Curriculum for B.Tech

Computer Science and Engineering
With specialization in

Artificial Intelligence

(From The Academic Year 2020)

Approved in Senate 43 & 44

Indian Institute of Information Technology, Design and Manufacturing, Kancheepuram

Chennai-600 127

Curriculum & Syllabus

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
10	HS1001	NSO/NCC/SSG/NSS	HSC	0	0	2	P/F
							25.0

Semester 2							
S.No	Course Code	Course Name	Category	L	T	P	C
1	MA1001	Differential Equations	BSC	3	1	0	4
2	MA1002	Linear Algebra	BSC	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
9	HS1001	NSO/NCC/SSG/NSS	HSC	0	0	2	P/F
10	HS1002	Earth, Environment and Design	HSC	1	0	0	P/F
							25.0

Semester 3							
S.No	Course Code	Course Name	Category	L	T	P	C
1	MA2000	Optimization Techniques for Machine Learning	BSC	3	1	0	4
2	CS2005	Applied Data Science	PMC	3	0	2	4
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	HS2000	Indian Constitution, Essence of Indian Traditional Knowledge	HSC	1	0	0	P/F
							24.0

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Semester 4							
S.No	Course Code	Course Name	Category	L	T	P	C
1	MA2001	Probability and Statistics	BSC	3	1	0	4
2	CS2012	Artificial Intelligence	PMC	3	0	2	4
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	HS2001	Human Values and Stress Management	HSC	1	0	0	P/F
							24.0

Semester 5							
S.No	Course Code	Course Name	Category	L	T	P	C
1	CS3007	Pattern Recognition and Machine Learning	PMC	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	HS3000	Professional Ethics and Organizational Behaviour	HSC	1	0	0	P/F
							25.0

Semester 6							
S.No	Course Code	Course Name	Category	L	T	P	C
1	CS3008	Deep Learning	PMC	3	0	2	4
2	CS3009	Reinforcement Learning	PMC	3	0	2	4
3		Professional Major Elective Course 1	PME	3	1	0	4
4		Professional Major Elective Course 2	PME	3	1	0	4
5		Elective Course 1	ELC	3	1	0	4
6	HS3001	Professional Communication	HSC	1	0	2	2
7	HS3002	Intellectual Property Rights	HSC	1	0	0	P/F
							22.0

Semester 7							
S.No	Course Code	Course Name	Category	L	T	P	C
1		Professional Major Elective Course 3	PME	3	1	0	4
2		Professional Major Elective Course 4	PME	3	1	0	4
3		Elective Course 2	ELC	3	1	0	4

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4	CS4000	Internship	PCD				P/F
							12.0

Semester 8

S.No	Course Code	Course Name	Category	L	T	P	C
1		Elective Course 3	ELC	3	1	0	4
2	CS4001	Project in AI	PCD	0	0	16	8
							12.0

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Semester wise Credit Distribution

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

Curriculum & Syllabus

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	•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.					

Curriculum & Syllabus

Course Name	Engineering Electromagnetics	Course Code	MA1000			
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 cylindrical polar co-ordinates; Concept ofvector fields; Gradient of a scalar field; flux, divergence of a vector, Gauss's theorem, Continuity equation; Curl –rotational and irrational vector fields, Stoke's theorem. (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 dielectric 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: • Electromotive force, Time-varying fields, Faradays' law of electromagnetic induction, • Self and mutual inductance, displacement current, Maxwell's equations in free space. Boundary condition, propagation in linear medium. Plane electromagnetic waves—reflection and refraction,electromagnetic energy density, Pointing Vector.(10)					
Essential Reading	1. W. H. Hayt and J. A. Buck, Engineering Electromagnetics, Tata McGraw Hill Education Pvt.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, Electricity and Magnetism Berkley Physics Course, V2, Tata McGraw Hill, 2008. 3. Feynman. R.P, Leighton. R.B, Sands. M, The Feynman Lectures on Physics, Narosa Publishing House, Vol. II, 2008. Hill, 2008. 4. G. B. Arfken, H. J. Weber and F. E. Harris, Mathematical Methods for Physicists, Academic Press, 2013					

Curriculum & Syllabus

Course Name	Electrical Circuits for Engineers	Course Code	EC1000			
Offered by Department	Electronics and Communication Engineering	Structure (LTPC)	3	1	0	4
To be offered for	B TECH	Course Type	Core			
Pre-requisite	NIL	Approved In	Senate-43			
Learning Objectives	This course aims to equip the students with a basic understanding of electrical circuits and machines for specific types of applications. This course also equips students with an ability to understand basics of analog and digital electronics.					
Learning Outcomes	The students shall develop an intuitive understanding of the circuit analysis, basic conceptsof electrical machines, and electronic devices and circuits and be able to apply them inproduct design and development					
Contents of the course *(With approximate break-up of hours)*	Elements in electrical circuits: R, L, C, voltage and current sources, Ohm's law, Kirchoff'sLaws **(4)** Network analysis: Nodal and mesh analysis with only independent sources **(4)** Network theorems: Superposition, Thevenin's & Norton's, Maximum power transfertheorems **(4)** DC circuits: Response of RC, RL and RLC circuits **(6)** AC circuits: AC signal measures, Phasor analysis of single-phase AC circuits, Three phase AC circuits **(6)** Machines: Transformers, DC generator, DC motor, AC induction machines **(8)** Diodes: V-I characteristics, applications -rectifiers, clippers, clampers **(2)** Op-amps: gain, feedback, applications - inverting/non-inverting amplifiers, sum anddifference amplifier, comparators **(4)** Logic gates and combinational circuits – Basic gates, Karnaugh maps, Full adder, half adder **(4)**					
Essential Reading	Edward Hughes, Ian McKenzie Smith, John Hiley, Keith Brown, 'Hughe's Electrical andElectronic Technology', 10th edition, Pearson, 2010					
Supplementary Reading	1. Charles Alexander and Matthew Sadiku 'Fundamentals of Electric Circuits' 7th Edition, McGraw Hill, 2021 2. C. H. Roth, Jr., Larry R Kinney, 'Fundamentals of Logic Design', 7th Edition, Cengage Learning, 2013. 3. Jacob Millman, Christos C Halkais, Satyabrata Jit, 'Millman's Electronic Devices and Circuits', 4th Edition, Mc Graw Hill India, 2015 4. Stephen D Umans, 'Fitzgerald & Kingsley's Electric Machinery', McGraw-Hill, 7thed. 2020.					

Curriculum & Syllabus

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 (4 hours) • 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					

Curriculum & Syllabus

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.					

Curriculum & Syllabus

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: 1. Unlearn limiting assumptions, risk avoidance, fear of failure 2. Awaken their senses & rediscover their creative selves **3.** Experience the impact of design and technology in everyday objects					
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. Koos Eissen and Roselien Steur, 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					

Curriculum & Syllabus

Course Name	Engineering Electromagnetics 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 the course	Electrical and magnetic properties of materials based on the concept of electrical polarization, magnetization of materials will be studied in various experiments. Experiments based on the concept of phenomena such as interference, diffraction etc. related to electromagnetic waves will be done here and these methods will be applied to measure some unknown physical quantities such as wavelength of a light, diameter of a very thin wire, very small aperture for light etc.					
Essential Reading	1. IIITD&M Laboratory manual for Electromagnetic Wave Practice					
Supplementary Reading	1. W. H. Hayt and J. A. Buck, Engineering Electromagnetics, Tata McFraw Hill Education Pvt. Ltd,2006.					

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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					

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<table>
<tr><td>Course Name</td><td>Effective Language and Communication Skills</td><td>Course Code</td><td colspan="4">HM1000</td></tr>
<tr><td>Offered by Department</td><td>SH-English</td><td>Structure(LTPC)</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-43</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• 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</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• Able to communicate effectively with grammatically acceptable constructions and appropriate wordsin formal and informal situations
• Can extract information effectively and able to think critically
• Able to present technical content confidently</td></tr>
<tr><td>Course Contents (with approximate breakup of hours forlecture/ tutorial/ be donepractice)</td><td colspan="6">• 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)</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. 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.</td></tr>
</table>

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	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

Curriculum & Syllabus

Course Name	Differential Equations	Course Code	MA1001			
Offered by Department	SH-Mathematics	Structure (LTPC)	3	1	0	3
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					

Curriculum & Syllabus

Course Name	Linear Algebra	Course Code	MA1002			
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 impart knowledge of basic concepts and applications of Linear Algebra					
Learning outcomes	At the end of the course, a student will be able to show that they get clear Understanding of methods of Linear Algebra					
Contents of thecourse	Linear System of Equations: Gaussian Elimination—echelon forms—existence, uniqueness and multiplicity of solutions of linear equations. (6) Vector Spaces: Definition—linear dependence and independence—spanning sets, basis, and dimension—definition of a subspace—intersection and sum of subspaces—direct sums. (8) Linear Transformations: Definition—matrix representation of a linear transformation—change of basis—similarity transformation—invertible transformation—system of linear equations revisited—the four fundamental subspaces associated with a linear transformation.(10) Inner Products: Definition—induced norm—orthogonality—Gram-Schmidt orthogonalization process—orthogonal projections—unitary transformations and isometry.(8) Eigen Decomposition: Eigenvalues and eigenvectors—characteristic polynomials and Eigenspaces—diagonalizability conditions—invariant subspaces—spectral theorem. (10) (8L,2T)					
Essential Readings	1. G. Strang, "Linear Algebra and its Applications," Cengage Learning, 4th Edition, 2005. 2. D. C. Lay, "Linear Algebra and its Applications," Pearson Education, 4th edition, 2011.					
Supplementary Reading	1. C. D. Meyer, "Matrix Analysis and Applied Linear Algebra," SIAM, 2000. 2. S. H. Friedberg, A. J. Insel, and L. E. Spence, "Linear Algebra," Pearson Education, 4th Edition, 2002.					

Curriculum & Syllabus

Course Name	Engineering Graphics	Course Code	ME1001			
Offered by Department	Mechanical Engineering	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 the basic concepts and techniques of technical drawing. • 2D and 3D representation of various shapes/objects and its engineering applications.					
Learning Outcomes	Students will acquire visualization skills and will be able to prepare technical drawings and 3D models using computer aided tools.					
Course Contents (with approximate breakup of hours for lecture/tutorial/practice)	• Role of technical drawing in product development process, Basics of technicaldrawing, Standards, Dimensioning principles. *(L2+P4 hrs.)* • Computer aided drafting. *(L2+P8 hrs.)* • Engineering curves and its applications. *(L4+P8 hrs.)* • Principles of orthographic projection. Orthographic projection of points, lines, planes and regular solids, Exercises related to engineering applications. *(L7+P8hrs.)* • Principles of isometric projections. Orthographic to isometric and isometric to orthographic transformation of objects. *(L3+P8 hrs.)* • Section and intersection of regular solids and their lateral developments. • *(L6+P12 hrs.)* • Introduction to 3D modelling of shapes and objects; electrical CAD. *(L2+P4hrs.)*					
Essential Reading	1. K. Venugopal and V Prabhu Raja, Engineering Drawing + AutoCAD, New Age International (P) Limited. 5th Edition Reprint: July, 2016 2. Narayana. K.L, and Kannaiah. P, Engineering Drawing, Scitech Pub. Pvt. Ltd, 3. 3rd Edition.					
Supplementaryreading	1. PI Varghese, Engineering Graphics, McGraw Hill Education, 2013. 2. Bhatt. N.D, Engineering Drawing – Plane and Solid Geometry, Charotar Publishing House Pvt. Ltd., 53 Edition 2014.					

Curriculum & Syllabus

Course Name	Data Structures and Algorithms	Course Code	CS100			
Offered by Department	Computer Science & Engineering	Structure (LTPC)	3	0	0	3
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	Given a computational problem, the focus is on design of algorithms, implementation of algorithms using a suitable data structures. The notion time and space complexity and design of efficient algorithms and data structures shall also be explored.					
Learning Outcomes	Students are expected to design efficient algorithms and data structures for computational problems					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Review of elementary data structures – time and space complexity – step count method based computation – asymptotic analysis and bounds – big oh, little oh, omega, theta notation (5L) • Analysis using recurrence relations – solving recurrence relations through guess method, recurrence tree method, master's theorem (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, number of nodes etc.) (6L) • Dictionary: Binary search trees, balanced binary search trees - AVL Trees – search tree variants such as B-trees. (7L) • Hashing - collisions, open and closed hashing, properties of good hash functions. (4L) • Priority queues: Binary heaps with application to in-place sorting (5L) • Graphs: Representations (Matrix and Adjacency List), basic traversal such asBFS, DFS with complexity (6L)					
Essential Reading	1. 1. M. A. Weiss, Data Structures and Algorithm Analysis in C, Pearson, 2nd edition, 2002.					
Supplementary Reading	1. Cormen T.H, Leiserson C.E and Rivest R.L, Introduction to Algorithms,Prentice Hall India, 2nd Edition, 2001. 2. Aho, Hopcroft and Ullmann, Data Structures and Algorithms, Addison Wesley, 1983. 3. Adam Drozdek, Data structures and Algorithms in C, 1994. 4. R G Dromey, How to solve it by Computer, Prentice Hall India, 1982. 5. Horowitz, Sahni and Anderson-Freed, Fundamentals of Data Structures in C, Silicon Press, 2007.					

Curriculum & Syllabus

Curriculum & Syllabus

Course Name	Sociology of Design	Course Code	DS1001			
Offered by Department	SIDI	Structure (LTPC)	1	2	0	3
To be offered for	B.Tech	Course Type	*Core*			
Prerequisite	Foundation Program	Approved In	Senate 43			
Learning objectives	The objective of the course is to introduce engineering students tothe importance of understanding the social context of technology and product design: • Observing the problem context and surfacing unstated user/customer needs / new product concepts, • Understanding people, team dynamics and working in multicultural / cross-functional / distributed teams.					
Course Outcomes	At the end of the course, the students should be in a position to: • Understand the need and the process of doing an ethnographic study • Surface unstated needs and articulate the high level product requirements Connect with people, form teams and collaborate towards a common goal					
Contents of the course (With approx. mate break up of hours)	Module 1: Technology, Design and Society - [9 hrs] • Observe the way people interact with objects • Understanding the relationship between people and a variety of objects • Actor Network Theory; History of Technology and Design; 2-3 Case studies • Discover your passion and domain of interest & network to identify partners Module 2: Understanding user/customer contexts [21 hrs] • Ethnography - immersion in a problem context • Learning to observe - see and listen; • Developing rich pictures; Gigamapping • Introduction to signs and semiotic analysis Module 3: Understanding groups (multicultural/cross-functional teams) [12 hrs] • Learning team formation and dynamics through a movie; • Introduction to sociological imagination - Functionalism, Conflict Theory, Symbolic Interactionism; Interaction Ritual Chains • Values, culture, methods of engineers and designers and how they shape thequality of our lives; • Group dynamics within organizations and across organizations andimplications for innovation and change Evaluation: Continuous assessment (40%); Final ethnography report (20%); End Semester (40%)					
Essential& Supplementary Readings	1. Trevor Pinch (Editors) (2012), The Social Construction of Technological Systems: New directions in the sociology and history of technology, MIT Press, Anniversary Edition 2. Wendy Gunn, Ton Otto and Rachel Smith (2013), Design Anthropology: Theory and practice, Bloomsbury 3. Adrian Forty (2014), Objects of desire: Design and society since 1750s, Thames & Hudson 4. Bernhard E Burdek(2015), History, theory and practice of product design,second revised edition 5. Keri Smith (2008), How to be an Explorer of the World: Portable Life Museum, Penguin Group					

Curriculum & Syllabus

Course Name	Design and Manufacturing Lab.	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 the domain of mechanical, electrical, electronics and communication engineering. The exercises will train the students to acquire skills which are very essential for the engineers through hands-on sessions.					
Contents of the course	Experiments will be framed to train the students in following common engineering practices: Basic manufacturing processes: Fitting, Drilling & tapping, Material joining processes, Carpentry, Sheet-metal work, Adhesive bonding and plastic welding, Arc Welding, 3D Printing. (10 hours) Familiarization of electronic components by Nomenclature, meters, power supplies, function generators and Oscilloscope – Bread board assembling of simple circuits: IR transmitter and receiver – LED emergency lamp – Communication study: amplitude modulation and demodulation. (6 hours) Domestic wiring practice: Fluorescent lamp connection, Staircase wiring – Estimation and costing of domestic and industrial wiring – power consumption by Incandescent, CFL and LED lamps. (2 Hours) Dismantle and assembly of PC. Installing OS and disk management. (4 hours)					
Essential Reading	1. Uppal S. L., “Electrical Wiring & Estimating”, 5Edn, Khanna Publishers, 2003. 2. Chapman. W. A. J., Workshop Technology, Part 1 & 2, Taylor & Francis.					
Supplementary Reading	1. Clyde F. Coombs, “Printed circuits hand book”, 6Edn, McGraw Hill, 2007. 2. John H. Watt, Terrell Croft, “American Electricians' Handbook: A ReferenceBook for the Practical Electrical Man”, Tata McGraw Hill, 2002.					

Curriculum & Syllabus

Course Name	Discrete Structures for Computer Science	Course Code	CS1005			
Offered by Department	Computer Science & 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 introduces logical reasoning, inferences, and proof techniques.Relations, Functions, counting principles are also discussed. Graph theory and various properties of graphs are also taught as part of this course.					
Learning Outcomes	The learner would appreciate the importance of combinatory and the various proof techniques, and in particular, in proving the correctness of algorithms. Counting principles learnt as part of the course will help the learner in counting various combinatorial objects					
Course Contents (with approximate breakup of hours forlecture/ tutorial/practice)	• Mathematical Reasoning – Propositions – Predicates –First order logic – Nested quantifier – logical puzzles (9L+3T) • Set theory – Relations between sets – Operation on sets –Inductive definition of sets - Proof techniques – Direct proof, proof by contradiction, mathematical induction (8L+3T) • Binary relation and digraphs – Special properties of relations – Composition of relations – Closure operations on relations – counting special relations (7L+3T) • Basic properties of functions – Special classes of functions – counting functions (5L+1T) • Pigenhole principle – onto functions – derangements (5L+1T) • Basic counting techniques – Finite and Infinite sets –Countable and uncountable sets–Cardinal numbers (6L+1T) • Graph Theory –Graphs – Sub graphs – Isomorphic and Homeomorphic graphs – • Paths – Connectivity Bridges of Konigsberg – Labeled and Weighted Graphs– Complete, Regular and Bipartite Graphs –Planar Graphs – Coloring (5L+2T)					
Essential Reading	1. 1. K. H. Rosen, Discrete Mathematics and its Applications, McGraw Hill, 6th Edition, 2007.					
Supplementary 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. 3. Busby, Kolman, and Ross, Discrete Mathematical Structures, PHI, 6th Edition, 2008. 4. C. L. Liu, Elements of Discrete Mathematics, Second Edition, Tata McGraw Hill, 1995.					

Curriculum & Syllabus

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			
Learning Objectives	Given a computational problem, the focus is on design of algorithms, implementation of algorithms using a suitable data structures. The notion time and space complexity and design of efficient algorithms and data structures shall also be explored.					
Learning Outcomes	Students are expected to design efficient algorithms and data structures for computational problems					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Implementation of case studies involving algorithms and data structures in Cprogramming. • Binary Trees – Traversal – Computation of Structural parameters • Hashing – implementation of hash functions – computing collisions – Open vs closed hashing • Sorting and Searching Algorithms • Priority Queues and Heaps and its applications • Graph Traversals – BFS, DFS and its applications					
Essential Reading	1. M. A. Weiss, Data Structures and Algorithm Analysis in C, Pearson, 2nd edition,2002.					
Supplementary Reading	1. Cormen T.H, Leiserson C.E and Rivest R.L, Introduction to Algorithms,Prentice Hall India, 2nd Edition, 2001. 2. Aho, Hopcroft and Ullmann, Data Structures and Algorithms, Addison Wesley,1983. 3. Adam Drozdek, Data structures and Algorithms in C, 1994. 4. R G Dromey, how to solve it by Computer, Prentice Hall India, 1982. 5. Horowitz, Sahni and Anderson-Freed, Fundamentals of Data Structures in C, Silicon Press, 2007.					

Curriculum & Syllabus

Course Name	Earth, Environment and Design	Course Code	HS1002			
Offered by Department	SIDI	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.					
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.					

Curriculum & Syllabus

Course Name	Optimization Techniques for Machine Learning	Course Code	MA2000			
Offered by Department	SH-Mathematics	Structure(LTP C)	3	0	0	3
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	The objective of this course is to teach mathematics of optimization that can be applied to Machine Learning. The focus will be on deriving solutions to various optimization problems .					
Learning Outcomes	• Students will be familiar with probabilistic models for optimization • Will be familiar with algorithms to solve constraint and unconstrained versions of optimization problems • Will be able to solve combinatorial optimization problems					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Categorization and characteristics of optimization problem (1) • Unconstrained Optimization: Fibonacci and Golden-Section Search (3) • Constrained Optimization: Lagrange Multiplier, Karush Kuhn Tucker(KKT) Conditions, First order and Second-order necessary conditions for minima and maxima; convex sets and functions, convex optimization; Duality, IRLS (12) • Derivatives and Gradients- First-Order Methods -Gradient descent -batch gradient descent - stochastic gradient descent -Adam (6) • Second-Order Methods –Conjugate gradient method- Quasi Newton method- Newton method (4) • Stochastic Methods –-simulated annealing -monte-carlo methods for stochastic optimization (6) • Combinatorial Optimization –Mincut-Maxflow-normalized cut (4)					
Essential Reading	1. Sra, Suvrit, Sebastian Nowozin, and Stephen J. Wright, eds. Optimization for machine learning. Mit Press, 2012. (ISBN: 9780262016469): 2. Roberto Battiti, Mauro Brunato. The LION Way: Machine Learning plus Intelligent Optimization. Lion solver, Inc. 2013.(ISBN: 9781496034021)					
Supplementary Reading	1. Bubeck, Sebastien. "Theory of Convex Optimization for Machine Learning." arXiv preprint arXiv:1405.4980, 2014. 2. Algorithms for Optimization, Mykel J. Kochenderfer (Author), Tim A. Wheeler (Author), 2019, ISBN-13: 978-0262039420; ISBN-10: 0262039427 (eBook)					

Curriculum & Syllabus

Course Name	Applied Data Science	Course Code	CS2005			
Offered by Department	Computer Science and Engineering	Structure(LTP C)	3	0	2	4
To be 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, 2nd Edn, 2019, ISBN 9781492041139 2. Leskovec, Anand Rajaraman,, Ullmann, Mining of Massive Data Sets, Cambridge University Press, Open Source free version , ISBN 9781107015357 3. P Bruce, Practical Statistics for Data Scientists, O'Reilly, 2017, iSBN 9789352135653					

Curriculum & Syllabus

Course Name	Object Oriented Programming	Course Code	DS2000			
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) • 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. Deitel P J and Deitel H M, C : How To Program, Prentice Hall, 10th Edn, 2016, ISBN 9780131596825 2. Deitel P J and Deitel H M, Java: How To Program, Prentice Hall, 9th Edn, 2016, ISBN 978-0132575669					
Supplementary Reading	1. David Flanagan, Java in a Nutshell, 5th Edition, O'Rielly, 2005, ISBN 9780596007737 2. Herbert Schildt, Java: A Beginners Guide, 9th Edition, McGraw Hill, 2014, ISBN 9781260440218 3. Herbet Schildt, Teach Yourself C++, 4th Edition, Tata McGraw Hill, 2003, ISBN 978-0070532465					

Curriculum & Syllabus

Course Name	Digital System Design	Course Code	CS2001			
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 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 theory for Logic minimization. • To implement Combinational Circuits using Primitive gates and logic functions. • To implement sequential circuit elements and finite state machines. • To design various circuits using Op-Amp 741 such as summing, difference, average, logarithmic amplifiers etc.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Digital Circuits: Number Representation: Fixed point and floating point, 1's and 2's complement. Switching Theory: Boolean algebra, switching functions, Truth Tables and Algebraic forms, Simplification of Boolean expressions – Algebraic methods, canonical forms and Minimization of functions using K-Maps. (5L,1T) • Binary Codes: BCD, 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.					

Curriculum & Syllabus

<table>
<tr><td>Course Name</td><td>Design and Analysis of Algorithms</td><td>Course Code</td><td colspan="4">CS2002</td></tr>
<tr><td>Offered by Department</td><td>Computer Science and Engineering</td><td>Structure (LTPC)</td><td>3</td><td>1</td><td>0</td><td>4</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">• To design time or space efficient algorithms using well known paradigms.
• To understand the limitations of computing machines.
• To explore tractable vs intractable problems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• To design efficient algorithms using paradigms such as divide and conquer, dynamic programming, greedy method etc.
• To differentiate easy vs hard problems.
• To design polynomial-time algorithms with proof of correctness.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Review of time/space complexity – recurrence relations – recurrence tree method – 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)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. T. H. Cormen, C. E. Leiserson, and R. L. Rivest, "Introduction to Algorithms," Prentice Hall India, 2 nd Edition, 2001. ISBN 978-0-262-53305-8
2. E. Horowitz, S. Sahni, and S. Rajasekaran, "Computer Algorithms," 2 nd Edition, Galgotia Publications, 2007. ISBN 0-7167-8316-9</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Aho, Hopcroft, and Ullmann, "Data Structures & Algorithms," Addison Wesley, 1983. ISBN13: 9780201000238
2. Algorithm Design , Eva Tardos and Kleinberg, Pearson, 2006, ISBN-13 : 978-0321295354</td></tr>
</table>

Curriculum & Syllabus

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, 3 rd Edition, ISBN-13 : 978-0077221430, 2008.					
Supplementary Reading	1. R.J. Tocci, N. S.Widmer, and G. L. Moss, "Digital Systems Principles and applications," Pearson Prentice Hall, 10 th Edition, ISBN-13 : 978-0135103821, 2010. 2. D. A. Neaman, "Electronic Circuits," TMH, 4 th Edition,ISBN-13 : 978-0070634336, 2006.					

Curriculum & Syllabus

Course Name	Design and Analysis of Algorithms Practice	Course Code	CS2004			
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 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					

Curriculum & Syllabus

Course Name	Probability and Statistics	Course Code	MA2001			
Offered by Department	SH-Mathematics	Structure(LTP C)	3	1	0	4
To be Offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	The objective of this course is to impart knowledge related to the essentials for probability and statistics to students so that students they can understand probabilistic machine learning models and also validate the models using statistical inference					
Learning Outcomes	• Will be familiar with fundamentals of probability and statistics • Students are expected to apply probability and statistics concepts in machine learning algorithm design • Expected to validate the algorithms					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Probability: Classical Probability-Axioms of Probability-Random variables – continuous and discrete (4) • Probability density Function-Binomial-Bernoulli, Poison-Gaussian-logistic (5) • Cumulative distribution function-quantile function-joint probability –Marginal Probability distribution (4) • independence of random variables-conditional Probability-Bayes theorem-base rate fallacy (4) • Gaussian Mixture model- Hidden Markov Model-Random Markov Field-central limit theorem and application (8) • Statistics: Summarizing data using descriptive statistics-expectation – variance – covariance- correlation (4) • Hypothesis testing, introduction to ANOVA (analysis of variance), regression analysis. (5) • Estimation Statistics- Nonparametric Statistics (4)					
Essential Reading	1. Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences, by J. Susan Milton, Jesse Arnold, 2002, 4th Edision, Published by McGraw-Hill. (ISBN: 9780070636941)					
Supplementary Reading	1. Introduction to Probability Theory and Statistical Inference by H.J. Larson, 3rd Edition, published by Wiley.(ISBN: 9780471059097) 2. Introduction to Probability and Statistics for Engineers and Scientists by S.M. Ross, 5th Edision, published by Elsevier(ISBN: 9780123948113)					

Curriculum & Syllabus

Course Name	Artificial Intelligence	Course Code	CS2012			
Offered by Department	Computer Science and Engineering	Structure(LTP C)	3	0	2	4
To be Offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	The course focuses on understanding, thinking and intelligence such that computer systems are able to reason in uncertain environment. The course shall primarily focus on a variety of representation formalisms and associated algorithms for reasoning.					
Learning Outcomes	• Thorough understanding of the core areas of AI such as Representation, Search, Uncertainty, interconnections amongst them; & with other areas such as robotics, NLP, expert systems, etc.; • Ability to decide on the apt representation for a domain model • Ability to choose appropriate algorithms for AI reasoning in that domain, implement and debug core AI algorithms.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Introduction to Artificial Intelligence – Philosophy of AI and Definitions, Problem Solving Methods - Formalism - Modelling a Problem as Search Problem - Uniformed Search - Examples - Basic Search Strategies – Iterative Deepening DFS, Bidirectional Search - Informed Search – Best First, A* Search, Iterative Deepening A*, Depth First Branch Bound - Heuristic Search, Domain Relaxations [12] • Local Search – Satisfaction, Optimization Queens Example, Hill Climbing – Limitations, Random walk / Restart, Simulated Annealing, Genetic Algorithms, Adversarial Search –Min Max algorithm • Game Playing, Alpha Beta pruning [10] • Constraint Satisfaction Problems – Representation, Examples – Backtracking search – Variable Value Ordering – Inferences - Logic in AI – Representation Systems – Syntax & Semantics – Forward Chaining –Resolution, Reduction to Satisfiability Problems [10] • Uncertainty in AI – Conditional Independence, Bayesian Networks, Inferences, Expectation Maximization, Decision Theory – MDPs – Applications of AI in NLP, Speech Recognition etc. [10] • Practice component shall involve programming exercises to supplement material covered in theory.					
Essential Reading	1. S Russell & P Norvig, Artificial Intelligence – A Modern Approach, Pearson, 3rd Edition, 2010, ISBN 9789332543515					
Supplementary Reading	1. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill, 2013, ISBN9783827370891 2. Nils J Nilsson, Artificial Intelligence – A New Synthesis, Morgan Kauffmann, 1998, ISBN 9781558604674 3. P Norvig, Paradigms of AI Programming, Morgan Kauffmann,1991, ISBN 9781558601918 4. Dean, Allen & Aloimonos , AI Theory & Practice, Addison Wesley, 1995, ISBN 978-0805325478					

Curriculum & Syllabus

Course Name	Computer Organization and Architecture	Course Code	CS2007			
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 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 Instructions in the Computer, Logical Operations Instructions for Making Decisions, addressing Modes, Parallelism & Instructions. (5L,1T) • Arithmetic Design: – Carry look ahead adder, Wallace tree multiplier, Floating–point adder/sub tractor, Division. (5L,2T) • The Processor: Logic Design Conventions, Building a Data path, A Simple Implementation Scheme (3L,1T) • An Overview of Pipelining, Pipelined Data path and Control, Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions and Parallelism via Instructions. (7L,2T) • Memory Hierarchy: Introduction, Memory Technologies (SRAM, DRAM), The Basics of Caches, Measuring and Improving Cache Performance, Dependable Memory, Virtual Machines, Virtual Memory, A Common Framework for Memory Hierarchy, using a Finite State Machine to Control a Simple Cache, Parallelism and Memory Hierarchies: Cache Coherence, Parallelism and Memory Hierarchy: Redundant Arrays of Inexpensive Disks and • Implementing Cache Controllers. (9L,2T) • Input/Output Unit: access of I/O devices, I/O ports, I/O control mechanisms – Program Controlled I/O. Interrupt controlled I/O and DMA controlled I/O; I/O interfaces – Serial port, parallel port, USB port, SCSI bus, PCI bus; I/O peripherals – Keyboard, display, secondary storage devices. (8L,2T)					
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.					

Curriculum & Syllabus

Course Name	Database Systems	Course Code	CS2008			
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	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					

Curriculum & Syllabus

Course Name	Theory of Computation	Course Code	CS2009			
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 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.					

Curriculum & Syllabus

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 C language. I/O interfacing and programming. Computer System Design.					
Essential Reading	1. Patterson and Hennessy, “Computer Organization and Design,” Morgan Kaufmann, 5 th Edition, ISBN-13 : 978-8131222744, 2013.					
Supplementary Reading	1. C. Hamacher, Z. Vranesic, and S. Zaky, “Computer Organization,” Tata McGraw Hill, ISBN-9789339212131, 2002.					

Curriculum & Syllabus

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					

Curriculum & Syllabus

Course Name	Pattern Recognition And Machine Learning	Course Code	CS3007			
Offered by Department	Computer Science and Engineering	Structure (LTPC)	3	0	2	4
To be offered For	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	Students will understand the concepts, theory and computational algorithms needed for several real world recognition tasks such as text, speech, characters, objects etc. Simulate and understand how machine will have power to accomplish these tasks and can aim at developing several examples based learning tasks in several domains ranging from medical, economical, engineering to industrial needs.					
Learning Outcomes	• Identify the ML&PR algorithms which are more appropriate for domain specific such as computer vision, NLP, etc. • Implement ML&PR algorithms and solve real-world problems • To know the cutting-edge research in this field.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• PR Overview-Feature Extraction-Statistical Pattern Recognition-Supervised & Unsupervised Learning; Bayes decision Theory, Linear discriminant functions (8 hours). • Parametric methods, ML and MAP Estimation-Bayes estimation. Non parametric methods; Parzen windows & k NN approaches (8 hours). • Dimensionality reduction (PCA) & Fishers linear discriminant. Linear perceptron and Neural Networks. Introduction to Deep Neural nets. Kernel methods and Support vector machine (10 hours). • Unsupervised learning and Clustering. K-means and Hierarchical clustering. Linear & Logistic Regression (8 hours). • Decision trees for classification. Ensemble/ Adaboost classifier. Expectation Maximization (EM). Applications to document analysis and recognition (8 hours).					
Essential Reading	1. Christopher M B, Pattern Recognition and Machine Learning, Springer, 2006. ISBN: 9780387310732 2. Duda R O, Hart P E, and Stork D G, Pattern classification, John Wiley and Sons, 2001. ISBN: 9788126511167					
Supplementary Reading	1. Sergios T and Konstantinos K, Pattern Recognition, 4 th edition, Academic Press, 2008. ISBN: 9781597492720					

Curriculum & Syllabus

<table>
<tr><td>Course Name</td><td>Entrepreneurship and Management Functions</td><td>Course Code</td><td colspan="4">DS3000</td></tr>
<tr><td>Offered by Department</td><td>SIDI</td><td>Structure (LTPC)</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 (Core / Elective)</td><td colspan="4">Core</td></tr>
<tr><td>Prerequisite</td><td>Systems Thinking and Design</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 is to provide engineering students an exposure to the basic concepts of entrepreneurship and management, with a specific focus on the process of turning an idea into a commercially viable venture.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students will learn how to
• Understand the market competition
• Prepare a business case for the product/idea</td></tr>
<tr><td>Contents of the course</td><td colspan="6">Module 1: Introduction
• Division of labor and creation of value
• Evolution of organizations, industries and sectors, for profit and non-profit
• Role of Entrepreneurs and Managers in value creation
• Principles of Management - Planning, Organizing, Resourcing, Directing (4)

Module 2: Strategy & Planning
• Understanding industry dynamics & competition (Porter's Framework)
• Understanding the industry value chain and firm positioning (6)

Module 3: Organizing
• Typical organizational functions (R&D, Marketing & Sales, HR, Operations)
• Cybernetics of organizational functions (Stafford Beer's viable systems model)
• Types of organization structures (product, functional, matrix, global) (6)

Module 4: Resource Management
• Financial management (Sources of funding, how to read a P&L, balance sheet)
• Human resource management (Interviewing, compensation, motivation)
• Global sourcing and supply chain management (8)

Module 5: Management Information & Decision Making (4)

Module 6: Legal and Regulatory environment (4)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. Peter F Drucker, The Practice of Management, Harper Collins, 2006, ISBN: 978-0060878979
2. Hentry Mintzberg, Managing, Berret-Koehler Publishers, 2009, ISBN: 978-1605098746
3. Michael Porter, On competition: Updated and Expanded Edition, HBS, 2008, ISBN: 978-1422126967
4. Vasanta Desai, Dynamics of Entrepreneurial Development and Management, HimalayaPublishing House, ISBN:9788183184113.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Walter Isaacson, Steve Jobs, 2011, ISBN:978-1451648539
2. Eric Ries, The Lean Startup, Portfolio Penguin, 2011, ISBN: 978-0307887894
3. Vineet Bajpai, Build from scratch, Jaico books, 2013, ISBN: 9788184952919.</td></tr>
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Curriculum & Syllabus

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 th Edn, 2015, ISBN 978-0471694663					
Supplementary Reading	1. Andrew S Tanenbaum, Modern Operating Systems, Prentice Hall, 2009, ISBN 9788120339040 2. Stallings. W, Operating System: Internals and Design Principles, Prentice Hall, 2011, ISBN 9332518807 3. Gary Nut, Operating Systems: A Modern Perspective, Addison Wesley, 2003, ISBN 978-0201773446					

Curriculum & Syllabus

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					

Curriculum & Syllabus

Course Name	Compiler Design	Course Code	CS3005			
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	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					

Curriculum & Syllabus

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 th Edn, 2015, ISBN 9788120339040					
Supplementary Reading	1. Robert Love, Linux Systems Programming, O Reilly Media, 2 nd Edition, 2013, ISBN 9781449339531 2. D Butlar, J Farrell, B Nichols, Pthreads Programming, O Reilly Media, 1996, ISBN 9781565921153					

Curriculum & Syllabus

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 known protocols would be addressed as part of this course.					
Learning Outcomes	• To design, test and troubleshoot aspects associated with local area networking. • To appreciate the importance of error detecting codes and flow control techniques.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	Connecting two nodes using Ethernet cable and study the performance evaluation parameters such as delay, effective bandwidth - Basic Networking commands – Ping, IPConfig, Traceroute, NSlookup - Introduction to Socket Programming. File transfer using TCP. Echo, Chat between two or more clients using socket programming - Simulation of Stop and Wait Protocol - Simulation of Stop and Wait protocol with NACK, Modelling of ACK, NACK drops, etc., -Modelling and simulation of Sliding window protocol - Sliding window protocol with ACK/NACK drops, frame drops etc., - Performance evaluation through simulation of IEEE 802.3/802.5 networks - Implementation of OSPF. Introduction to NS2/OPNET simulator, Case studies.					
Essential Reading	1. Larry L.Peterson and Bruce S Davie, Computer Networks: A systems Approach,Morgan, 5th Edn, 2011.ISBN: 9780123850591 2. William Stallings, Data and Computer Communications, 10th Edn, Pearson, 2017.ISBN: 9780133506488					
Supplementary Reading	1. Andrew S. Tanenbaum, Computer Networks, 5th Edn, 2014. ISBN: 9788131770221 2. Behrouz Forouzan, TCP/IP protocol suite, Tata McGraw Hill, 4th Edn, 2010. ISBN: 9780070706521					

Curriculum & Syllabus

Course Name	Compiler Design Practice	Course Code	CS3005			
Offered by Department	Computer Science and Engineering	Structure(LT PC)	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					

Curriculum & Syllabus

Course Name	Deep Learning	Course Code	CS3008			
Offered by Department	Computer Science and Engineering	Structure (LTPC)	3	0	2	4
To be Offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	Introduce major deep learning algorithms, the problem settings and their applications to solve real world problems.					
Learning Outcomes	• Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains • Implement deep learning algorithms and solve real-world problems • To know the cutting-edge research in this field.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Introduction- to Neural Network (Recap), Gradient Descent, Linear Classifiers- Perceptron, Multilayer Perceptron, Delta Rule [4] • Deep Artificial Neural Networks- Back Propagation Learning, Gradient Descent – Stochastic, Batch and Mini-Batch, Activation Functions- RelU, Leaky RelU, Loss Functions [4] • Optimization Techniques – Momentum, Nesterov, AdaGrad, RMSProp, AdaDelta, Adam, AdaMax, Nadam, AMSGrad, etc. Training tricks in Deep Models - Regularization, Early stopping, Dropout, Data Augmentation, Normalization- Batch, Layer, Instance, and Group [7] • Deep Convolutional Neural Network- Convolution, pooling, Popular CNN models- AlexNet, VGG16, GoogleNet, and Transfer Learning, Recent Trends in Deep Learning Architectures, Skip Connection Network, Residual Network (ResNet) [9] • Deep Sequential Modeling -Recurrent Neural Network (RNN), LSTM Networks, Applications [3] • Classical Supervised Tasks with Deep Learning**:** Image Denoising, Semantic segmentation, Instance Segmentation, Object Detection, and Classification –YOLO [4] • Unsupervised Learning with Deep Network: Auto encoders, Variational Auto encoder [4] • Deep Generative Modelling - Generative Adversarial Network, Applications of Deep Learning to Computer Vision, NLP and Medical Data Analysis [6] • Practice: Evaluation Metrics- Confusion Matrix, Sensitivity, Specificity, Dice Score, Precision, Recall, Hausdorff Distance and Other popular metrics, K-fold Cross Validation- Stratification [4]					
Essential Reading	1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016. ISBN: 9780262035613 2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006. ISBN: 9780387310732					
Supplementary Reading	1. François Chollet, Deep Learning with Python, 1st Edition, Manning Publication ISBN: 9781617294433 2. http://www.deeplearningbook.org/lecture_slides.html 3. http://www.cse.iitm.ac.in/~miteshk/CS7015.html					

Curriculum & Syllabus

Course Name	Reinforcement Learning	Course Code	CS3009			
Offered By the Department	Computer Science and Engineering	Structure(LTP C)	3	0	2	4
To be Offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	The goal of the course is to introduce the basic mathematical foundations of reinforcement learning, as well as highlight some of the recent directions of research.					
Learning Outcomes	• It aims to model the trial-and-error learning process that is needed in many problem situations where explicit instructive signals are not available. • Implement RL algorithms and solve real-world problems • To know the cutting-edge research in this field.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• The Reinforcement Learning problem: evaluative feedback, non-associative learning, Rewards and returns, Markov Decision Processes, Value functions, optimality and approximation [8]. • Dynamic programming: value iteration, policy iteration, asynchronous DP, generalized policy iteration. Monte-Carlo methods: policy evaluation, roll outs, on policy and off policy learning, importance sampling [8]. • Temporal Difference learning: TD prediction, Optimality of TD (0), SARSA, Q-learning, R-learning, Games and after states. Eligibility traces: n-step TD prediction, TD (lambda), forward and backward views, Q (lambda), SARSA (lambda), replacing traces and accumulating traces [10]. • Function Approximation: Value prediction, gradient descent methods, linear function approximation, ANN based function approximation, lazy learning, instability issues [8] • Policy Gradient methods : non-associative learning – REINFORCE algorithm, exact gradient methods, estimating gradients, approximate policy gradient algorithms, actor-critic methods [8]					
Essential Reading	1. Richard S. Sutton and Andrew G. Barto. Introduction to Reinforcement Learning, 2nd Edition, MIT Press. 2017. ISBN: 9780262193986 2. Neuro Dynamic Programming. Dimitri Bertsikas and John G. Tsitsiklis. Athena Scientific. 1996. ISBN: 9781886529106					
Supplementary Reading	1. Reinforcement Learning Algorithms, Analysis and Real Evaluation Application, by Boris Belousov, Simone Parisi, Hany Abdulsamad, Jan Peters, Springer ISBN: 9783030411879					

Curriculum & Syllabus

Course Name	Professional Communication	Course Code	HS3001			
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-44			
Learning Objectives	• 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					
Learning Outcomes	• 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					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• 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)					
Essential & Supplementary Reading	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.					