gain,feedback,applications-inverting/non-invertingamplifiers,sumanddifferenceamplifier,comparators **(4)** Logicgatesandcombinationalcircuits–Basicgates,Karnaughmaps,Fulladder,halfadder**(4)**					
Essential Reading	1. EdwardHughes,IanMcKenzieSmith,JohnHiley,KeithBrown,'Hughe'sElectricalandElectronicTechnology',10th edition,Pearson,2010					
Supplementary Reading	1. CharlesAlexanderandMatthewSadiku'FundamentalsofElectricCircuits'7thEdition,McGrawHill,2021 2. C.H.Roth,Jr.,LarryRKinney,'FundamentalsofLogicDesign',7thEdition,CengageLearning,2013. 3. JacobMillman,ChristosCHalkais,SatyabrataJit,'Millman'sElectronicDevicesandCircuits',4thEdition,McGrawHillIndia,2015 4. StephenDUmans,'Fitzgerald&Kingsley'sElectricMachinery',McGraw-Hill,7thed.2020.					

Course Name	Problem Solving and Programming	Course Code	CS1000			
Offered by Department	Computer Science	Structure (LTPC)	3	0	0	3
To be offered for	B.Tech	Course type	Core			
Prerequisite	NIL	Approved In	Senate -43			
Learning Objectives	Focus is on problem solving using computers with C programming as the language. Data representation, base conversions, arithmetic in fixed and floating point representations, and problems related to this shall be covered. The sequence, selection and repetition statements in C programming language shall be discussed with case studies. The practice component of this course shall supplement theory by providing hands-on experience.					
Learning Outcomes	The teaching and assessment shall ensure that given a computational problem, students can use computers as a tool to model and solve the problem. Writing pseudo codes and C programming using basic programming constructs are expected out of the students. Students are expected to be conversant in number conversions and representations.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Computing Machine - Need and Applications - Evolution of Computing Machines (Calculators through Computers) Number Representation - Fixed and Floating Point - Base Conversions: Binary, Decimal, Octal, Hexa decimal number systems and conversions. (8 hours) • Basic programming constructs in C – Data types in C – Input and output statements – Formatted input/output - Control strings - return types - Case studies involving sequence statements (4hours) • Operators - Arithmetic, logical, relational, shift, unary operators - Precedence and Associativity (3 hours) • Selection Statements: IF-ELSE, SWITCH-CASE - Programs involving sequence and selection - GOTO statements - break statement - Nested IF - Switch inside if and vice-versa (5 hours) • Repetition Statements: FOR, WHILE - Programs involving sequence, selection and repetition - continue statement - Nested loops (5 hours) • Introduction to Arrays and Strings - Array manipulation - string manipulation - string operations - multi-dimensional arrays (6 hours) • Functions in C – Function declaration, definition – scope -storage Class-Built and user defined functions –Recursive functions (7 hours) • Introduction to Pointers, Dynamic Memory Allocation, Structures and File processing (7 hours)					
Essential Reading	Deitel P J and Deitel H M, C : How To Program, Prentice Hall, 7th Edn, 2012.					
Supplementary Reading	Kernighan, Ritchie D, The C Programming Language, Prentice Hall, 2 Edn, 1988					

Course Name	Materials for Engineers	Course Code	ME1000			
Offered by Department	Mechanical Engineering	Structure (LTPC)	3	0	0	3
To be offered for	B. Tech	Course Type	Core			
Pre-requisite	NIL	Approved In	Senate- 43			
Learning Objectives	• To provide overview of microstructure and properties of various engineering materials • To explore relations between performance of engineering products and microstructure, properties of materials that are used to construct them.					
Learning Outcomes	After the completion of the course, students will be able: • To explain the microstructure and properties of materials like steels, polymers, ceramics, and composites. • To understand the correlation of microstructure-properties-performance of materials so as to select suitable materials for engineering products.					
Contents of the course	• Classification and evolution of engineering materials, crystal structure, defects, crystallographic planes, directions, slip, deformation mechanical behavior, strengthening mechanisms, microstructure and properties of metal alloys (12) • Properties and processing of polymers, ceramics and composite materials, microstructure-property relationships (9) • Electrical, electronic and magnetic properties of materials, microstructure-property relationships (6) • Introduction to Nano, Bio, Smart and Functional materials. (3) • Introduction to selection of materials, Product based case studies on microstructure-property-performance of materials in the design of automobile; aircraft structures; e-vehicles; energy storage; electronic, optical and magnetic devices; and biomedical devices. (12)					
Essential Reading	1. William D. Callister Jr., David G. Rethwisch, "Materials Science and Engineering: An Introduction", 10th Edition, Wiley, 2018. 2. Michael Ashby, Hugh Shercliff, David Cebon, "Materials – Engineering, Science, Processing and Design", 4th Edition, Butterworth-Heinemann, 2018.					
Supplementary Reading	1. V Raghavan, "Materials Science and Engineering: A First Course, 5th Ed, 2007, PHI India. 2. Donald R. Askeland K Balani, "The Science and Engineering of Materials," 7th Edition, Cengage Learning, 2016. 3. Michael Ashby, "Materials Selection in Mechanical Design", 5th Edition, Butterwoth-Heinemann, 2016.					

Course Name	Foundation for Engineering and Product Design	Course Code	DS1000			
Offered by Department	SIDI	Structure (LTPC)	1	2	0	3
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate -43			
Learning Objectives	The objective of this foundation program is to help students coming from +2 background to: • Unlearn limiting assumptions, risk avoidance, fear of failure • Awaken their senses & rediscover their creative selves • Experience the impact of design and technology in everyday objects					
Learning Outcomes	At the end the course, the student should • demonstrate qualities of immersion in a task; • unlearn key limiting assumptions; • become comfortable with sketch-thinking and develop skills in design sketching; • be excited by the potential of technology and design in improving lives;					
Contents of the course (With approximate break up of hours)	**Module-1: Induction: (5 hrs.)** • History of the place; the industrial ecosystem; institution • Exercises to improve interaction; local visits; **Module-2: Learn to observe nature and self (12 hrs)** • Know your context - physical and social; • Unlearning activities; Start journaling • Observe wholes-parts (trees-leaves); variety of leaves; colors • Document in a variety of ways - collage; sketch, paint, photograph, video **Module-3: Learn to observe everyday objects (15 hrs)** • Unbundle everyday objects, observe, reorganize • Whole-part relations; System physics; • Observe interplay of art, design, culture, technology in everyday objects **Module-4: Visualize and Realize 3D objects (15 hrs)** • Introduction to design sketching-1 (paper/pencil) • Concepts of perspective drawing and product sketching. • Introduction to color theory - mixing of colors to get different shades • Explore variations on the form of chosen objects • Realize designs with tools/materials (Origami; Clay; Foam cutting; Laser cutting; Glues) • Introduction to digital sketching & 3D printing Evaluation: Continuous assessment (80%); Final Form Designs Presentation (20%)					
Essential &Supplementary Reading	1. Kevin Henry, Drawing for Product Designers, Laurence King Publishing, 2012, ISBN:9781856697439 2. KoosEissen and RoselienSteur, Sketching – The Basics, BIS Publishers, 2011, ISBN:9789063695347 3. Thomas C Wang, Pencil Sketching, John Wiley, 2002, ISBN:9780471218050 4. Wucius Wong, Principles of Color Design: Designing with Electronic Color, John Wiley, 2nd Edition, 1996, ISBN:9780471287087					

Course Name	Engineering Electro-magnetics Practice	Course Code	PH1001			
Offered by Department	SH-Physics	Structure(LTPC)	0	0	3	1.5
To be offered for	B.Tech	Course Type	Core			
Pre-requisite	NIL	Approved In	Senate-43			
Learning Objectives	The objective of this course is to give a hand on experience how the electromagnetic wave behaves in different situations. The students will be able to relate the knowledge they have got in the theory class with their experience. This course will enhance their skill of handling instruments and the presentation of the results obtained from the experiments.					
Contents of thecourse	Electricalandmagneticpropertiesofmaterialsbasedontheconceptofelectricalpolarization,magnetization of materials will be studied in various experiments. Experiments based on the concept of phenomena such as interference ,diffraction etc.related to electro-magnetic waves will be done here and the se methodswillbeappliedtomeasuresomeunknown physical quantities such as wavelength of a light, diameter of a very thin wire, very smallaperture forlightetc.					
Essential Reading	1.IIITD&MLaboratorymanualforElectromagneticWavePractice					
Supplementary Reading	1.W.H.Hayt andJ. A.Buck,EngineeringElectromagnetics,TataMcFrawHill EducationPvt. Ltd,2006.					

Course Name	Problem Solving and Programming Practice	Course Code	CS1001			
Offered by Department	Computer Science	Structure (LTPC)	0	0	3	1.5
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-43			
Learning Objectives	Focus is on problem solving using computers with C programming as the language. The sequence, selection and repetition statements in C programming language shall be discussed with case studies.					
Learning Outcomes	The teaching and assessment shall ensure that given a computational problem, students can use computers as a tool to model and solve the problem. Writing pseudo codes and C programming using basic programming constructs are expected out of the students. Students are expected to be conversant in number conversions and representations.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• 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 • Case studies using sequence statements - input/output statements - arithmetic with precedence and associativity. • Case studies involving selection and repetition statements - functions – recursion					
Essential Reading	Deitel P J and Deitel H M, C : How To Program, Prentice Hall, 7th Edn, 2012.					
Supplementary Reading	Kernighan, Ritchie D, The C Programming Language, Prentice Hall, 2 Edn., 1988					

	Effective Language and Communication Skills	Course Code	HS1000			
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-43			
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

Course Name	Differential Equations	Course Code	MA1001			
Offered by Department	SH-Mathematics	Structure (LTPC)	3	1	0	4
To be offered for	B.Tech	Course Type	Core			

Pre-requisite	NIL	Approved In	Senate-44
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 (10) Power series solution of ordinary differential equations and Singular points Bessel and Legendre differential equations; properties of Bessel functions and Legendre Polynomials (12) Fourier series (6) Laplace transforms elementary properties of Laplace transforms, inversion by partial fractions, convolution theorem and its applications to ordinary differential equations (6) Introduction to partial differential equations, wave equation, heat equation, diffusion equation(8)		
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, 8 Edn, 2004. 2. Sneddon. I, Elements of Partial Differential Equations, Tata McGraw Hill, 1972. 3. Ross. L.S, Differential Equations, Wiley, 2007. 4. Trench, W, Elementary Differential Equations, http://digitalcommons.trinity.edu/mono		

Course Name	EngineeringGraphics	Course Code	ME1001			
Offered by Department	MechanicalEngineering	Structure(LTPC)	2	0	4	4
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	• To introduce thebasicconceptsandtechniquesoftechnicaldrawing. • 2D and 3D representation of various shapes/objects and its engineeringapplications.					
LearningOutcomes	Students will acquire visualization skills and will be able to prepare technicaldrawingsand 3Dmodels usingcomputer aidedtools.					

Course Contents(with approximatebreak up of hours forlecture/tutorial/ practice)	• Roleoftechnicaldrawinginproductdevelopmentprocess,Basicsoftechnicaldrawing,Standards, Dimensioningprinciples.*(L2+P4hrs.)* • Computeraideddrafting.*(L2+P8hrs.)* • Engineeringcurvesanditsapplications. *(L4+P8hrs.)* • Principles of orthographic projection. Orthographic projection of points, lines,planes and regular solids, Exercises related to engineering applications. *(L7+P8hrs.)* • Principlesofisometricprojections.Orthographictoisometricandisometrictoorthographictransformation ofobjects.*(L3+P8hrs.)* • Sectionandintersectionofregularsolidsandtheirlateraldevelopments. • *(L6+P12hrs.)* • Introduction to 3D modelling of shapes and objects; electrical CAD. *(L2+P4hrs.)*
Essential Reading	1. K.Venugopal andVPrabhuRaja,EngineeringDrawing+AutoCAD,NewAgeInternational (P)Limited.5th EditionReprint:July, 2016 2. Narayana.K.L,andKannaiah.P,EngineeringDrawing,ScitechPub.Pvt.Ltd, 3. 3rdEdition.
Supplementa ryReading	1. PIVarghese,EngineeringGraphics,McGrawHillEducation,2013. 2. Bhatt.N.D,EngineeringDrawing– PlaneandSolidGeometry,CharotarPublishingHouse Pvt. Ltd.,53 Edition 2014.

Course Name	Data Structures and Algorithms	Course Code	CS1004			
Offered by Department	ComputerScience&Engineering	Structure (LTPC)	3	0	0	3
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	Givenacomputationalproblem,thefocusisondesignofalgorithms,implementation of algorithms using a suitable data structures.The notion time andspacecomplexityanddesignofefficientalgorithmsanddatastructuresshallalsobe explored.					
LearningOutcomes	Studentsareexpectedtodesignefficientalgorithmsanddatastructuresfor computationalproblems					
Course Contents(with approximatebreakup of hours forlecture/tutorial/practice)	• Review of elementary data structures – time and space complexity – step countmethod based computation – asymptotic analysis and bounds – big oh, little oh,omega,theta notation(5L) • Analysis using recurrence relations – solving recurrence relations through guessmethod,recurrencetree method, master'stheorem(5L) • Analysis of sorting/searching algorithms - Incremental Design - insertion sort,Decremental Design - Celebrity problem - Divide and Conquer- merge sort, quicksort – 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, numberofnodes etc.) (6L) • Dictionary: Binary search trees, balanced binary search trees - AVL Trees – searchtreevariants such as B-trees. (7L) • Hashing - collisions, open and closed hashing, properties of good hash functions.(4L) • Priorityqueues: Binaryheapswithapplicationtoin-placesorting(5L) • Graphs:Representations(Matrixand AdjacencyList),basictraversalsuchasBFS,DFSwith complexity(6L)					
Essential Reading	1. 1.M.A. Weiss,DataStructuresandAlgorithmAnalysisinC,Pearson,2nd edition,2002.					
Supplementary Reading	1. CormenT.H,LeisersonC.EandRivestR.L,IntroductiontoAlgorithms,PrenticeHallIndia, 2nd Edition,2001. 2. Aho,HopcroftandUllmann,DataStructuresandAlgorithms,AddisonWesley,1983. 3. AdamDrozdek,DatastructuresandAlgorithmsinC,1994. 4. RGDromey,HowtosolveitbyComputer,PrenticeHallIndia,1982. 5. Horowitz,SahniandAnderson-Freed,FundamentalsofDataStructuresinC,SiliconPress, 2007.					

Course Name	SociologyofDesign	Course Code	DS1001			
Offered by Department	SIDI	Structure(LTPC)	1	2	0	3
To be offered for	B.Tech	Course Type	Core			
Prerequisite	FoundationProgram	Approved In	Senate 43			

Learning objectives	The objective of the course is to introduce engineering students tothe importance of understanding the social context of technologyandproductdesign: • Observing the problem context and surfacing unstateduser/customerneeds/newproductconcepts, • Understanding people, team dynamics and working in multicultural /cross-functional/distributed teams.
Learning Outcome	Attheend ofthecourse,thestudentsshould beinaposition to: • Understandtheneedandtheprocessofdoinganethnographicstudy • Surfaceunstatedneeds andarticulate thehighlevel productrequirements Connectwith people,formteams andcollaborate towardsacommongoal
Contents of the course(With approx. mate breakupofhours)	Module1:Technology,DesignandSociety-[9hrs] • Observethewaypeopleinteract withobjects • Understandingthe relationship betweenpeopleandavarietyofobjects • ActorNetworkTheory;HistoryofTechnologyandDesign;2-3Casestudies • Discoveryourpassionanddomainofinterest&networktoidentifypartners Module2:Understandinguser/customercontexts[21hrs] • Ethnography-immersioninaproblemcontext • Learningtoobserve-seeandlisten; • Developingrichpictures;Gigamapping • Introductiontosignsandsemioticanalysis Module3:Understandinggroups(multicultural/cross-functionalteams)[12hrs] • Learningteamformationanddynamicsthroughamovie; • Introduction to sociological imagination - Functionalism, ConflictTheory,SymbolicInteractionism;InteractionRitualChains • Values,culture, methodsofengineersanddesignersandhowtheyshapethequalityof our lives; • Groupdynamicswithinorganizationsandacrossorganizationsandim plications for innovationandchange Evaluation:Continuousassessment(40%);Finalethnographyreport(20%);End Semester(40%)
Essential & Supplementary Reading	1. TrevorPinch(Editors)(2012),TheSocialConstructionofTechnologicalSyste ms:Newdirections inthesociologyandhistoryoftechnology, MITPress,AnniversaryEdition 2. WendyGunn,TonOttoandRachelSmith(2013),DesignAnth ropology:Theoryand practice,Bloomsbury 3. AdrianForty(2014),Objectsofdesire:Designand societysince1750s,Thames&Hudson 4. BernhardEBurdek(2015),History,theoryandpracticeofproductdesign,seco nd revisededition 5. KeriSmith(2008),Howto beanExplorer oftheWorld:PortableLifeMuseum,PenguinGroup

Course Name	DesignandManufacturingLab.	Course Code	ID1000			
Offered by Department	SIDI	Structure(LTPC)	0	0	2	1
To be offered for	B.Tech	Course Type	Core			
Pre-requisite	NIL	Approved In	Senate-44			
Learning Objectives	The objective of this course is to give an exposure on the basic practices followed in thedomainofmechanical,electrical,electronicsandcommunicationengineering.Theexercises will train the students to acquire skills which are very essential for the engineersthroughhands-on sessions.					

Contents of thecourse	Experimentswillbeframedtotrainthestudentsinfollowingcommonengineeringpractices: Basic manufacturing processes: Fitting, Drilling & tapping, Material joining processes,Carpentry, Sheet-metal work, Adhesive bonding and plastic welding, Arc Welding, 3DPrinting.(10 hours) Familiarizationofelectroniccomponentsby Nomenclature,meters,powersupplies,function generators and Oscilloscope – Bread board assembling of simple circuits: Earth, Environment and Design – Transmitterand receiver – LED emergencylamp – Communicationstudy amplitudemodulationanddemodulation.(6 hours) Domestic wiring practice: Fluorescent lamp connection, Staircase wiring – Estimation andcosting of domestic and industrial wiring – power consumption by Incandescent, CFL andLEDlamps. (2 Hours) Dismantleand assemblyofPC.InstallingOS anddiskmanagement.(4 hours)
Essential Reading	1. UppalS.L., ElectricalWiring&Estimating", 5Edn,KhannaPublishers,2003. 2. Chapman.W.A.J., WorkshopTechnology, Part1&2, Taylor &Francis.
Supplementary Reading	1. ClydeF.Coombs,"Printed circuitshand book",6Edn,McGraw Hill,2007. 2. John H. Watt, Terrell Croft, "American Electricians' Handbook: A ReferenceBookforthe PracticalElectricalMan",Tata McGraw Hill,2003.

Course Name	Earth, Environment and Design	Course Code	NC1008			
Offered by Department	SHD	Structure(LTPC)	1	0	0	P/F
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	The course aims to provide an understanding of systems and processes in aquatic and terrestrial environments, and to explore changes in the atmosphere, lithosphere, hydrosphere, biosphere, and the evolution of organisms, since the origin of life on earth.					
Essential Reading	1.					
Supplementary Reading	1.					

Course Name	Discrete Structures for ComputerScience	Course Code	CS1005			
Offered by Department	ComputerScience&Engineering	Structure(LTPC)	3	1	0	4
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	Thiscourseintroduceslogicalreasoning,inferences,andprooftechniques.Relations,Functions,counting principlesarealsodiscussed.Graphtheoryand variouspropertiesof graphsarealsotaught aspartofthiscourse.					
LearningOutcomes	The learner would appreciate the importance of combinatory and the various prooftechniques, and in particular, in proving the correctness of algorithms. Countingprinciplesleart aspartofthecoursewillhelpthelearnerincountingvarious combinatorialobjects					
Course Contents(with approximatebreak up of hours forlecture/tutorial/ practice)	• Mathematical Reasoning – Propositions – Predicates – First order logic 2– Nestedquantifier –logicalpuzzles(9L+3T) • Set theory – Relations between sets – Operation ofsets- Proof techniques – Direct proof, proof by contradiction, mathematicalinduction(8L+3T) • Binary relational and digraphs – Special properties of relations – Composition of relations – Closureoperations – Equivalence relations – Partial orders(7L+3T) • Basic principles of counting – Special classes of functions – counting functions(5L+1T) • Pigenholeprinciple – ontofunctions – derangements(5L+1T) • Basiccountingtechniques – Finiteand Infinitesets – Countableanduncountablesets – Cardinal numbers(6L+1T) • Graph Theory – Graphs – Subgraphs – Isomorphic and Homeomorphic graphs – Paths – Connectivity Bridges of Konigsberg – Labeled and Weighted Graphs – Complete,RegularandBipartiteGraphs – Planar Graphs – Coloring(5L+2T)					
Essential Reading	1. K. H Rosen, Discrete Mathematics and its Applications, McGraw Hill, 6th Edition, 2007.					
Supplementa ry Reading	1. D.F.Stanat and D.F.McAllister, Discrete Mathematics in Computer Science, Prentice Hall, 1977. 2. R.L.Graham, D.E.Knuth, and O.Patashnik, Concrete Mathematics, Second Edition, Addison Wesley, 1994.					

Course Name	Data Structures and Algorithms Practice	Course Code	CS1006			
Offered by Department	Computer Science&Engineering	Structure(LTPC)	0	0	4	2
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Course Contents(with approximatebreakup of hours forlecture/tutorial/practice)	• Implementationofcasestudiesinvolvingalgorithmsanddatastructuresin C program ming. • BinaryTrees–Traversal –ComputationofStructuralparameters • Hashing–implementationofhashfunctions–computingcollisions–Openvsclosedhashing • SortingandSearchingAlgorithms • PriorityQueuesandHeapsandits applications • GraphTraversals–BFS,DFSanditsapplications					
Essential Reading	1.M.A. Weiss, Data Structures and Algorithm Analysis in C, Pearson, 2nd edition, 2002.					
Supplementary Reading	1. C.L.Liu, Elements of Discrete Mathematics, Second Edition, Tata McGraw Hill, 1995. 2. Aho, Hopcroft and Ullmann, Data Structures and Algorithms, Addison Wesley, 1983. 3. Adam Drozdek, Datastructures and Algorithms in C, 1994. 4. RG Dromey, how to solve it by Computer, Prentice Hall India, 1982. 5. Horowitz, Sahni and Anderson-Freed, Fundamentals of Data Structures in C, Silicon Press, 2007.					

Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Introduction to environment and ecology – Ecosystems Impacts of natural and human activities on ecosystems • Environmental policies, acts and standards, Environmental Impact Assessment Prediction and assessment of the impacts on air, water, land, and biological environments Assessment of impacts of the cultural, socioeconomic and eco sensitive environments
Essential Reading	1. Rubin. E. S, Introduction to Engineering and the Environment, McGraw Hill, 2000. 2. Masters. G. M., Introduction to Environmental Engineering & Science, Prentice Hall, 1997.
Supplementary Reading	1. Henry. J. G, and Heike, G. W, Environmental Science & Engineering, Prentice Hall International, 1996. 2. Dhameja. S. K, Environmental Engineering and Management, S. K. Kataria and Sons, 1999. 3. Shyam Divan and Armin Rosancranz, Environmental Law and Policy in India, Cases, Materials and Statutes, Oxford University Press, 2001.

Course Name	SystemsThinkingforDesign	Course Code	DS2000			
Offered by Department	SIDI	Structure(LTPC)	1	2	0	3
To be offered for	B.Tech	Course Type	Core			
Pre-requisite	Sociology of Design	Approved In	Senate-43			
Learning Objectives	Designforeffectiveness –Level 1					
Learning Outcomes	Thiscoursewillhelpstudentsunderstand • Theimportanceofmodelingsystemstorealizeeffectivedesigns • Abstractionof keyelements fromproblemsituations Useofspecifictechniquestomodel problemsinaholisticmanner					
Contents of thecourse	•Real-worldproblems&theneedforinter-disciplinaryapproaches [2] •Basicconceptsofsystemsthinking(parts,relations,patterns)[6] •Technique#1:RichPictures •Technique#2:MappingStakeholder,Needs,Alterables,Constraints[6] •Technique#3:StructuralModeling(Hierarchicaldecomposition)[6] Technique#4:InfluenceDiagrams(Self-regulatingsystems)[6]					
Essential Reading	1. Hitchins,DerekK. (2007) SystemsEngineering:A21stCenturySystemsMethodology,JohnWiley,ISBN :978-0-470-05856-5. 2. Wilson,Brian(1991)Systems:Concepts,MethodologiesandApplications.2ndEdition,Wiley.ISBN:04719 27163. Hutchinson,William;SystemsThinkingandAssociatedMethodologies,PraxisEducation.ISBN:0 646 34145 6.					
Supplementary Reading	1. GeraldWienberg(2001),Anintroductiontogeneralsystemsthinking,DorsetHousePublishing. 2. Sage,A.P.(1977);MethodologyforLargeScaleSystems,McGrawHill,New York.					

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Course Name	Object Oriented Programming	Course Code	CS2000			
Offered by Department	Computer Science and Engineering	Structure (LTPC)	2	0	4	4
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	The course introduces students to the object oriented programming paradigm and its benefits in application development. Both C++ and Java would be used as implementation platforms for the various object oriented features.					
Learning Outcomes	• To understand Object Oriented Concepts for Software Design • To analyse various aspects of Software Design in a reusable and secure fashion • To create applications supporting a command line & graphical user interface in Object Oriented fashion.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Object oriented programming – Encapsulation – Constructors – Destructors - Composition – Friend functions/classes – this pointer + Dynamic memory management (8L) • Operator overloading Reusability – Inheritance – Base & derived classes – Protected members – Constructors – Destructors in derived classes – public/private/protected inheritance – Polymorphism (9L) • Virtual functions - Templates – Function & Class templates – Streams – Stream Input Output Stream format states – Manipulators – Exception handling – Re-throwing exceptions –specifications–and exception handling – Inheritance – STL (9L) • Event handling, Applets, Frames, Buttons, Menu – visual design layout, Multithreading, Networking, Database connectivity support (10L)					
Learning Outcomes	• To introduce the basic understanding of digital representation, Boolean algebra and the operation of the logic components, combinational and sequential circuits, and to introduce the analogy device concepts like diode, FET and op-amp. • To understand Digital Number systems, fixed and floating point representation and arithmetic operations. • To Use Boolean Algebra and Switching theorems for Logical manipulation. • To implement Combinational Circuits using Primitive gates and logic functions. • To implement sequential circuit elements and finite state machines. • To design various circuits using Op-Amp 741 such as summing, difference, average, logarithmic amplifiers etc. Practice component will test drive the concepts covered in theory using C++/Java approximately for 14 sessions in the semester [Overall 36 Hours Theory + 28 Hours for lab.]					
Essential Reading	1. De ISI 2. De ISI					
Supplementary Reading	1. Da 978 2. He 978 3. He 978					

Course Name	Digital System Design	Course Code	CS2001			
Offered by Department	Computer Science and Engineering	Structure (LTPC)	3	1	0	4
Offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	To introduce the basic understanding of digital representation, Boolean algebra and the operation of the logic components, combinational and sequential circuits, and to introduce the analogy device concepts like diode, FET and op-amp.					
Learning Outcomes	• To understand Digital Number systems, fixed and floating point representation and arithmetic operations. • To Use Boolean Algebra and Switching theorems for Logical manipulation. • To implement Combinational Circuits using Primitive gates and logic functions. • To implement sequential circuit elements and finite state machines. • To design various circuits using Op-Amp 741 such as summing, difference, average, logarithmic amplifiers etc.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Digital Circuits:Number Representation: Fixed point and floating point, 1's and 2's complement. Switching Theory: Boolean algebra, switching functions, Truth Tables and Algebraic forms, Simplification of Boolean expressions – Algebraic methods, canonical forms and Minimization of functions using K-Maps. (5L,1T) • Binary Codes: BCD, Gary, Excess 3, Alpha Numeric codes and conversion circuits. (3L,1T) • Arithmetic circuits: Binary adders and sub tractors, multipliers and division, ALU. (5L,2T) • Synthesis of combinational logic functions using MSIs: mux/demux, decoders/encoders, Priority encoders, Comparators. (2L,2T) • Sequential Circuits: Latches and Flip-Flops: SR, JK, D, T; Excitation tables. (2L,1T) • Shift Registers, Counters, Random Access Memory. (3L,1T) • Synchronous sequential circuits: Finite State Machines- Mealy & Moore types- Basic design steps- Design of counters, sequence generators, and sequence detectors - Design of simple synchronous machines – state minimization. (8L,3T) • Analog Circuits: Diodes – Basics and Circuits – Clippers, Clampers, rectifiers. (3L,1T) • Operational amplifiers (op-amp) – Basics and op-amp circuits – non inverting and inverting amplifiers – Signal offset. (4L,1T) • Analog to Digital and Digital to Analog Conversion and circuits, Applications of Digital ICS: 555 Timer, V to F converters, Introduction to Logic Families, Noise in Digital System. (7L,1T)					
Essential Reading	1. M. Mano and C. Kime, "Logic and Computer Design Fundamentals," Prentice Hall, Upper Saddle River, NJ, 4 th Edition, ISBN-13 : 978-9332518728, 2008. 2. B. Razavi, "Fundamentals of Microelectronics," Wiley Student Edition, ISBN: 978-1-118-15632-2, 2010.					
Supplementary Reading	1. Sedra and Smith, Microelectronic Circuits, 7 th Edition, ISBN-13 : 978-0198089131, Oxford University Press, 2013. 2. J. F. Wakerly, "Digital Design - Principles and Practices," 3 rd Edition, Pearson, ISBN-13 : 978-9332508125, 2008. 3. M. M. Mano, "Digital Design," PHI, ISBN-13: 978-0-13-277420-8, 1979. 4. S. Franco, "Design with Operational Amplifiers and Analog Integrated Circuits," McGraw-Hill Series in Electrical and Computer Engineering, 4th Edition, ISBN-13 : 978-0072320848, 2015. 5. R. J. Tocci, N. S. Widmer, and G. L. Moss, "Digital Systems Principles and applications," Pearson Prentice Hall,10 th Edition, ISBN-13 : 978-0135103821, 2010.					

Course Name	Design and Analysis of Algorithms	Course Code	CS2002			
Offered by Department	Computer Science and Engineering	Structure (LTPC)	3	1	0	4
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	• To design time or space efficient algorithms using well known paradigms. • To understand the limitations of computing machines. • To explore tractable vs intractable problems.					
Learning Outcomes	• To design efficient algorithms using paradigms such as divide and conquer, dynamic programming, greedy method etc. • To differentiate easy vs hard problems. • To design polynomial-time algorithms with proof of correctness.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Review of time/space complexity – recurrence relations – recurrence tree method – master's theorem (5L,2T) • Incremental and decremental strategies – divide and conquer – case studies – lower bounds for sorting (5L,3T) • Greedy Method – Container loading – knapsack – scheduling – coin change – proof of correctness (8L,2T) • Dynamic programming – matrix chain, optimal binary search tree, travelling salesman, LCS, knapsack, greedy vs dynamic programming – Principle of optimality, overlapping sub problems – Dynamic programming vs Divide and Conquer (8L,2T) • Graph algorithms – Topological sort – Shortest path algorithms – Dijskstra's Algorithm, – Bellman-Ford's Algorithm – minimum spanning tree – Principle of optimality (8L,2T) • Tractability - Introduction to NP-completeness – NP, NP-hardness, polynomial-time reductions (6L,1T) • Coping with intractable problems - Branch and bound – Back tracking – case studies (5L,1T) • Solvable vs Unsolvable problems – Halting problem, Reducibility to Halting problem (3L)					
Essential Reading	1. T. H. Cormen, C. E. Leiserson, and R. L. Rivest, "Introduction to Algorithms," Prentice Hall India, 2 nd Edition, 2001. ISBN 978-0-262-53305-8 2. E. Horowitz, S. Sahni, and S. Rajasekaran, "Computer Algorithms," 2 nd Edition, Galgotia Publications, 2007. ISBN 0-7167-8316-9					
Supplementary Reading	1. Aho, Hopcroft, and Ullmann, "Data Structures & Algorithms," Addison Wesley, 1983. ISBN13: 9780201000238 2. Algorithm Design , Eva Tardos and Kleinberg, Pearson, 2006, ISBN-13 : 978-0321295354					

Course Name	Digital System Design Practice	Course Code	CS2003			
Offered by Department	Computer Science and Engineering	Structure	0	0	4	2
To be offered for	B.Tech	Course Type	Core			

Prerequisite	NIL	Approved In	Senate-44
Learning Objectives	To provide hands on design and implementation of analogy and digital circuits. Students will build simple digital systems on general purpose PCBs.		
Learning Outcomes	• To implement and verify logic circuits • To implement and verify arithmetic circuits using discrete components • To implement and verify digital systems using Combinational/ Sequential elements • To implement and verify analog circuits		
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Design and implementation of logic functions, combinational circuits (code converters, half & full adders, comparator, ripple carry adder, priority encoder, Decoders, Seven segment display, multiplexer) • Design of sequential Circuits. • Design of 4-bit ALU (Adder, subtract or, logic and shift operations). • Design project • Static characteristics of rectifiers and filters, clipping and clamping circuits, Op-Amp based amplifier circuits. • Design and implementation of a digital system.		
Essential Reading	1. S. Franco, "Design with Operational Amplifiers and Analog Integrated Circuits," McGraw-Hill Series in Electrical and Computer Engineering, 4th Edition, ISBN-13: 978-0072320848, 2015. 2. S. Brown and Z. Vranesic, "Fundamentals of Digital Logic with VHDL Design," TMH, 2nd Edition, ISBN-13 : 978-0077221430, 2008.		
Supplementary Reading	1. R.J. Tocci, N. S.Widmer, and G. L. Moss, "Digital Systems Principles and applications," Pearson Prentice Hall, 10 th Edition, ISBN-13 : 978-0135103821, 2010. 2. D. A. Neaman, "Electronic Circuits," TMH, 4 th Edition ISBN-13 : 978-0070634336, 2006.		

Course Name	Design and Analysis of Algorithms Practice	Course Code	CS2004				
Offered by Department	Computer Science and Engineering	Structured (T/ P/ O)	L	T	P	C	VHDL
			0	0	4	2	
To be offered for	B.Tech	Course Type	Core				
Prerequisite	NIL	Approved In	Senate-44				
Learning Objectives	• To design time or space efficient algorithms using well known paradigms. • To understand the limitations of computing machines. • To explore tractable vs intractable problems.						
Learning Outcomes	• To design efficient algorithms using paradigms such as divide and conquer, dynamic programming, greedy method etc. • To differentiate easy vs hard problems. • To design polynomial-time algorithms with proof of correctness.						
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• The laboratory component will require the student to write computer programs using a careful choice of data structures and algorithmic paradigms (in C++/Java language) from scratch, based on the concepts learnt in the theory course. • Case studies in respect of different paradigms discussed in theory shall be implemented in C++/Java • Paradigms – Divide and conquer, dynamic programming, greedy, backtracking.						
Essential Reading	1. T. H. Cormen, C. E. Leiserson, and R. L. Rivest, "Introduction to Algorithms," Prentice Hall India, 2 nd Edition, 2001. ISBN 978-0-262-53305-8 2. E. Horowitz, S. Sahni, and S. Rajasekaran, "Computer Algorithms," 2 nd Edition, Galgotia Publications, 2007. ISBN 0-7167-8316-9						
Supplementary Reading	1. Aho, Hopcroft, and Ullmann, "Data Structures & Algorithms," Addison Wesley, 1983. ISBN13: 9780201000238 2. Algorithm Design , Eva Tardos and Kleinberg, Pearson, 2006, ISBN-13 : 978-0321295354						

<table>
<tr><td>Course Name</td><td>Smart ProductDesign</td><td>Course Code</td><td colspan="4">DS2001</td></tr>
<tr><td>Offered by Department</td><td>SIDI</td><td>Structure(LTP C)</td><td>1</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td>To be offered for</td><td>B. Tech</td><td>Course Type</td><td colspan="4">Core</td></tr>
<tr><td>Prerequisite</td><td>SystemsThinking forDesign</td><td>Approved In</td><td colspan="4">Senate-43</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 contextsensitive</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 chosenproduct 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>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Module 1: Introduction to intelligence behaviour (9 hours)
• Definition of intelligence
• Dimensions of intelligence
• Levels of intelligence

Module 2: Architecture for intelligent behaviour (15 hours)
• Functional arch for Intelligent Behaviour (Intelligence and information
• intensity relation (equilibrium, amplification))
• Biological metaphors for cyber-physical systems (Bio-inspired adaptive
• systems (Positive and negative feedback)
• Theory of living systems (Self evolve, self-improve, self-aware (e.g., self-configuration, -organization, -optimization) properties)

Module 3: Selection of appropriate AI Techniques (18 hours)
Rule-based systems - Fuzzy inferencing - Artificial neural networks -
• Evolutionary computation -
• determine which type of intelligent system methodology would be suitable
• for a given type of application problem
• Demonstrate a working prototype, in the form of a major project work, the
• ability to design and develop an intelligent system for a selected application.
• Poster Session
• Evaluation: Continuous assessment (40%); Final concept presentation (20%); EndSem(40%)</td></tr>
<tr><td>Essential & Supplementary Reading</td><td colspan="6">1. Donald A Norman (2007), The design of future things, Basic Books, New York
2. Dario Floreano and Claudio Mattiussi (2008), Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, MIT Press
3. Michael Negnevitsky (2005), Artificial Intelligence: A Guide to Intelligent Systems, Second Edition, Addison Wesley</td></tr>
</table>

Course Name	Computer Organization and Architecture	Course Code	CS2007			
Offered by Department	Computer Science and Engineering	Structure(LTPC)	3	1	0	4
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	The course aims to introduce various aspects of computer organization such as Instruction format, Instruction codes, Addressing Modes, processor design and hierarchical memory design, Input and Output Interface design using Programmed Controlled and Interrupt Control way					
Learning Outcomes	• Understand the organization of a Computer system and ISAs • Apply the knowledge of combinational and sequential logical circuits to design computer architecture. • Understand the input / output and Memory related concepts. • Analyse the performance of different scalar Computers • Develop the Pipelining Concept for a given set of Instructions • Distinguish the performance of pipelining and non-pipelining environment in a processor					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Introduction: function and structure of a computer, functional components of a computer, performance of a computer system. Instruction set architectures – CISC and RISC architectures. (5L,1T) • Instructions: Language of the Computer, Operations of the Computer Hardware, Operands of the Computer Hardware, Representing [illegible]uctions in the Computer, Logical Operations Instructions for Making D[illegible]ons, addressing Modes, Parallelism & Instructions. (5L,1T) • Arithn[illegible] Design: – Carry look ahead adder, Wallace tree multiplier, Floating–point adder/sub tractor, Division. (5L,2T) • The Processor: Logic Design Conventions, Building a Data path, A Simple [illegible]plementation Scheme (3L,1T) • An Overview of Pipelining, Pipelined Data pa[illegible] and Control, Data Hazards: Forwarding versus Stalling, Control Hazards, Ex[illegible]ions and Parallelism via Instructions. (7L,2T) • [illegible] • [illegible] n • Input/output Unit: access of I/O devices, I/O ports, I/O control mechanisms – Program Controlled I/O. Interrupt controlled I/O and DMA controlled I/O; I/O interfaces – Serial port, parallel port, USB port, SCSI bus, PCI bus; I/O peripherals – Keyboard, display, secondary storage devices. (8L,2T)					
Essential Reading	1. Patterson and Hennessy, "Computer Organization and Design," Morgan Kaufmann, 5 th Edition, ISBN-13 : 978-8131222744, 2013. 2. C. Hamacher, Z. Vranesic, and S. Zaky, "Computer Organization," Tata McGraw Hill, 5 th Edition, ISBN-9789339212131, 2002.					
Supplementary Reading	1. J. P. Hayes, "Computer Architecture and Organization," Tata McGraw Hill,ISBN-13 : 978-1259028564, 2017. 2. M. J. Murdocca, V. P. Heuring, "Computer Architecture and Organization - An Integrated Approach," John Wiley & Sons Inc., ISBN-13:978-0471733881, 2007. 3. A. S. Tanenbaum, "Structured Computer Organization," Prentice Hall, 5th Edition, ISBN-13 : 978-0132916523, 2006.					

Course Name	Database Systems	Course Code	CS2008			
Offered by Department	Computer Science and Engineering	Structure(LTPC)	3	1	0	4
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	Objective of the course is to equip students with skillsets required for database design and implementation. Various concepts such as ER modelling, Schema Mapping, Normalization, Lossless Join etc. would be explored to help in efficient an and effective databases.					
Learning Outcomes	• To appreciate the systematic design and principals involved in any database development. • To understand the Importance of canonical normal forms and its design in large scale database systems • To design and implement Database with formal analysis and design thinking					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Introduction to Database Systems, Database System Architecture, Schema, Database Models, Relational Model, ER Modelling and case studies. (7L,2T) Expressive power of relational databases, Relational Algebra (5L,2T) Database Languages, DDL, DML, Structured Query Language (SQL), SQL views, case studies (8L,3T) Database Design, Normal Forms (First to third normal form), Boyce codd Normal Form, Database decomposition, Functional Dependencies, Loss-less Join decomposition (8L,2T) Transaction Processing and Concurrency control (4L,1T) Internal schema Design, Indexing, B-trees, B+ trees (5L,2T) Introduction to advanced concepts like Data mining, Data warehousing, XML(5L)					
Essential Reading	1. R. Elmasri and S. B. Navathe, "Fundamentals of Database Systems," Pearson, 7th Edition, 2016, ISBN 9789332582705					
Supplementary Reading	1. A. Silberschatz, H. F. Korth, and S. Sudharsan, "Database System Concepts," Tata McGraw Hill, 6th Edition, 2011, ISBN 9332901384. 2. C. J. Date, A. Kannan, and S. Swamynathan, "An Introduction to Database Systems," Pearson, 8th Edition, 2006, ISBN 978-0321197849					

Course Name	Theory of Computation	Course Code	CS2009			
Offered by Department	Computer Science and Engineering	Structure(LTPC)	3	1	0	4
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	This course aims to provide fundamentals of computing models such as finite state automata, push down automata, linear bounded automata and Turing machine. Powers and limitations of the models will also be discussed. Solvability and Tractability will be introduced through Turing machine					
Learning Outcomes	• To design various computational models useful for solving problems					

	• To understand the relationship among digital computer, algorithm and Turing machine. • To verify whether a given problem is solvable or tractable.
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Finite Automata & Regular Languages - (10L,3T) • Languages vs Problems. Finite State Automata, Regular Languages. Closure properties, Limitations, Pumping Lemma, Myhill-Nerode relations, Quotient Construction. Minimization Algorithm. • Non-determinism, Regular Grammar & Regular Expressions - (10L,3T) • Notion of non-determinism. Acceptance condition. Equivalence of NFA and DFA. Regular Grammar and NFA, Pattern matching and regular expressions. Regular Expressions and Regular languages. More closure properties of regular languages. • Push Down Automata & Context-free Languages (CFLs) - (12L,4T) • Grammars and Chomsky Hierarchy, CFLs, Chomsky Normal Form, Pumping Lemma for CFLs, Inherent Ambiguity of Context-Free Languages, Cock-Younger-Kasami Algorithm, Applications to Parsing. Pushdown Automata (PDA), PDA vs CFLs. Non-equivalence of Deterministic and non- deterministic versions of PDA. Deterministic CFLs. • Linear Bounded Automata, Turing Machines & Computability - (12L,4 T) • Introduction to Linear Bounded Automata (LBA), Turing Machines. Context Sensitive Language Vs LBA. Turing Machine vs Phrase Structure Language. Multi-tape Turing machines. Recursive and Recursively enumerable languages. Undecidability of Halting Problem. Reductions. Introduction to Theory of NP-completeness.
Essential Reading	1. Introduction to Automata Theory, Languages and Computation, Hopcroft, Motwani, and Ullman, Pearson Publishers, Third Edition, ISBN: 9780321455369, 2006.
Supplementary Reading	1. Elements of the Theory of Computation, H. R. Lewis and C.H. Papadimitriou, Prentice Hall Publishers, ISBN. 0-13-2624 78-8, 1981 2. Introduction to Languages and the Theory of Computation, John. C. Martin, Tata McGraw-Hill, ISBN 978-00731914612003.

Course Name	Computer Organization and Architecture Practice	Course Code	CS2010			
Offered by Department	Computer Science and Engineering	Structure(LTP C)	0	0	4	2
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	Exposure to assembly language programming, instruction set design, and processor design for a given instruction set are given. Assembler macros, interrupt service routines, and simple device driver programs would also be introduced. Computer system design concepts are introduced.					
Learning Outcomes	• Assembly Language Instructions and programming • Machine code based program execution • Input and output device interfacing and programming • Programming Interrupt service routines • Writing device driver program to control and monitor the peripheral device					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Exercises will mainly involve writing the assembly language programs - Execution of assembly language programs: Single–step, break points, Accessing the contents of registers, accessing the contents of memory locations - Implementation of higher level language assignment statements with arithmetic expressions and logical expressions - Implementation of control transfer statements. Macros - Software interrupts - Operating system function calls - Interrupt service routines - Simple device drivers - Assembly language programming in Clanguage. I/O interfacing and programming. Computer System Design.					

Essential Reading	1. Patterson and Hennessy, "Computer Organization and Design," Morgan Kaufmann, 5 th Edition, ISBN-13 : 978-8131222744, 2013.
Supplementary Reading	1. C. Hamacher, Z. Vranesic, and S. Zaky, "Computer Organization," Tata McGraw Hill, ISBN-9789339212131, 2002.

Course Name	Database Systems Practice	Course Code	CS2011			
Offered by Department	Computer Science and Engineering	Structure(LTP C)	0	0	4	2
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	The focus of this course is on database design, architecture, and relational models. Normal forms, internal schema design would also be explored. This course introduces SQL programming. Database design preserving functional dependencies and loss-less decomposition properties would be addressed.					
Learning Outcomes	• Conceptual design using ER diagrams, programming using structured query language, Ability to Design and Implement Database based on formal guidelines • Students would also be equipped with skills required for basic application development involving database connectivity.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Introduction to SQL. Schema, table creation using SQL, Data definition and data manipulation using SQL. Implementation of set theoretic operations on databases. Views using SQL. Implementation of algorithms related to functional dependencies and loss-less decomposition. Indexing using B-trees and B+ trees (creation, insertion, deletion). Assignment/Mini project-based application design and development involving database					
Essential Reading	1. R. Elmasri and S. B. Navathe, "Fundamentals of Database Systems," Pearson, 7th Edition, 2016, ISBN 9789332582705					
Supplementary Reading	1. A. Silberschatz, H. F. Korth, and S. Sudharsan, "Database System Concepts," Tata McGraw Hill, 6th Edition, 2011, 978-0321197849 2. C. J. Date, A. Kannan, and S. Swamynathan, "An Introduction to Database Systems," Pearson, 8th Edition, 2006, ISBN 978-0321197849					

Course Name	Introduction to Data Science for Engineers	Course Code	CS3006			
Offered by Department	Computer Science and Engineering	Structure(LTP C)	3	0	2	4
Offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	This course covers the basic concepts of Data Science to help the student to learn, understand and practice data analytics encompassing concepts from descriptive, inferential statistics and predictive techniques and big data concepts.					
Learning Outcomes	• Ability to identify the characteristics of datasets; Ability to select and implement machine learning techniques suitable for the respective application; • Ability to solve problems associated with big data characteristics such as high dimensionality; • Ability to integrate machine learning libraries and mathematical and statistical tools					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Introduction to relevant industry applications and analytics – Descriptive Statistics – Data Visualization & Interpretation -Measures of Central Tendency & Dispersion - Basic and advanced plots such as Stem-Leaf Plots, Histograms, Pie charts, Box Plots, Violin Plots etc. – Merits of Demerits & Interpretation (10) • Inferential Statistics – Hypothesis Testing - Tests of Significance – Analysis of Variance - Regression – Linear and Logistic (8) • Predictive Analytics – Supervised and Unsupervised – Association Rules, Classification, Clustering, Outlier Analysis, Time Series Modelling (14) • Big Data Characteristics – Map Reduce – Deduplication, Distributed Storage, Implementation using Hadoop / Pyspark platforms (8) • Practice Component**:** Concepts from Descriptive Statistics, Inferential and Predictive Analytics would be test driven using platforms such as Python, R etc. ML support in these platforms for rule mining and application, classification & clustering algorithms etc. would also be test driven as part of the practice exercises. Modern technologies for big data handling such as Pyspark – support for Map reduce would also be test driven. Applications relevant to the student's stream of Offered by Department would be explored for exercises / course project as case studies. (14 sessions – weekly exercises)					
Essential Reading	1. J Han, M Kamber, Data Mining Concepts & Techniques, Elsevier, 3rd Edition, 2007, ISBN 9780123814791					
Supplementary Reading	1. Joel Grus, Data Science from Scratch, Orielly, 2ndEdn, 2019, ISBN 9781492041139 2. Leskovec, AnandRajaraman,, Ullmann, Mining of Massive Data Sets, Cambridge University Press, Open Source free version , ISBN 9781107015357 3. P Bruce, Practical Statistics for Data Scientists, O'Reilly, 2017, iSBN 9789352135653					

Course Name	EntrepreneurshipandManagement Functions	Course Code	DS3000			
Offered by Department	SIDI	Structure(LIPC)	1	2	0	3
To be offered for	B.Tech	Course Type(Core/Elective)	Core			

Prerequisite	SystemsThinkingandDesign	Approved In	Senate-43
Learning objectives	The objective of this course is toprovide engineering students an exposure tothe basic conceptsofentrepreneurshipandmanagement,withaspecificfocusontheprocessofturninganideaint oacommerciallyviableventure.		
Learning Outcomes	Attheendofthecourse,thestudentswilllearnhowto • Understand the market competition • Prepareabusinesscaseforthe product/Idea		
Contentsofthe course	Module1:Introduction • Divisionoflaborandcreationofvalue • Evolutionoforganizations,industriesandsectors,forprofitandnon-profit • RoleofEntrepreneursandManagersinvaluecreation • PrinciplesofManagement-Planning,Organizing,Resourcing,Directing (4) Module2:Strategy&Planning • Understandingindustrydynamics&competition(Porter'sFramework) • Understandingtheindustryvaluechainandfirmpositioning (6) Module3:Organizing • Typicalorganizationalfunctions(R&D,Marketing&Sales,HR,Operations) • Cyberneticsoforganizationalfunctions(StaffordBeer'sviablesystemsmodel) • Typesoforganizationstructures(product,functional,matrix,global) (6) Module4:ResourceManagement • Financialmanagement(Sourcesoffunding,howtoreadaP&L,balancesheet) • Humanresourcemanagement(Interviewing,compensation,motivation) • Globalsourcingandsupplychainmanagement (8) Module5:ManagementInformation&DecisionMaking (4) Module6:LegalandRegulatoryenvironment (4)		
Essential Reading	1. PeterFDrucker,*ThePracticeofManagement*,HarperCollins,2006,ISBN:978-0060878979 2. HentryMintzberg,*Managing*,Berret-KoehlerPublishers,2009,ISBN:978-1605098746 3. MichaelPorter,*Oncompetition:UpdatedandExpandedEdition*,HBS,2008,ISBN:978-1422126967 4. VasantaDesai,*DynamicsofEntrepreneurialDevelopmentandManagement*,HimalayaPublishingHouse,ISBN:9788183184113.		
Supplementary Reading	1. WalterIsaacson,*SteveJobs*,2011,ISBN:978-1451648539 2. EricRies,*TheLeanStartup*,PortfolioPenguin,2011,ISBN:978-0307887894 3. VineetBajpai,Buildfromscratch,Jaicobooks,2013,ISBN:9788184952919.		

Course Name	Operating Systems	Course Code	CS3000			
Offered by Department	Computer Science and Engineering	Structure(LTP C)	3	1	0	4
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	This first level course focuses on exposing students to the purpose, structure and functions of an operating system. Operating systems abstraction, mechanisms and their implementation support for concurrency (threads) and synchronization, resource management, scheduling strategies, etc. are explored.					
Learning Outcomes	• Sound understanding of basic concepts relating to the design and implementation of an operating system. • Specifics relating to scheduling, multithreading, synchronization, etc. to understand the structure of the operating system (Linux), at the concept and the source code level. • Ability to use Kernel API support to implement various features to be supported by an OS					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Functionalities & Services of an Operating System – System Calls & Types - Process Concept – Process Control Block – Linux System calls for Process creation, Inter Process Communication using Shared memory / Message passing. (10L,2T) Concurrency – Multithreaded programming – benefits, challenges, models, Pthreads library in Linux – thread creation, cancellation, thread specific data, Thread pools, Signal handling, Scheduling – Pre-emptive, Non pre-emptive algorithms FCFS, SJF, SRT, RR – Thread scheduling – contention scope, pthread support for scheduling. (11L,3T) Synchronization – Race condition – Critical Section Problem, Solution, Mutex Locks and Semaphores – Priority Inversion, Pthreads synchronization - Producer Consumer problem (multi-threaded) example Deadlock characterization – Resource graph – Avoidance & Prevention – Safe state – Bankers algorithm – recovery schemes. (10L,3T) Memory management – logical v/s physical address space – Segmentation, Paging, Page table structures, Virtual memory, Page replacement strategies, File Systems – file operations, types, access methods, Directory structure, Mounting file systems. (11L,3T) Introduction to operating systems for hand held devices - RTOS, Free RTOS					
Essential Reading	1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts, John Wiley, 9 thEdn, 2015, ISBN 978-0471694663					
Supplementary Reading	1. Andrew S Tanenbaum, Modern Operating Systems, Prentice Hall, 2009, ISBN 9788120339040 2. Stallings. W, Operating System: Internals and Design Principles, Prentice Hall, 2011, ISBN 9332518807 3. Gary Nut, Operating Systems: A Modern Perspective, Addison Wesley, 2003, ISBN 978-0201773446					

Course Name	Computer Networking	Course Code	CS3001			
Offered by Department	Computer Science and Engineering	Structure(LTP C)	3	1	0	4
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	To introduce the basics of computer networking, error detection and correction techniques, and flow control techniques. Also an exposure to IP addressing and routing and its associated protocols would be given. A highlight of various application layer protocols and its relevance in modern networking world would be discussed.					
Learning Outcomes	• To design a local area network and analyse the network using performance metrics. • To appreciate the importance of subnetting, masking, and nuances involved in setting up a campus network.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Evolution of computer networks, creating a small network, Data transfer between nodes, encoding of bits in physical layer, NRZ, Manchester, Differential Manchester, Performance evaluation of a network: propagation delay, transmission delay, RTT, effective bandwidth. (10L,3T) • Error detection techniques in Data link layer (LRC, CRC, two dimensional parity check), Hamming Error correcting codes. Data transfer between nodes using stop and wait protocol, sliding window protocol (Go-back-n and selective					

	reject), performance analysis of stop and wait and sliding window protocols. Flow control at data link layer. Introduction to layer-2 devices (switches, bridges) and addressing scheme at Layer-2 (MAC addresses). (10L,3T) • Creating a small network using Ethernet (IEEE 802.3) Token Ring (IEEE 802.5), Performance evaluation of IEEE 802.3 and 802.5 networks. Introduction to Layer-3 devices, IP addresses, IPv4, IPv6, Error detection at layer-3 using Checksum. IP addressing schemes, subnetting, CIDR (10L,3T) • Introduction to TCP/IP, IP routing, RIP, OSPF, Circuit and Packet switching, ICMP, • Introduction to networking commands: Ping, Traceroute, Ipconfig, UDP, congestion control and avoidance. (10L,3T) • Introduction to DHCP, FTP, HTTP(s) and other application layer protocols, Introduction to Network security. (5L)
Essential Reading	1. Larry L.Peterson and Bruce S Davie, Computer Networks: A systems Approach,Morgan, 5th Edn, 2011. ISBN: 9780123850591 2. William Stallings, Data and Computer Communications, 10th Edn, Pearson, 2017. ISBN: 9780133506488
Supplementary Reading	1. Andrew S. Tanenbaum, Computer Networks, 5th Edn, 2014. ISBN: 9788131770221 2. Behrouz Forouzan, TCP/IP protocol suite, Tata McGraw Hill, 4th Edn, 2010. ISBN: 9780070706521

Course Name	Compiler Design	Course Code	CS3002			
Offered by Department	Computer Science and Engineering	Structure(LTP C)	3	1	0	4
Offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	The objective of this course is to train students to design various phases of compiler such as Lexical analyser, syntax analyser, semantic analyser, intermediate code generator, code optimizer and code generator. Students are also exposed to design compiler construction tools such as Lexical Analyser generator and parser generator. Applications of finite state machine and pushdown automation in compiler design are also taught in this course.					
Learning Outcomes	• At the end of the course, students will be able to design a programming language and compiler for the same. • Students will also be able to write large programs.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Need of compiler-cross Compiler-Introduction to phases of compiler –Lexical Analyser Design using DFAs —regular expression and its application to give syntax of word –Automatic design of Lexical Analyser from regular expression, Construction of NFA without epsilon moves from regular expression- Efficient Lexical analyser using Minimization of automata- limitation of recognition capability of Lexical analyser using Pumping lemma (12L,3T) • Context free grammar & its application to give syntax of program statement – Types of parsing – Top down & bottom up–Recursive descent– Predictive–Shift reduce–Operator precedence–SLR (10L,3T) • Semantic analysis - Intermediate code generation: Declaration – Assignment statements – Boolean expressions– looping and branching statements (7L,2T) • Back patching and procedure calls code generator design issues – Runtime storage management – Code Optimization: Basic blocks – Flow graphs – Next use information – Code generator case study – Directed acyclic graph representation of basic blocks – Peephole optimization technique Introduction to code optimization (10L,3T) • Storage optimization & allocation strategies). Assembly Code Generation: from syntax tree and Directed acyclic graph - from three address code. (5L,1T)					

Essential Reading	1. Alfred Aho, Ravi Sethi and Jeffrey D Ullman, Compilers Principles, Techniques and Tools, Pearson Education, 2003. ISBN: 9780321491695
Supplementary Reading	1. Levine J.R, Mason T, Brown D, Lex &Yacc, OReilly Associates, 1992 ISBN: 9781565920002. 2. Allen I. Holub, Compiler Design in C, Prentice Hall, 2003. ISBN: 9780131550452

Course Name	Operating System Practice	Course Code	CS3003			
Offered by Department	Computer Science and Engineering	Structure(LTP C)	0	0	4	2
To be Offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	The course aims to equip the student with implementation level constructs / support in Linux for various concepts such as process management, concurrency, scheduling, deadlock avoidance, etc.					
Learning Outcomes	● To relate the operating system concepts listed above to the Linux operating system and support for the same available through various system calls. ● To use LINUX Kernel Support for various features such as multiprocessing multithreading etc. ● To Test Drive various Features of an OS relating to application scenario					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Linux System Calls for process creation, management – Applications such as command prompt simulator using fork – Interposes Communication using Shared Memory and Pipes – Producer Consumer – Applications using pipes / shm – Concurrency – Multithreading – Pthread support – Applications such as merge sort, min-max average, etc. in a multi-threaded fashion – Scheduling – pthread interfaces setschedpolicy – getschedpolicy based applications – Synchronization – threaded solution for classical problems like dining philosophers, readers writers, etc. using mutex locks and semaphores – Deadlock detection / avoidance algorithms.					
Essential Reading	1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts, John Wiley, 9 thEdn, 2015, ISBN 9788120399040 Robert Love, Linux Systems Programming, O Reilly Media, 2 nd Edition, 2013, ISBN 9781449339531.					
Supplementary Reading	2. D Butlar, J Farrell, B Nichols, Pthreads Programming, O Reilly Media, 1996, ISBN 9781565921153.					

Course Name	Computer Networking Practice	Course Code	CS3004			
Offered by Department	Computer Science and Engineering	Structure(LTP C)	0	0	4	2
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	To understand basic networking commands, MAC/IP addressing, file transfer between two systems, etc. Simulation of error control techniques and flow control techniques using well knownprotocols would be addressed as part of this course.					
Learning Outcomes	● To design, test and troubleshoot aspects associated withlocal area networking. ● To appreciate the importance of error detecting codes and flow control techniques.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Connecting two nodes using Ethernet cable and study the performance evaluation parameters such as delay, effective bandwidth - Basic Networking commands – Ping, IPConfig, Traceroute,NSlookup - Introduction to Socket Programming. File transfer using TCP. Echo, Chat betweentwo or more clients using socket programming - Simulation of Stop and Wait Protocol -Simulation of Stop and Wait protocol with NACK, Modelling of ACK, NACK drops, etc., -Modelling and simulation of Sliding window protocol - Sliding window protocol with ACK/NACK drops, frame drops etc., - Performance evaluation through simulation of IEEE 802.3/802.5 networks - Implementation of OSPF. Introduction to NS2/OPNET simulator, Case studies.					
Essential Reading	1. Larry L.Peterson and Bruce S Davie, Computer Networks: A systems Approach,Morgan, 5th Edn, 2011.ISBN: 9780123850591 2. William Stallings, Data and Computer Communications, 10th Edn, Pearson, 2017.ISBN: 9780133506488					
Supplementary Reading	1. Andrew S. Tanenbaum, Computer Networks, 5th Edn, 2014. ISBN: 9788131770221 2. Behrouz Forouzan, TCP/IP protocol suite, Tata McGraw Hill, 4th Edn, 2010. ISBN: 9780070706521					

Course Name	Compiler Design Practice	Course Code	CS3005			
Offered by Department	Computer Science and Engineering	Structure(LTPC)	0	0	4	2
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	The objective of this course is to train students to design various phases of compiler such as Lexical analyser, syntax analyser, semantic analyser, intermediate code generator, code optimizer and code generator. Students are also exposed to design compiler construction tools such as Lexical Analyser generator and parser generator. Applications of finite state machine and pushdown automation in compiler design are also taught in this course.					
Learning Outcomes	• At the end of the course, students will be able to design a programming language and compiler for the same. • Students will also be able to write large programs.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Lexical analyser implementation in C - Lexical analyser implementation using LEX tool Recursive descent parser implementation in C for an expression grammar - YACC and LEX based implementation for an expressions grammar - YACC implementation of a calculator that takes an expression with digits, + and * and computes and prints its value - Front end implementation of a compiler that generates the three address code for a simple language- Back end implementation of a compiler which takes the three address code (output of previous exercise) and results in assembly language instructions - Implementation of peephole optimization in C.					
Essential Reading	1. Alfred Aho, Ravi Sethi and Jeffrey D Ullman, Compilers Principles, Techniques and Tools, Pearson Education, 2003. ISBN: 9780321491695					
Supplementary Reading	1. Levine J.R, Mason T, Brown D, Lex &Yacc, OReilly Associates, 1992 ISBN: 9781565920002. 2. Allen I. Holub, Compiler Design in C, Prentice Hall, 2003. ISBN: 9780131550452					

<table>
<tr><td></td><td>Professional Communication</td><td>Course Code</td><td colspan="4">HS3000</td></tr>
<tr><td>Offered by Department</td><td>SH-English</td><td>Structure(LT PC)</td><td>1</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>To be offered for</td><td>B.Tech.</td><td>Course Type</td><td colspan="4">Core</td></tr>
<tr><td>Prerequisite</td><td>NIL</td><td>Approved In</td><td colspan="4">Senate-44</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• Develop the capability to apply for a job and participate in selection process
• Acquire interview skills
• Gain proficiency in language skills indispensable for a successful professional
• Develop emotional intelligence</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• Prepare résumé and cover letter
• Ready to perform at different levels of the interview process
• Able to use interpersonal skills in challenging situations
• Competent to draft various documents for specific purposes</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Preparing cover letter, résumé, digital profile; video profile; Email etiquette (L2, P4)
• Interview skills, Group discussion and impromptu speech (L2, P6)
• Social communication skills (L4, P6)
➢ Conversational English appropriateness, context based speaking in general situations, discussion and associated vocabulary in professional situations)
➢ Non-verbal communication – relevance and effective use of paralinguistic features – body language, chronemics, haptics, proxemics
➢ Emotional intelligence (EI) and social intelligence at workplace – theoretical perspectives and their application in relevant workplace situations – EI and leadership skills – assessments and best practices in organizations
• Conflict management and communication at workplace (L4, P6)
➢ Cross-cultural communication, Argumentation, negotiation, persuasion, decision making, case study of challenging situations
➢ Organizing a meeting, working as part of a team, briefing
➢ Business presentations – Preparing effective presentations, delivering presentations and handling questions
• Writing proposals, statement of purpose, research article, agreements, summary Proofreading (L1, P4)
• Training for proficiency assessment (L1,P2)</td></tr>
<tr><td>Essential&Supplementary Reading</td><td colspan="6">1. Tebeaux, Elizabeth, and Sam Dragga. The Essentials of Technical Communication. OUP, 2018.
2. Sabin, William A. The Gregg Reference Manual: A Manual of Style, Grammar, Usage, and Formatting. McGraw-Hill, 2011, pp 408-421.
3. Raman, Meenakshi and Sangeeta Sharma. Technical Communication: Principles and Practice. OUP, 2015.
4. Caruso, David R. and Peter Salovey. The Emotionally Intelligent Manager: How to Develop and Use the Four Key Emotional Skills of Leadership. John Wiley and Sons, 2004.
5. https://learnenglish.britishcouncil.org/business-english/youre-hired/episode-01
6. https://www.youtube.com/watch?v=HAnw168huqA
7. https://www.youtube.com/watch?v=azrqlQ_SLW8
8. https://owl.purdue.edu/owl/purdue_owl.html
9. Turabian,Kate L. Student's Guide to Writing College Papers. University of Chicago Press, 2010.</td></tr>
</table>

	Prototyping & Testing	Course Code	DS3001			
Offered by Department	SIDI	Structure(LT PC)	1	2	0	3
To be offered for	B.Tech	Course Type	Elective			
Prerequisite	NIL	Approved In	Senate-43			
Learning Objectives	The objective of the course is to help students develop rapid prototyping skills andrealize aminimumviableproduct					
Learning Outcomes	• Students will develop skills in rapid prototyping; project management and focusingondeliveringoutcomes					

Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	**1. Minimumviableproductplan(3hours)** ● Markets andNeeds ● Business Goals ● Keyfeatures **2. CoreProductArchitecture(6hours)** ● Storyboardingofthe product core. ● Frameworkformechanical,electronicsandcomputingparadigm **3. DesignforManufacture&Assembly(3hours)** ● ManufacturingProcess:Form ● Assemblyconstraints:Fit **4. DevelopingtheProofofConcept(30hours)** ● Build ● Assemble ● Iterate ● Validate ● Pitch Evaluation:Continuousassessment(80%);FinalPoCdemo (20%) 2 one-day hackathons may be organized during this period (one weekends) toacceleratePoC development
Essential & Supplementary Readings	1. How to Solve Big Problems and Test New Ideas in Just Five Days by **Jake Knapp,JohnZeratsky,BradenKowitz** 2. TheTotalInventorsManual: Transform YourIdeaintoaTop-SellingProduct by **SeanMichaelRagan** 3. PrototypingandModel makingforProductDesignby**BjarkiHallgrimsson** Bringing a Hardware Product to Market: Navigating the Wild Ride from ConcepttoMassProductionby **ElaineChen**