Syllabus of B.Tech Computer Engineering (COE) for 1st and 2nd Semesters

(According to 22nd and 23rd Senate meeting minutes)

Course Title	Calculus	Course No *(will be assigned)*				
Specialization	Mathematics	Structure (LTPC)	3	0	0	3
Offered for	UG& DD	Status	Core ■		Elective ☐	
Faculty		Type	New ☐		Modification ☐	
Pre-requisite		To take effect from				
Submission date	21/07/2014	Date of approval by Senate				
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, Lagrangemultipliers – Optimization problems (7) Multiple integrals – Evaluation of line and surface integrals (6)					
Textbook	1. Thomas. G.B, and Finney R.L, Calculus, Pearson Education, 2007.					
References	1. Piskunov. N, Differential and Integral Calculus, Vol. I & II, Mir. Publishers, 1981. 2. Kreyszig. E, Advanced Engineering Mathematics, Wiley Eastern 2007. 3. J Hass, M D Weir, F R Giordano, Thomas Calculus, 11th Edition, Pearson.					

Course Title	Differential Equations	Course No *(will be assigned)*				
Specialization	Mathematics	Structure (LTPC)	3	0	0	3
Offered for	UG & DD	Status	Core ▬		Elective	
Faculty		Type	New		Modification ▬	
Pre-requisite		To take effect from				
Submission date	21/07/2014	Date of approval by Senate				

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)
Textbooks	1. Simmons. G.F, Differential Equations, Tata McGraw Hill, 2003. 2. Kreyszig. E, Advanced Engineering Mathematics, Wiley, 2007.
References	1. William. E. Boyce and R. C. Diprima, Elementary Differential Equations and Boundary Value Problems, John Wiley, 8 Edn, 2004. 2. Sneddon. I, Elements of Partial Differential Equations, Tata McGraw Hill, 1972. 3. Ross. L.S, Differential Equations, Wiley, 2007. 4. Trench, W, Elementary Differential Equations, http://digitalcommons.trinity.edu/mono

Course Title	Engineering Mechanics	Course No *(will be assigned)*				
Specialization	Physics	Structure (LTPC)	3	0	0	3
Offered for	UG & DD	Status	Core ■		Elective □	
Faculty		Type	New ■		Modification □	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	In this course, students will learn a basic knowledge of forces, moments on the components of a structure of engineering problems. They will also learn to analyze: forces and moments on a static rigid body, moments on/between multiple static rigid bodies and internal forces/moments in a static rigid body. This course will help the student to develop the ability visualize physical configurations in terms of real materials constraints which govern the behavior of machine and structures.					
Contents of the course	Equivalent force systems; free-body diagrams; degrees of freedom; equilibrium equations; analysis of determinate trusses and frames; properties of surfaces - friction; (10) Particle Dynamics: equations of motion; work-energy and impulse-momentum principles;. Generalized coordinates; Lagrangian mechanics. (12) Rigid body dynamics: plane kinematics and kinetics of rigid bodies including work-energy and impulse-momentum principles; single degree of freedom rigid body systems (10) Stresses and strains (including thermal starin); principal stresses and strains; generalized Hooke's Law; free vibration of single degree-of freedom systems. (10)					
Textbook	1. F. Beer. R. Johnston, Vector mechanics for engineers: statics and dynamics. Tata McGraw-Hill, 2010.					
References	1. Meriam. J. L and Kraige. L. G, Engineering Mechanics, Vol. I – Statics, Vol 2: Dynamics, 2007. 2. H. Goldstein , Classical Mechanics, Pearson Education, 2011. 3. Kittle. C, Mechanics – Berkley Physics Course, Vol. 1, Tata McGraw Hill, 2008.					

Course Title	Engineering Electromagnetics	Course No *(will be assigned)*				
Specialization	All Branches of UG	Structure (LTPC)	3	0	0	3
Offered for	UG	Status	Core ■		Elective □	
Faculty	Tapas Sil	Type	New ■		Modification □	
Pre-requisite	-----	To take effect from				
Submission date	21/07/2014	Date of approval by Senate				

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 of vector fields; Gradient of a scalar field; flux, divergence of a vector, Gauss's theorem, Continuity equation; Curl –rotational and irrotational 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, Laplaces equation Image problem , Dielectric polarization, electric displacement vector, dielectric susceptibility , energy in dielectric systems. (10)

Magnetostatics:
Lorentz Force law Biot-Savart's law and Ampere's law in magnetostatics, 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, Poynting vector. (10)

Textbook

1. W. H. Hayt and J. A. Buck, Engineering Electromagnetics, Tata McFraw Hill Education Pvt. Ltd, 2006.

References

1. Grifiths. D. J, Introduction to Electrodynamics, Prentice Hall, 2007.
2. Purcell. E.M, Electricity and Magnetism Berkley Physics Course, V2, Tata McGraw Hill, 20 08.
3. Feynman. R.P, Leighton. R.B, Sands. M, The Feynman Lectures on Physics, Narosa Publish ing House, Vol. II, 2008. Hill, 2008.
4. G. B. Arfken, H. J. Weber and F. E. Harris, Mathematical Methods for Physicists, Academic Press, 2013.

Course Title	Computational Engineering	Course No *(will be assigned)*				
Specialization	Computer Engineering	Structure (LTPC)	3	0	0	3
Offered for	UG & DD	Status	Core ■		Elective ☐	
Faculty		Type	New ☐		Modification ■	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objective	The course introduces students to computer systems and organization and a higher level language (C) to communicate with the system. The student would be equipped with basic skillset required to interact with the system / create applications supporting a command line interface.					
Contents of the course	Introduction to computers & breadth scope in engineering – Computer organization basics – Problem solving strategies – Higher level languages – Program design and development – Phases of program development - Basic programming constructs in C – Data types in C – Input output statements – Operators, control structures in C - Sequential, Selection, Repetition (12) Functions in C –Function declaration, definition – Built and user defined functions –Storage classes and scope –Recursive functions – Arrays in C – multidimensional arrays-String manipulations – Library support (14) Introduction to pointers – References – Pointer Arithmetic – Formatted input output – User defined data types – File processing in C - Sequential & Random - Dynamic Memory Allocation – Command Line Arguments – Usable CLI based applications - Non linear equations– Bisection, Newton raphson methods. (16)					
Textbook	1. Deitel P J and Deitel H M, C : How To Program, Prentice Hall, 7th Edn, 2012.					
References	1. Kernighan, Ritchie D, The C Programming Language, Prentice Hall, 2 Edn. 2. Chapra S.C and Canale R.P, Numerical Methods for Engineers, McGraw Hill, 2006.					

Course Title	Basic Electrical and Electronics Engineering	Course No *(will be assigned)*					
Specialization		Structure (LTPC)	3	0	0	3	
Offered for	UG/DD	Status	Core ■		Elective □		
Faculty		Type	New ■		Modification □		
Pre-requisite		To take effect from					
Submission date	21/07/2014	Date of approval by Senate					

Objectives	Learn how to develop and employ circuit models for elementary electronic components and circuit analysis, network theorems, role of power flow and energy storage in electronic circuits;step and sinusoidal-steady-state response, AC signal powers, three phase circuits and loads, and brief introduction to diodes and BJTs.
Contents of the course	Electrical circuit elements: voltage and current sources, R,C,L,M,I,V, linear, non linear, active and passive elements, inductor current and capacitor voltage continuity, Kirchhoff's laws, Elements in series and parallel, superposition in linear circuits, controlled sources, energy and power in elements, energy in mutual inductor and constraint on mutual inductance (7) Network analysis: Nodal analysis with independent and dependent sources, modified nodal analysis, mesh analysis, notion of network graphs, nodes, trees, twigs, links, co-tree, independent sets of branch currents and voltages (6) Network theorems: voltage shift theorem, zero current theorem, Tellegen's theorem, reciprocity, substitution theorem, Thevenin's and Norton's theorems, pushing a voltage source through a node, splitting a current source, compensation theorem, maximum power transfer (8) RC and RL circuits: natural, step and sinusoidal steady state responses, series and parallel RLC circuits, natural, step and sinusoidal steady state responses (5) AC signal measures: complex, apparent, active and reactive power, power factor (2) Introduction to three phase supply: three phase circuits, star-delta transformations, balanced and unbalanced three phase load, power measurement, two wattmeter method (5) Semiconductor diodes and application: PN diodes, rectifiers and filters, clipping and clamping circuits, voltage multiplier circuits (5) Bipolar Junction Transistors: DC characteristics, CE, CB, CC configurations, biasing, load line (4)
Textbook	1. Hayt. W. W, Kemmerly. J.E, and Durbin. S.M, Engineering Circuits Analysis, Tata McGraw Hill, 2008. 2. Boylestad R. &Nashelsky L., Electronic Devices & Circuit Theory, Pearson Education, 2009
References	1. Hughes Edward, Electrical & Electronic Technology, Pearson Education, 2007. 2. Hambley. A, Electrical Engineering Principles and Applications: International Version, Pearson Education, 4 Edn, 2007. 3. Alexander.C. K. & Mathew. N. O. Sadiku, Fundamentals of Electrical circuits, Tata McGraw Hill, 2008.

Course Title	Science and Engineering of Materials	Course No *(will be assigned)*				
Specialization		Structure (LTPC)	3	0	0	3
Offered for	UG & DD	Status	Core ■		Elective □	
Faculty		Type	New ■		Modification □	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	The objective of this course is to provide a basic conceptual understanding of crystal structure and its relevance in classification of different materials based on their properties. The engineering of structure of different materials and development of natural and man-made materials with their applications would also be discussed.					
Contents of the course	Crystal structure, defects, crystallographic planes, directions, slip, deformation mechanical behaviour, and strengthening mechanisms. (10) Electrical, electronic, magnetic properties of materials, property management and case studies alloys, steel, aluminum alloys. (6) Polymeric structures, polymerization, structure property relationships, processing property relationships,. (6) Natural and manmade composites, processing, properties, applications (6) Ceramics, manufacturing and properties, applications (4) Environmental degradation of engineering materials (4) Introduction to Nano, Bio, Smart and Functional materials. (4)					
Textbook	1. Callister's Materials Science and Engineering, 2nd ED, Adapted by R Balasubramaniam, 2010, ISBN-13: 978-8126521432, Wiley India Ltd. 2. V Raghavan, "Materials Science and Engineering: A First Course, 5th Ed, 2004, PHI India					
References	1. Donald R. Askeland K Balani, "The Science and Engineering of Materials," 2012, Cengage Learning					

Course Title	Concepts in Engineering Design	Course No *(will be assigned)*				
Specialization	Design	Structure (LTPC)	3	0	0	3
Offered for	UG & DD	Status	Core ■		Elective □	
Faculty		Type	New □		Modification ■	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	The purpose of this course is to introduce to the undergraduate student the fundamental principles of Engineering Design which is very important and relevant in the context of todays engineering professionals. The course will be generic to all engineering disciplines and will not require specialized preparation or prerequisites in any of the individual engineering disciplines. Case studies from field situations and real products will be used to illustrate these principles.					
Contents of the course	Design Conceptualization and Philosophy, Original, Adaptive, Variant and Re-Design, Evolution of Concept, Need for Systematic design Past methods of and design Product life cycle, Innovation, Types of innovation Needs and opportunities, Vision and Mission of a concept, Type of needs, Technology S - curve, Need analysis, market analysis and competitive analysis, Kano Diagrams, SWOT analysis Conceptualization techniques – Idea generation – ideation, brainstorming, Trigger session Brain writing, Mind maps, SCAMPER, TRIZ, Biommicry, Shape mimicry, Familiarity Matrix Concepts screening, Concept testing - exploratory tests, Assessment tests , Validation tests Comparison tests – Case studies Organization of design concept and design methods, Engineering Design - Descriptive and prescriptive model, Design decisions and development of design Group work and case studies					
Textbook	1. Otto. K and Wood, K, Product Design, Pearson Education, 2001. 2. Pahl. G and Beitz. G, Engineering Design, Springer, 1996					
References	1. Ullman. D. G, The Mechanical Design Process, McGraw- Hill, 1997.					

Course Title	English for Communication	Course No *(will be assigned)*				
Specialization	Humanities	Structure (LTPC)	2	0	0	2
Offered for	UG and DD	Status	Core ■		Elective □	
Faculty		Type	New ■		Modification □	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	Read a given text at a reasonable speed - Comprehend and critically read the text - Understand and use lexis accurately and appropriately - Listen to various types of spoken discourses understand, analyse and apply the same Listen and comprehend lectures and speeches - Speak coherently and fluently on a given topic Speak with confidence and present point of view - Write fluently and coherently on a given topic - Write various types of tasks short and long - Use lexis appropriate to the task while writing - Use accurate grammatical structures while speaking and writing - Give Power Point presentations. Use idioms appropriately.					
Contents of the course	Listening – Listening comprehension. Listen to various types of spoken discourses understand, analyse and apply the same. Listen and comprehend lectures and speeches. (3) Speaking – Organization, articulation and correctness. Speak with confidence and present a point of view. Speak coherently and fluently on a given topic. (8) Reading – Comprehend and critically read the text. Read a given text at a reasonable speed (5) Writing – Memos, letters, reports, reviews and writing fluently and coherently on a given topic. Write various types of tasks; short and long. (7) Presentation Skills – Oral presentation using Power Point. Study Skills – Dictionary, thesaurus & reference Structure of English – Remedial grammar/ Grammar for Communication (5)					
Textbook	1. Shreesh Choudhry, Devaki Reddy , Technical English, Macmillan Publishers,2009.					
References	1. Martin Hewings , Advanced English Grammar, Cambridge University Press,2007. 2. V. Saraswathi, Leena Anil, Manjula Rajan , Grammar for Communication,2012. 3. Thomson and Martinet , Practical English Grammar, Oxford University Press, 1986. 4. 4. Leech, Geoffrey & Jan Svartvik, A Communicative Grammar of English, Longman,2003					

Course Title	Design History	Course No *(will be assigned)*				
Specialization	Design	Structure (LTPC)	2	0	0	2
Offered for	UG & DD	Status	Core ■		Elective □	
Faculty		Type	New □		Modification ■	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	This course will help students to (a) understand the evolution and application of the concept of Design in everyday life of people (b) appreciate its role in national and international economic and social systems, and (c) analyze the emerging designs from a societal perspective.					
Contents of the course	Definition of Design; Origin of designers; Historical context of design and designers. Designers and designed products: Art, design and technology - Select International and Indian designers. Industrial Revolution: Mass production, Birth of Modern architecture, International Style, The modern home. Craft and Design: Type forms; William Morris and Arts and Craft Movement; Shantiniketan. Design movements: Art Nuoveau; Art Deco, Werkbund; Bauhaus; De Stijl. Changing values: Information Revolution: Impact of technology, industrialization and globalization on design: kitsch, pastiche, 'retro'; Shopping malls. Design Studies: Materials and techniques; Chinese ceramics; Typology; Content analysis : Anthropology / sociology; Nationalist and global trends in Design; Nationalist Design; Global trends and global identity; Nostalgia, Heritage and Design;					
Textbook	1. Conway Hazel, Design History – A Students' Handbook, Routledge: London, 1987.					
References	1. Raizman David, History of Modern Design, Graphics and Products since the Industrial Revolution. Laurence King Publishing :London, 2003 2. Walker John. A, Design History and History of Design. Pluto Press: London, 2003. 3. Woodham Jonathan M, Twentieth Century Design, Oxford University Press: Oxford, 2003.					

Course Title	Earth, Environment & Design	Course No *(will be assigned)*				
Specialization	Interdisciplinary	Structure (LTPC)	2	0	0	2
Offered for	UG	Status	Core ■		Elective □	
Faculty		Type	New ■		Modification □	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
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.					
Contents of the course	Introduction to environment and ecology – Ecosystems – Principles concepts, components and function Atmospheric, aquatic and terrestrial ecosystems – Biogeochemical cycles and limiting factor concepts –Impacts of natural and human activities on ecosystems Environmental policies, acts and standards – Sustainable development and environmental impact assessment – Institutional frame work and procedures for EIA Methods for impact identification-matrices – Networks and Check lists – Environmental settings, indices and indicators Prediction and assessment of the impacts on air, water, land, noise and biological environments – Assessment of impacts of the cultural, socioeconomic and ecosensitive environments Mitigation measures, economic evaluation – Public participation and design making –Preparation of Environmental statement					
Textbook	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.					
References	1. Henry. J. G, and Heike, G. W, Environmental Science & Engineering, Prentice Hall International, 1996. 2. Dhameja. S. K, Environmental Engineering and Management, S. K. Kataria and Sons, 1999. 3. Shyam Divan and Armin Rosancranz, Environmental Law and Policy in India, Cases, Materials and Statutes, Oxford University Press, 2001.					

Course Title	Professional Ethics for Engineers	Course No *(will be assigned)*				
Specialization	Management	Structure (LTPC)	2	0	0	2
Offered for	UG & DD	Status	Core ■		Elective □	
Faculty		Type	New □		Modification ■	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	In this course, students will be aware on Human Values and Ethics in Professional life. They will understand social responsibility of a professional person especially of an engineer. They will learn the techniques and logical steps to solve ethical issues and dilemmas.					
Contents of the course	Professionalism and Ethics: Profession and occupation, Qualities of a professional practitioner, Variety of ethics and moral issues, moral dilemmas; Kohlberg's theory - Gilligan's theory of moral development - consensus and controversy. Values- concept of intrinsic good, instrumental good and universal good. Kant's theory of good action and formula for universal law of action. Codes of ethics for engineers: need and scope of a code of ethics; Ethics and Law (10) Understanding Ethical Problems: ethical theories – utilitarianism, cost-benefit analysis, Duty ethics - Right ethics and virtue ethics. Applications for various case studies. Ethical Problem Solving Techniques: issues-factual, conceptual and moral; Bribery and acceptance of gifts; Line drawing and flow charting methods for solving conflict problem. (09) Risk, Safety and Accidents: Safety and risk, types of risk, types of accidents and how to avoid accidents. Rights and Responsibilities of an Engineer: Professional responsibility, professional right and whistle blowing. Ethical Issues in Engineering Practice: environmental ethics, computer ethics, ethics and research. (09)					
Textbook	1. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004					
References	1. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000. 2. Velasquez. M. G, Business Ethics and Cases, 5 Edn, Prentice Hall, 2002. 3. Sekha. R.C, Ethical Choices in Business Response, Sage Publication, 2002. 4. Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw Hill, 1996.					

Course Title	Engineering Skills Practice	Course No *(will be assigned)*				
Specialization	Interdisciplinary	Structure (LTPC)	0	0	3	2
Offered for	UG & DD	Status	Core ■		Elective □	
Faculty		Type	New □		Modification ■	
Pre-requisite	----	To take effect from				
Submission date	March 2014	Date of approval by Senate				
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 – PCB making – Assembling and testing – Electrical wiring. 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 – PCB: designing and making of simple circuits – Soldering and testing of electronic components and circuits –Various types of Domestic wiring practice: Fluorescent lamp connection, Staircase wiring – Estimation and costing of domestic and industrial wiring – power consumption by Incandescent, CFL and LED lamps.					
Textbook	1. Uppal S. L., "Electrical Wiring & Estimating", 5Edn, Khanna Publishers, 2003. 2. Chapman. W. A. J., Workshop Technology, Part 1 & 2, Taylor & Francis.					
References	1. Clyde F. Coombs, "Printed circuits hand book", 6Edn, McGraw Hill, 2007. 2. John H. Watt, Terrell Croft, "American Electricians' Handbook: A Reference Book for the Practical Electrical Man", Tata McGraw Hill, 2002.					

Course Title	Engineering Electromagnetics Practice	Course No *(will be assigned)*				
Specialization	All Branches of UG	Structure (LTPC)	0	0	3	2
Offered for	UG	Status	Core ■		Elective ☐	
Faculty	Tapas Sil	Type	New ■		Modification ☐	
Pre-requisite	---	To take effect from				
Submission date	21/07/2014	Date of approval by Senate				
Objectives	The objective of this course is to give an 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 theconcept ofphenomena 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.					
Textbook	1. IIITD&M Laboratory manual for Electromagnetic Wave Practice					
References	1. W. H. Hayt and J. A. Buck, Engineering Electromagnetics, Tata McFraw Hill Education Pvt. Ltd, 2006.					

Course Title	Computational Engineering Practice	Course No *(will be assigned)*				
Specialization	Computer Engineering	Structure (LTPC)	0	0	3	2
Offered for	UG & DD	Status	Core ■		Elective □	
Faculty		Type	New □		Modification ■	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objective	The practice course would supplement the concepts presented in COM 102 course with assignments on application use and creation using the various programming constructs supported in C language. Programming assignments employing the various constructs are used to address real life situations such as a telephone directory creation / search, student grading, etc. A demo session to highlight the usability aspect relating to software / application development shall also be included.					
Contents of the course *(With approximate break up of hours)*	Learning operating system commands - editors – compilation - Assignments on using the operating system and open office suite - Programs involving output statements, input statements and expression evaluation - Assignments covering If-then-else statement iterative statements - Programs using arrays and functions based approach – Recursion sorting (bubble Sort) on a set of integers and a set of strings and linear search over a set of integers and a set of strings - structures and files in C - Implementation of a grading system computation of e^x, sin(x) and cos(x) - Bisection and Newton Raphson methods in C.					
Textbook	1. Deitel P J and Deitel H M, C : How To Program, Prentice Hall, 7th Edn, 2012.					
References	1. Kernighan, Ritchie D, The C Programming Language, Prentice Hall, 2 Edn 2. Chapra S.C and Canale R.P, Numerical Methods for Engineers, McGraw Hill, 2006.					

Course Title	Measurements and Data Analysis Practice	Course No *(will be assigned)*				
Specialization	Interdisciplinary	Structure (LTPC)	0	0	3	2
Offered for	UG & DD	Status	Core ■		Elective □	
Faculty		Type	New ■		Modification □	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	To introduce the students to different measurements techniques/instruments of data acquisition and statistical methods of data analysis. At the end of the course, the student should be able to plan/design, conduct, analyze and report the results of an experiment.					
Contents of the course	Role of Experiments and measurements: Evaluation of different measurement techniques in measurement of various physical/chemical/mechanical/electrical/thermal/environmental parameters Reporting Methodology: Collection, consolidation and reporting of the data Probability and Statistics: Presentation, analysis and interpretation of the data Uncertainty/Error Analysis: Performance evaluation and determination Signal Characterization, data acquisition and Analysis: Study of vivid waveforms and digitization process					
Textbook	1. Patrick F. Dunn, "Measurement and Data Analysis for Engineering and Science", First Edition, McGraw-Hill Book Company, 2005					
References	1. Julius S. Bendat, Allan G. Piersol, "Random Data: Analysis and Measurement Procedures", 4th Edition, Wiley, 2010 2. Anthony J. Wheeler, Ahmad Reza Ganji, "Introduction to Engineering Experimentation" 3rd Edition, Prentice Hall, 2010					

Course Title	Materials and Mechanics Practice	Course No *(will be assigned)*				
Specialization	Physics	Structure (LTPC)	0	0	3	2
Offered for	UG & DD	Status	Core ☑		Elective ☐	
Faculty		Type	New ☑		Modification ☐	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	The objective of this course is to give an hand on experience with mechanical properties of an object. 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 how to present the result.					
Contents of the course	Experiments here will give hand on experience of concepts of small oscillations, friction, elasticity and strength of material. Experiments will be done to measure various properties of different mechanical objects such as object such rigidity modulus, Young's modulus, radius of gyration etc. Study of material properties such as microstructure, hardness, response to tensile load and long-term constant loading etc. will also be done in various experiments.					
Textbook	1. IIITD&M Laboratory manual for Mechanics and Materials Practice					
References	1. F. Beer. R. Johnston, Vector mechanics for engineers: statics and dynamics. Tata McGraw-Hill, 2010. 2. Callister's Materials Science and Engineering, 2nd ED, Adapted by R Balasubramaniam, 2010,Wiley India Ltd.					

Course Title	Industrial Design Sketching	Course No *(will be assigned)*				
Specialization	Interdisciplinary	Structure (LTPC)	0	0	3	2
Offered for	UG & DD	Status	Core ■		Elective □	
Faculty		Type	New □		Modification ■	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	Develop necessary artistic skills required for the engineer to make communications with the industrial designers. Train the students to make realistic sketches of concept design using the commercial concept sketching software and hardware. This course will cover the concepts in perspective projections, shading, texturing, and concepts of light, shadow, reflection and colors.					
Contents of the course	• Role and importance of sketching in industrial design (2) • Principles of perspective drawing (8) • Perspective drawing of planar and curved shapes (12) • Shading and texturing (8) • Representation of shadow and reflections (8) • Colors in Industrial design and coloring (4) • Introduction to 3D forms and form development (4)					
Textbooks	1. Thomas C Wang, Pencil Sketching, John Wiley, 2002. 2. Itten Johannes, Design and Form, John Wiley, 1975.					
References	1. Kasprin Ron, Design Media – Techniques for Water Colour, Pen and Ink Pastel and colored markers, John Wiley,1999.					

Course Title	Engineering Graphics	Course No (will be assigned)				
Specialization	Interdisciplinary	Structure (LTPC)	1	0	3	3
Offered for	UG & DD	Status	Core ■		Elective □	
Faculty		Type	New □		Modification ■	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by AAC				
Objectives	To impart the basic engineering problem solving skills and to teach the fundamentals in technical drawing. Train the students to make orthographic projections and isometric projects of objects using drawing instruments and commercial drafting software.					
Contents of the course *(With approximate break up of hours)*	• Introduction to IS code of drawing (1hr) • Construction of basic shapes (4 hrs) • Dimensioning principles (1hr) • Conventional representations (1 hr) • Orthographic projection of points, lines, planes, right regular solids and objects (17 hrs) • Section of solids and objects (4 hrs) • Isometric projection of objects (6 hrs) • Intersection of solids (4 hrs) • Development of surfaces (4 hrs)					
Textbook	1. Narayana. K.L, and Kannaiah. P, Engineering Drawing, Charaotar Publ House, 1998. 2. Bhatt. N.D, Engineering Drawing, New Age International, 2007.					
References	1. Gopalakrishnan. K.R, Engineering Drawing, Subash Stores, 2002. 2. Natarajan. K.V, A text book of Engineering Drawing, Classic Prints, 2000.					

Course Title	Design Realization	Course No *(will be assigned)*				
Specialization	Design	Structure (LTPC)	0	0	3	2
Offered for	UG & DD	Status	Core ▬		Elective ☐	
Faculty		Type	New ▬		Modification ☐	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	In Product Realization Lab, students practice conceptualization, making of simple product and realize them.					
Contents of the Course	The students are exposed to tools and equipments to machine external appearance of products of simple shapes. Wood carving, Plastic welding and cutting, engraving, sheet metal works, wire cutting are some of the process that the students will learn and use for product realization. The students will also be exposed high end machines to realize the product during demo sessions. Few sessions will be allocated to re-design an existing simple products in terms of shape, size functionality etc.					

Syllabus of B. Tech. Computer Engineering (COE) for 3rd and 4th Semesters

(According to 26th Senate meeting held on 30th June 2015)

Course Title	Linear Algebra	Course No	To be filled by the office		
Specialization	Mathematics	Structure (IPC)	3	0	3
Offered for	UG and DD	Status	Core ■	Elective ☐	
Course Objectives	To impart knowledge of basic concepts and applications of Linear Algebra				
Course 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 the course *(With approximate break up of hours)*	**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 eigen spaces—diagonalizability conditions—invariant subspaces—spectral theorem. (10)				
Textbook	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.				
References	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.				

Course Title	Systems Thinking for Design	Course No	To be filled by the office		
Specialization	Design	Structure (IPC)	2	0	2
Offered for	UG and DD	Status	Core ■	Elective ☐	
Pre-requisite	Matrix Methods	To take effect from			
Course Objectives	Design for effectiveness – Level 1				
Course Outcomes	This course will help students understand • The importance of modeling systems to realize effective designs • Abstraction of key elements from problem situations • Use of specific techniques to model problems in a holistic manner				
Contents of the course	• Real-world problems & the need for inter-disciplinary approaches [2] • Basic concepts of systems thinking (parts, relations, patterns) [6] • Technique #1: Rich Pictures • Technique #2: Mapping Stakeholder, Needs, Alterables, Constraints [6] • Technique #3: Structural Modeling (Hierarchical decomposition) [6] • Technique #4: Influence Diagrams (Self-regulating systems) [6]				
Textbook	1. Hitchins, Derek K. (2007) Systems Engineering: A 21st Century Systems Methodology, John Wiley, ISBN: 978-0-470-05856-5. 2. Wilson, Brian (1991) Systems: Concepts, Methodologies and Applications. 2nd Edition, Wiley. ISBN: 0471927163. 3. Hutchinson, William; Systems Thinking and Associated Methodologies, Praxis Education. ISBN: 0 646 34145 6.				
References	1. Gerald Wienberg (2001), An introduction to general systems thinking, Dorset House Publishing. 2. Sage, A.P. (1977); Methodology for Large Scale Systems, McGraw Hill, New York.				

Course Title	Engineering Economics	Course No	To be filled by the office		
Specialization	Management	Structure (LTPC)	2	0	2
Offered for		Status	Core ■	Elective ☐	
Pre-requisite	Basic Mathematics	To take effect from			
Course Objectives	Help students learn basics of economics and cost analysis to make economically sound design decisions				
Course Outcomes	This course will help students understand: • the basics of micro-economics and cost analysis • Techniques to make economically sound decisions				
Contents of the course *(With approximate break up of hours)*	• Engineering Economic Decisions • Time is Money • Understanding Financial Statements • Cost Concepts and Behaviors • Understanding Money and Its Management • Principles of Investing • Present Worth Analysis • Annual Equivalent Worth Analysis • Rate of Return Analysis • Depreciation • Capital Budgeting Decisions				
Textbook	1. John A. White, Kellie S. Grasman, Kenneth E. Case, Kim LaScola Needy, David B. Pratt, "Fundamentals of Engineering Economic Analysis (First Edition)," Wiley 2014. 2. Chan S.Park, "Contemporary Engineering Economics," Prentice Hall of India, 2002.				
References	1. Blank Tarquin (2005). Engineering Economy. 6th Edition. McGraw-Hill.				

Course Title	Discrete Structures for Computing	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	3	0	3
Offered for	UG and DD	Status	Core ■		Elective ☐
Course 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.				
Course Outcomes	The learner would appreciate the importance of combinatorics and the various proof techniques, and in particular, in proving the correctness of algorithms. Counting principles learnt as part of the course will help the learner in counting various combinatorial objects				
Contents of the course	Mathematical Reasoning – Propositions – Predicates –First order logic –Methods of proof (10) Set theory – Relations between sets – Operation on sets –Inductive definition of sets (5) Binary relation and digraphs – Special properties of relations – Composition of relations – Closure operations on relations (5) Basic properties of functions – Inductively defined functions – Special classes of functions – Inverse functions, functions , Asymptotic growth of functions –(8) Basic counting techniques – Recurrence systems – Solving recurrence relations. Finite and Infinite sets –Countable and uncountable sets–Cardinal numbers (10) Graph Theory –Graphs – Sub graphs – Isomorphic and Homeomorphic graphs – Paths – Connectivity Bridges of Konisberg – Labeled and Weighted Graphs – Complete, Regular and Bipartite Graphs –Planar Graphs – Coloring (7)				
Textbook	1. K. H. Rosen, "Discrete Mathematics and its Applications," McGraw Hill, 6th Edition, 2007.				
References	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," Addison Wesley, 1994. 3. Busby, Kolman, and Ross, "Discrete Mathematical Structures," PHI, 6th Edition, 2008. 4. C. L. Liu, "Elements of Discrete Mathematics," Tata McGraw Hill, 1995.				

Course Title	Digital and Analog Circuits Design	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	3	0	3
Offered for	UG and DD	Status	Core ■		Elective ☐
Course Objectives	To introduce the basic understanding of digital representation, Boolean algebra and the operation of the logic components, combinational and sequential circuits, and to introduce the analog device concepts like diode, FET and op-amp.				
Course Outcomes	Students shall be able to construct digital circuits and systems for real life applications, and design amplifiers, analog to digital and digital to analog converters.				
Contents of the course	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. (5) Binary Codes: BCD, Gray, Excess 3, Alpha Numeric codes and conversion circuits. (3) Arithmetic circuits: Binary adders and subtractors, multipliers and division, ALU. (5) Synthesis of combinational logic functions using MSIs: mux/demux, decoders/encoders, Priority encoders, Comparators. (2) Sequential Circuits: Latches and Flip-Flops: SR, JK, D, T; Excitation tables. (2) Shift Registers, Counters, Random Access Memory. (3) 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. (8) Analog Circuits: Diodes – Basics and Circuits – Clippers, Clampers, rectifiers. (3) Transistors –Basics of Bipolar Junction Transistor and Field Effect Transistors – operating modes, amplifier circuits. (3) Operational amplifiers (op-amp) – Basics and op-amp circuits – non inverting and inverting amplifiers – Signal offset. (3) 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. (5)				
Textbook	1. M. Mano and C. Kime, "Logic and Computer Design Fundamentals," Prentice Hall, Upper Saddle River, NJ, 4th Edition, 2008. 2. B. Razavi, "Fundamentals of Microelectronics," Wiley Student Edition, 2010.				
References	1. Sedra and Smith, Microelectronic Circuits, 7th Edition, Oxford University Press. 2. J. F. Wakerly, "Digital Design - Principles and Practices," 3rd Edition, Pearson. 3. M. M. Mano, "Digital Design," PHI, 1979. 4. S. Franco, "Design with Operational Amplifiers and Analog Integrated Circuits," McGraw-Hill Series in Electrical and Computer Engineering, 4th Edition, 2015. 5. R. J. Tocci, N. S. Widmer, and G. L. Moss, "Digital Systems Principles and applications," Pearson Prentice Hall,10th Edition.				

<table>
<tr><td>Course Title</td><td>Signals, Systems, and Communication</td><td>Course No</td><td colspan="3">To be filled by the office</td></tr>
<tr><td>Specialization</td><td>Computer Engineering</td><td>Structure (IPC)</td><td>3</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>UG and DD</td><td>Status</td><td colspan="2">Core ■</td><td>Elective ☐</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The objective of this course is to introduce the students to the concepts of discrete time signals and systems, and their significance in practice. Further, the basics of digital communication like various digital modulation and demodulation techniques are introduced.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">At the end of the course, the students will have learnt about digital signal, analyze an LTI system with its impulse and frequency response. Further, students will be able to design an IIR filter (e.g., LPF and HPF). In the digital communication front, students will have learnt various digital modulation techniques and analyze their BER performance.</td></tr>
<tr><td>Contents of the course</td><td colspan="5"><u>Signal and Systems</u>
Types of signals, operation on signals, discrete time systems,-static, dynamic, stable, unstable, causal, LTI system, correlation –auto,cross correlation, properties, computation, Analog to digital conversion (8)

<u>Signal Processing</u>
Discrete Fourier Transform- Properties, Convolution- circular, linear, comparison (8)
Fast Fourier Transform: DIT-FFT (4)
Butterworth Filter design: low-pass, high-pass (4)

<u>Communications</u>
Modulation, need for modulation, Frequency Modulation, (8)
ASK,FSK,BPSK-BER performance, QAM. (8)</td></tr>
<tr><td>Textbook</td><td colspan="5">1. A. Oppenheim, R. Schafer, and J. Buck, “Discrete-Time Signal Processing,” Pearson, 2007.
2. S. Haykin and M. Moher, “An Introduction to Analog and Digital Communications,” Wiley, 2nd Edition, 2001.</td></tr>
<tr><td>References</td><td colspan="5">1. S. K. Mitra, “Digital Signal Processing,” McGraw Hill, 2nd Edition.
2. B. P. Lathi, “Modern Digital and Analog Communication Systems,” Oxford Press, 2008.</td></tr>
</table>

Course Title	Programming and Data Structures	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	0	3	2
Offered for	UG and DD	Status	Core ■		Elective ☐
Course Objectives	The objective of the course is to teach programming (with an emphasis on problem solving) and introduce elementary data structures. The student should, at a rudimentary level, be able to prove correctness (loop invariants, conditioning, etc) and analyze efficiency (using the `O' notation).				
Course Outcomes	At the end of the course, students will be able to design data structures so that efficient algorithms that make use of those data structures to solve a given problem				
Contents of the course	1. Review of Problem Solving using computers, Abstraction, Elementary Data Types: Algorithm design- Correctness via Loop invariants as a way of arguing correctness of programs, preconditions, post conditions associated with a statement. (3 lectures) Complexity and Efficiency via model of computation (notion of time and space), mathematical preliminaries, Elementary asymptotics (big-oh, big-omega, and theta notations). (3 lectures) 2. ADT Array -- searching and sorting on arrays: Linear search, binary search on a sorted array. Bubble sort, Insertion sort, Merge Sort and analysis; Emphasis on the comparison based sorting model. Counting sort, Radix sort, bucket sort. (6 lectures) 3. ADT Linked Lists, Stacks, Queues: List manipulation, insertion, deletion, searching a key, reversal of a list, use of recursion to reverse/search. Doubly linked lists and circular linked lists. (3 lectures) Stacks and queues as dynamic data structures implemented using linked lists. Analyse the ADT operations when implemented using arrays. (3 lectures) 4. ADT Binary Trees: Tree representation, traversal, application of binary trees in Huffman coding. Introduction to expression trees: traversal vs post/pre/infix notation. Recursive traversal and other tree parameters (depth, height, number of nodes etc.) (4 lectures) 5. ADT Dictionary: Binary search trees, balanced binary search trees - AVL Trees. Hashing - collisions, open and closed hashing, properties of good hash functions. (8 lectures) 6. ADT Priority queues: Binary heaps with application to in-place sorting (5 lectures) 7. Graphs: Representations (Matrix and Adjacency List), basic traversal techniques: Depth First Search + Breadth First Search (Stacks and Queues) (7 lectures)				
Textbook	1. M. A. Weiss, “Data Structures and Algorithm Analysis in C,” Addison-Wesley, 1997.				
References	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,” PHI, 1982. 5. Horowitz, Sahni and Anderson-Freed, “Fundamentals of Data Structures in C,” Silicon Press, 2007.				

Course Title	Digital and Analog Circuits Design Practice	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	0	3	2
Offered for	UG and DD	Status	Core ■		Elective ☐
Course Objectives	To provide hands on design and implementation of analog and digital circuits. Students will build simple digital systems on general purpose PCBs.				
Course Outcomes	Students shall be equipped with the skill set required for the construction of digital and analog circuits for real time applications using ICs.				
Contents of the course	Design and implementation of logic functions, combinational circuits (code converters, half & full adders, comparator, ripple carry adder, priority encoder, Decoders, Seven segment display, multiplexer) – Design of sequential Circuits. Design of 4-bit ALU (Adder, subtractor, logic and shift operations). Design project Static characteristics of rectifiers and filters, clipping and clamping circuits, Op-Amp based amplifier circuits				
Textbook	1. S. Franco, "Design with Operational Amplifiers and Analog Integrated Circuits," McGraw-Hill Series in Electrical and Computer Engineering, 4th Edition, 2015. 2. S. Brown and Z. Vranesic, "Fundamentals of Digital Logic with VHDL Design," TMH, 3rd Edition.				
References	1. R. J. Tocci, N. S.Widmer, and G. L. Moss, "Digital Systems Principles and applications," Pearson Prentice Hall, 10th Edition. 2. D. A. Newman, "Electronic Circuits," TMH, 4th Edition.				

Course Title	Data Structures Practice Using C-Programming	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	0	3	2
Offered for	UG and DD	Status	Core ■		Elective ☐
Course Objectives	Data Structure plays an important role in solving problems efficiently. Unless data are arranged in an efficient way, the algorithms which use the data cannot run efficiently. This course helps students to design and implement data structures to solve real world/mathematical problems.				
Course Outcomes	At the end of the course, students will be able to design efficient data structure which will be used by efficient algorithms to solve real problems.				
Contents of the course	The laboratory component will require the student to write computer programs using a careful choice of data structures (in C language) from scratch, based on the concepts learnt in the theory course. Arrays: Linear and Binary search(1)- Array and Pointer based implementation of list, stack and queue (2) - Application of linked lists – Polynomial manipulations (1) - Representing sets using lists and implementation of set theoretic operations(1) - Expression conversion(1) and evaluation of postfix expressions(1) - Binary trees (1)- binary search trees(2), AVL Trees and dictionary ADT using AVL trees(2)- Heap and Priority queue ADT implementation using Heap(2) –Hashtables(1)				
Textbook	1. M. A. Weiss, "Data Structures and Algorithm Analysis in C++," Pearson Education, 2nd Edition, 2002.				
References	1. T. H. Cormen, C. E. Leiserson, and R. L. Rivest, "Introduction to Algorithms," Prentice Hall India, 2nd Edition, 2001. 2. Aho, Hopcroft, and Ullmann, "Data Structures & Algorithms," Addison Wesley, 1983.				

Course Title	Probability Theory	Course No	To be filled by the office		
Specialization	Mathematics	Structure (IPC)	3	0	3
Offered for	B.Tech. (COE, EDM), DD (CED, ESD, EVD)	Status	Core ■	Elective ☐	
Course Objectives	To impart knowledge of basic concepts and applications of Probability and Statistics				
Course Outcomes	At the end of the course, a student will be able to apply the knowledge in solving engineering problems				
Contents of the course *(With approximate break up of hours)*	Introduction to Probability: Sets, Events, Axioms of Probability, Conditional Probability and Independence, Bayes Theorem and MAP Decision Rule (8) Random Variables: Definitions, Cumulative Distribution Functions, mass and density functions, joint and conditional distributions, Functions of Random Variables (8) Expectations: Mean, Variance, Moments, Correlation, Chebychev and Schwarz Inequalities, Moment-generating and Characteristic Functions, Chernoff Bounds, Conditional Expectations (8) Random Vectors: Jointly Gaussian random variables, Covariance Matrices, Linear Transformations, Diagonalization of Covariance Matrices (6) Random Sequences: Sequences of independent random variables, correlation functions, wide-sense stationary sequences, LTI filtering of sequences (6) Law of Large Numbers, Central Limit Theorem (6)				
Textbook	1. Stark and Woods, "Probability and Random Processes with Applications to Signal Processing," 3rd Edition, Pearson Education 2002. 2. S. Ross, "A First Course in Probability," 6th Edition, Pearson.				
References	1. J. S. Milton and J. Arnold, Introduction to Probability and Statistics, Tata McGraw Hill Education Private Limited, 4th Edition, 2006. 2. S. Kay, Intuitive Probability and Random Processes Using MATLAB, Springer, 2008. 3. R. M. Gray and L. D. Davisson, "An Introduction to Statistical Signal Processing," Cambridge University Press, 2004.				

Course Title	Designing Intelligent Systems	Course No	To be filled by the office		
Specialization	Design	Structure (LTPC)	2	0	2
Offered for	UG and DD	Status	Core ■	Elective □	
Pre-requisite	Systems Thinking for Design	To take effect from			
Course Objectives	Design for effectiveness – Level-2				
Course Outcomes	This course will help students understand • Principles of complex and living systems • Concepts such as Information intensity & Knowledge • Introduction to emerging digital technologies • Apply these ideas in design				

Contents of the course *(With approximate break up of hours)*	• Design Metaphors & Patterns (incl biomimetic) **[10]**
	  • Metaphors such as living systems, complex networks, viable systems
	  • Key principles governing living / complex systems (Self-organization, self-production, recursion, fractal)
	• Increasing information-intensity in products **[8]**
	  • Concept of information intensity vs material/energy intensity
	  • Self-learning, usage patterns, early warning systems
	  • Using data, voice, collaborative technologies (semantic, big data, speech, Remote-help, Indic computing), Internet-of-things
	• Synthesizing the above ideas for creative design **[8]**				

Textbook and References	1. H. G. Hey, A. M. Agogino, "Metaphors in Conceptual Design," ASME Design Engineering Technical Conferences, Las Vegas, Nevada, in review, 2007. 2. H. Casakin, and G. Goldschmidt, "Expertise and the Use of Visual Analogy: Implications for Design Education," Design Studies, 20(2), 153-175, 1999. 3. Kryssanov, V. V., Tamaki, H. and Kitamura, S., "Understanding Design Fundamentals: How Synthesis and Analysis Drive Creativity, Resulting in Emergence," Artificial Intelligence in Engineering, 15, 329 – 342, 2001.				

Course Title	Sociology of Design	Course No	To be filled by the office		
Specialization	Management	Structure (LTPC)	2	0	2
Offered for	UG and DD	Status	Core ■	Elective ☐	
Pre-requisite	None	To take effect from			
Course Objectives	Design as a Social Activity – Level 1				
Course Outcomes	This course will help students understand • Design as a social activity involving people, their relationships & values - How designs can emerge out of or be constrained by social patterns of relating • How technology can influence interactions among people, cooperative work, ethical issues around technology interventions • Exposure to techniques like ethnomethodology				
Contents of the course *(With approximate break up of hours)*	Basics concepts of sociology (behavior, interaction, language) **[6]** Historical evolution of Societies (Agrarian, Industrial, Digital) and current human and organizational contexts in which engineers and other professionals work, Personal and corporate social responsibility & ethics **[10]** Relationship between people (age, gender, cultures) and technology - Social and psychological dimensions of technological change, Technology & Work, Co-operative Work & Coordinative Practices, Ethnomethodology, Critical Systems Heuristics **[10]**				
Textbook and References	1. Manuel Castells (1996); The Rise of Network Society. 2. Herbert Blumer (1986); Symbolic Interactionism: Perspective and Method. 3. Herkert, J. (ed.), Social, Ethical, and Policy Implications of Engineering: Selected Readings. New York, NY: IEEE Press, 2000. 4. Heath, C. and Luff, P. (2000); Technology in Action, Cambridge: Cambridge Univ Press. 5. Werner Ulrich (1983), Critical Systems Heuristics, John Wiley, London.				

Course Title	Design and Analysis of Algorithms	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	0	3	3
Offered for	UG and DD	Status	Core ■		Elective ☐
Course Objectives	Data Structure and Algorithm course is essential to understand many areas in Computer Science and Engineering. This course also trains the students to solve problems using computer.				
Course Outcomes	At the end of the course, students will be able to design data structures and efficient algorithms to solve given problem.				
Contents of the course	Introduction to Asymptotic Notation – Solving Recurrence relations – Master's theorem – Recurrence Tree method (8) Incremental and Decremental Algorithm Design Strategies – case studies, lower bound for sorting (3) Divide & Conquer – Merge – Quick sort – Median Finding- (6) Greedy algorithms – knapsack problem (fractional and 0/1 versions) - Minimum spanning tree – Prims- Kruskal's algorithm- Huffman coding, Set of Intervals (6) Dynamic programming – case studies — LCS-Matrix Multiplication – Knapsack (7) Graph algorithms – Topological sort – Shortest path algorithms – Dijskstra's Algorithm, – Bellman-Ford's Algorithm (5) Solvability & Tractability – Introduction to unsolvable problem-Hatling problem- Introduction to NP-completeness – Search/Decision, SAT, Independent set, VC, X3C, Hamilton circuit, etc Backtracking – n queen problem-subset problem - Branch & Bound- Job Scheduling problem (10)				
Textbook	1. E. Horowitz, S. Sahni, and S. Rajasekaran, "Computer Algorithms," 2nd Edition, Galgotia Publications, 2007.				
References	1. T. H. Cormen, C. E. Leiserson, and R. L. Rivest, "Introduction to Algorithms," Prentice Hall India, 2nd Edition, 2001. 2. Aho, Hopcroft, and Ullmann, "Data Structures & Algorithms," Addison Wesley, 1983.				

Course Title	Database Systems	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	3	0	3
Offered for	UG and DD	Status	Core ■		Elective ☐
Course Objectives	The focus of this course is on database design, architecture, and relational models. Normal forms, internal schema design would also be explored				
Course Outcomes	Learner would appreciate the systematic design and principles involved in any database development. The importance of canonical normal forms and its design in large scale database systems would be a secondary outcome of this course				
Contents of the course	Introduction to Database Systems, Database System Architecture, Schema, Database Models, Relational Model, ER Modelling and case studies. (7) Expressive power of relational databases, Relational Algebra (5) Database Languages, DDL, DML, Structured Query Language (SQL), SQL views, case studies (8) Database Design, Normal Forms (First to third normal form), Boyce codd Normal Form, Database decomposition, Functional Dependencies, Loss-less Join decomposition(8) Transaction Processing and Concurrency control (4) Internal schema Design, Indexing, B-trees, B+ trees (5) Introduction to advanced concepts like Data mining, Data warehousing, XML (5)				
Textbook	1. R. Elmasri and S. B. Navathe, "Fundamentals of Database Systems," Pearson, 4th Edition, 2007.				
References	1. A. Silberschatz, H. F. Korth, and S. Sudharsan, "Database System Concepts," Tata McGraw Hill, 5th Edition, 2006. 2. C. J. Date, A. Kannan, and S. Swamynathan, "An Introduction to Database Systems," Pearson, 8th Edition, 2006.				

Course Title	Computer Organization and Design	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	3	0	3
Offered for	UG and DD	Status	Core ■		Elective □
Course 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				
Course Outcomes	Students will be able to interface and program various components such as Memory, I/O, etc. with the processor.				
Contents of the course	Introduction: function and structure of a computer, functional components of a computer, performance of a computer system. Instruction set architectures – CISC and RISC architectures.(5) 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. (5) Arithmetic Design: – Carry look ahead adder, Wallace tree multiplier, Floating–point adder/subtractor, Division. (5) The Processor: Logic Design Conventions, Building a Datapath, A Simple Implementation Scheme (3) An Overview of Pipelining, Pipelined Data path and Control, Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions and Parallelism via Instructions. (7) 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. (9) 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. (8)				
Textbook	1. Patterson and Hennessy, "Computer Organization and Design," Morgan Kaufmann, 5th Edition, 2013. 2. C. Hamacher, Z. Vranesic, and S. Zaky, "Computer Organization," Tata McGraw Hill, 5th Edition, 2002.				
References	1. J. P. Hayes, "Computer Architecture and Organization," Tata McGraw Hill 1998. 2. M. J. Murdocca, V. P. Heuring, "Computer Architecture and Organization - An Integrated Approach," John Wiley & Sons Inc., 2007. 3. A. S. Tanenbaum, "Structured Computer Organization," Prentice Hall,5th Edition, 2006.				

<table>
<tr><td>Course Title</td><td>Object Oriented Algorithm Design and Analysis Practice</td><td>Course No</td><td colspan="3">To be filled by the office</td></tr>
<tr><td>Specialization</td><td>Computer Engineering</td><td>Structure (IPC)</td><td>0</td><td>3</td><td>2</td></tr>
<tr><td>Offered for</td><td>UG and DD</td><td>Status</td><td colspan="2">Core ■</td><td>Elective ☐</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The objective is to introduce object oriented programming (OOP) paradigm and implement algorithms using OOP concepts.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">Students would be capable of using OOP concepts effectively while implementing various algorithmic paradigms.</td></tr>
<tr><td>Contents of the course</td><td colspan="5">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.

OOP concepts: Object oriented programming - Encapsulation – Constructors – Destructors - Composition – Friend functions/classes – this pointer – Dynamic memory management
Operator overloading Reusability – Inheritance – Base & derived classes – Protected members – Constructors –Destructors in derived classes – public/private/protected inheritance–Polymorphism
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

Case studies involving Data structures and Algorithms using OOPs concepts.</td></tr>
<tr><td>Textbook</td><td colspan="5">1. P. J. Deitel and H. M. Deitel, “C++ : How To Program,” Prentice Hall, 8th Edition, 2011.</td></tr>
<tr><td>References</td><td colspan="5">1. H. Schildt, “Teach Yourself C++,” 3rd Edition, Tata McGraw Hill.
2. R. Lafore, “Object Oriented Programming in C++,” 4th Edition, Sams Publishing.</td></tr>
</table>

Course Title	Database Systems Practice	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	0	3	2
Offered for	UG and DD	Status	Core ■		Elective ☐
Course Objectives	This course introduces SQL programming. Database design preserving functional dependencies and loss-less decomposition properties would be addressed.				
Course Outcomes	Conceptual design using ER diagrams, programming using structured query language, and database design respecting third normal form shall be the outcomes of this course.				
Contents of the course	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).				
Textbook	1. Loney Koch, Oracle – The complete reference, Tata McGraw Hill, 2002 2. R.Elmasri and S.B.Navathe, Fundamentals of Database Systems, Pearson, 4th Edn, 2007.				
References	1. A. Silberschatz, H. F. Korth, and S. Sudharsan, "Database System Concepts," Tata McGraw Hill, 5th Edition, 2006. 2. C. J. Date, A. Kannan, and S. Swamynathan, "An Introduction to Database Systems," Pearson, 8th Edition, 2006.				

Course Title	Computer Organization & Design Practice	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	0	3	2
Offered for	UG and DD	Status	Core ■		Elective ☐
Course 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.				
Course Outcomes	Students would be able to demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target computer, and design microcomputer systems.				
Contents of the course	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.				
Textbook	1. Patterson and Hennessy, "Computer Organization and Design," Morgan Kaufmann, 5th Edition, 2013.				
References	1. C. Hamacher, Z. Vranesic, and S. Zaky, "Computer Organizaton," Tata McGraw Hill, 2002.				

Syllabus of B.Tech Computer Engineering for 5th to 8th Semesters

(According to 28th Senate meeting held on 23rd December 2015)

Course Title	Sustainable Design	Course No	To be filled by the office		
Specialization	Design	Structure (IPC)	2	0	2
Offered for	UG and DD All streams	Status (Core / Elective)	Core		
Prerequisite	Earth Environment and Design	To take effect from			
Course Objectives	The objective of this course is to prepare engineering students to address product design from a broader, holistic perspective, integrating environmental responsibility into the core of the design process.				
Course Outcomes	Upon completion of the course students are expected to demonstrate knowledge, skill and abilities in the following areas: (a) To equip the design student with specific environmentally-responsive tools, principles and methodologies in preparation for professional application. Management (b) To use a variety of techniques to communicate effectively (sketches, illustrations, photographs, persuasive writing, presentation skills, etc.).				
Contents of the course	Module 1: Introduction, Definitions, History (4) • the environmental origins of sustainability • theory of sustainability. Module 2: Environmentally-responsive design methodologies (10) • industrial ecology • dematerialization • design for reuse / modularity • design for recycling • Remanufacturing: issues/problems, current and future developments Module 3: Alternative resources (10) • alternative energy • alternative materials • sustainable packaging. Module 4: life-cycle assessment methods. (8)				
Textbook	1. Victor Papanek, *The Green Imperative*, 1995, ISBN: 978-0500278468 2. William McDonough and Michael Braungart, *Cradle to Cradle*, 2009, ISBN: 978-0099535478 3. Stuart Walker (2006), *Sustainable by Design: Explorations in Theory and Practice*, ISBN: 978-1844073535 4. Charter, Tischner, *Sustainable Solutions*, Green Leaf Publishing, 2001, ISBN: 978-1874719366.				
References	1. Cattanach, Holdreith, Reinke, Sibik, *The Handbook of Environmentally Conscious Manufacturing*, 1995, ISBN: 9780786301478 2. Sim van der Ryn, Stuart Cowan, *Ecological Design*, 1995, ISBN: 978-1559633895 3. Paul Hawken, *The Ecology of Commerce*, 2010, Collins Business Essentials, ISBN: 978-0061252792 4. Nattrass & Altomare, *The Natural Step for Business*, New Society Publishers, 1999, ISBN: 978-0865713840.				

Course Title	Entrepreneurship and Management Functions	Course No	To be filled by the office		
Specialization	HMC	Structure (IPC)	2	0	2
Offered for	UG and DD All streams	Status (Core / Elective)	Core		
Prerequisite	Systems Thinking and Design	To take effect from			
Course Objectives	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.				
Course Outcomes	At the end of the course, the students will learn how to Understand the market & competition Prepare a business case for the product/idea				
Contents of the course	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)				
Textbook	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*, Himalaya Publishing House, ISBN:9788183184113.				
References	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.				

Course Title	Operating Systems	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	3	0	3
Offered for	UG and DD Computer Engineering	Status (Core / Elective)	Core		
Prerequisite	Computer Organization and Design	To take effect from			
Course 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.				
Course Outcomes	Students shall have a sound understanding of basic concepts relating to the design and implementation of an operating system. Specifics relating to scheduling, multithreading, synchronization, etc. shall help them understand the structure of the operating system (Linux), at the concept and the source code level.				
Contents of the course	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. (10) Concurrency – Multithreaded programming – benefits, challenges, models, Pthreads library in Linux – thread creation, cancellation, thread specific data, Thread pools, Signal handling , Scheduling – Premptive, Non preemptive algorithms FCFS, SJF, SRT, RR – Thread scheduling – contention scope, pthread support for scheduling. (11) 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. (10) 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. (11)				
Textbook	1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts, John Wiley, 9th Edn, 2015.				
References	1. Andrew S Tanenbaum, Modern Operating Systems, Prentice Hall, 2007. 2. Stallings. W, Operating System: Internals and Design Principles, Prentice Hall, 2009. 3. Gary Nut, Operating Systems: A Modern Perspective, Addison Wesley, 2003.				

Course Title	Computer Networking	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	3	0	3
Offered for	UG and DD Computer Engineering	Status (Core / Elective)	Core		
Prerequisite	Computer Organization and Design	To take effect from			
Course 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.				
Course Outcomes	To be able to design a local area network and analyze the network using performance metrics. To appreciate the importance of subnetting, masking, and nuances involved in setting up a campus network.				
Contents of the course	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. (10) 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). (10) 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 (12) 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. (10) Introduction to DHCP, FTP, HTTP and other application layer protocols. (3)				
Textbook	1. Larry L.Peterson and Bruce S Davie, Computer Networks: A systems Approach, Morgan, 3rd Edn, 2003. 2. William Stallings, Data and Computer Communications, 6th Edn, Pearson, 2000.				
References	1. Andrew S. Tanenbaum, Computer Networks, 4th Edn, 2003.				

Course Title	VLSI System Design	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	3	0	3
Offered for	UG and DD Computer Engineering	Status (Core / Elective)	Core		
Prerequisite	Computer Organization and Design	To take effect from			
Course Objectives	The goal of the course is to introduce architecture and design concepts underlying the modern complex VLSI circuits/systems and system-on-chip.				
Course Outcomes	The student would be able to design the digital subsystem using VLSI techniques and can estimate circuit/system performance, and design digital subsystems/system on chip.				
Contents of the course	MOS Transistors, CMOS Logic - Inverter, Logic Gates, Pass Transistors and Transmission Gates, Tristates, Multiplexers, Sequential Circuits. (3) CMOS Fabrication and Layout - Inverter Cross-section, Fabrication process, Layout Design Rules, Gate Layouts, Stick Diagrams. (4) Design Partitioning: Design Abstractions, Structured Design, Behavioral, Structural and Physical Domains. (3) Logic Design, Circuit Design, Physical Design, Design verification, Fabrication, Packaging and Testing. Technology related CAD Issues: Design Rule Checking (DRC), Circuit extraction. (4) Delay: Timing optimization, Transient response, RC Delay Model, Linear Delay Model, Logical Effort of Paths. Statistical timing analysis. (3) Power: Sources of Power Dissipation, Dynamic Power, Static Power, Energy-Delay Optimization, Low Power Architectures. (3) Robustness: Variability, Reliability, scaling, statistical Analysis of Variability, Variation-Tolerant design. (3) Datapath Subsystem, Array Subsystems, Special purpose Subsystems. (4) Design Methodology and Tools - Structured Design Strategies, Design Methods, Design Flows, Design Economics, Data sheets and Documentation. (4) Testing, Debugging and Verification: Testers, text fixtures, and Test Programs, Logic verification Principles, Silicon Debug Principles, Manufacturing Test Principles, Design for Testability. (4) CMOS chip design options: Full custom ASICs, Std. Cell based ASICs, Gate Array based ASICs, Programmable logic structures-PLA, PAL, PROM, FPGA. (7)				
Textbook	1. Weste & Eshraghian: Principles of CMOS VLSI design, Addison Wesley, 4th Edn, 2011.				
References	1. Samir Palnitkar; Verilog HDL - Guide to Digital design and synthesis, Pearson Education, 3rd Edn 2003. 2. Geiger R. L., Allen, P. E. and Strader, N. R., VLSI Design Techniques for Analog and Digital Circuits, McGraw-Hill, 1990. 3. Wolf W., Modern VLSI Design, Pearson Education, 1997.				

Course Title	Automata & Compiler Design	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	3	0	3
Offered for	UG and DD Computer Engineering	Status (Core / Elective)	Core		
Prerequisite	----	To take effect from			
Course Objectives	The objective of this course is to train students to design various phases of compiler such as Lexical analyzer, syntax analyzer, semantic analyzer, intermediate code generator, code optimizer and code generator. Students are also exposed to design compiler construction tools such as Lexical Analyser generator and parser generator. Fundamentals of automata theory and applications of finite sate machine and pushdown automaton in compiler design are also taught in this course.				
Course 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.				
Contents of the course	Introduction to phases of compiler– DFA – NFA to DFA —regular expression and its application to give syntax of word -regular expression to NFA, Construction of NFA without epsilon moves from regular expression- Regular grammar-regular grammar to automata, and automata to regular grammar-Minimization of automata- Pumping lemma application-Lexical analyzer Design (12) 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 (10) Semantic analysis - Intermediate code generation: Declaration – Assignment statements – Boolean expressions – looping and branching statements (7) 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 (10) Storage optimization & allocation strategies).Assembly Code Generation: from syntax tree and Directed acyclic graph - from three address code. (5)				
Textbook	1. Alfred Aho, Ravi Sethi and Jeffrey D Ullman, Compilers Principles, Techniques and Tools, Pearson Education, 2003.				
References	1. Levine J.R, Mason T, Brown D, Lex & Yacc, OReilly Associates, 1992. 2. Allen I. Holub, Compiler Design in C, Prentice Hall, 2003. 3. Kamala Krithivasan and R Rama, Introduction to Formal Languages, Automata Theory and Computation, Pearson Education, 2009.				

Course Title	Computer Networking Practice	Course No	To be filled by the office		
Specialization	Computer Science and Engineering	Structure (IPC)	0	3	2
Offered for	B.Tech Computer Engineering	Status (Core / Elective)	Core		
Prerequisite	----	To take effect from			
Course 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.				
Course Outcomes	Learner would be comfortable in design, testing, and trouble shooting aspects associated with local area networking. Learner would also appreciate the importance of error detecting codes and flow control techniques.				
Contents of the course	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.				
Textbook	1. Larry L.Peterson and Bruce S Davie, Computer Networks: A systems Approach, 3rd Edn, Morgan, 2003. 2. William Stallings, Data and Computer Communications, 6th Edn, Pearson, 2000.				
References	1. Andrew S. Tanenbaum, Computer Networks, 4th Edn, 2003				

Course Title	Operating Systems Practice	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	0	3	2
Offered for	B.Tech. and DD	Status (Core / Elective)	Core		
Prerequisite	----	To take effect from			
Course 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.				
Course Outcomes	The student shall be able to relate the operating system concepts listed above to the Linux operating system and support for the same available through various system calls.				
Contents of the course	Linux System Calls for process creation, management – Applications such as command prompt simulator using fork – Interprocess Communication using Shared Memory and Pipes – Producer Consumer – Applications using pipes / shm – Concurrency – Multithreading –Pthread support – Applications such as merge sort, min-max-average, etc. in a multi threaded fashion – Scheduling –pthread interfaces setschedpolicy – getschedpolicy based applications – Synchronization – threaded solution for classical problems like dining philosophers, readers writers, etc. using mutex locks and semaphores - Deadlock detection / avoidance algorithms.				
Textbook	1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts, John Wiley, 9th Edn, 2015.				
References	1. Robert Love, Linux Systems Programming, O Reilly Media, 2nd Edition 2. D Butlar, J Farrell, B Nichols, Pthreads Programming, O Reilly Media, 1996				

Course Title	VLSI System Design Practice	Course No	To be filled by the office		
Specialization	Computer Science and Engineering	Structure (IPC)	0	3	2
Offered for	B.Tech Computer Engineering	Status (Core / Elective)	Core		
Prerequisite	----	To take effect from			
Course Objectives	The lab course is intended to give exposure to the design of different functional components of a computer system using Verilog and development kits, and use VLSI Design flow to generate RTL to GDS-II format.				
Course Outcomes	The student would be able to model and design any digital system at circuit/layout level. They will also be able to design an ASIC using RTL codes.				
Contents of the course	Design at circuit level and layout level for Datapath Subsystem Design: Addition/Sbtraction, one/zero Detectors, comparators, counters, shifters, multiplication, SRAM, DRAM, ROM, Flash, CAM – Delay, Area and Power Analysis using EDA Tools. Simple Digital System design using Verilog HDL – VLSI Design flow from RTL to GDS-II using EDA Tools.				
Textbook	1. Samir Palnitkar; Verilog HDL - Guide to Digital design and synthesis, 3rd Edn, Pearson Education, 2003.				
References	1. Weste & Eshraghian: Principles of CMOS VLSI design, 4th Edn, Addison Wesley 2011.				

Course Title	Design for Quality and Reliability	Course No	To be filled by the office		
Specialization	Design	Structure (IPC)	2	0	2
Offered for	B.Tech. and DD All streams	Status (Core / Elective)	Core		
Prerequisite	Measurements and Data Analysis Lab (Probability and Statistics)	To take effect from			
Course Objectives	The objectives of the course are to help engineering students understand: (1) To understand concepts of quality & reliability (2) To evaluate the overall reliability of a system from component reliability.				
Course Outcomes	Attending the course would enable the student to: 1. Model repairable and non-repairable systems and calculate failure rate, repair rate, reliability and availability 2. Use various probability density distributions significant to reliability calculations 3. Fit a given failure data set of a product into a Weibull distribution and estimate the reliability parameters.				
Contents of the course	Module 1: Concepts of Product Quality • Quality Function Deployment / House of Quality • Six Sigma (6) Module 2: Concepts of Reliability · Basic concepts of repairable and non-repairable systems · Reliability, Availability and Maintainability (6) Module 3: Failure data analysis · Fitting discrete and continuous distributions to failure data sets, Weibull analysis, estimation of important reliability parameters (8) Module 4: Calculation of System Reliability from Component reliabilities · Markov modeling of repairable and non-repairable systems · Reliability Logic Diagrams · Fault-tree analysis (8) Module 5: Preventive and Predictive maintenance Failure Modes and Effects Analysis. (4)				
Textbook	1. Louis Cohen, Joseph P. Ficalora, *Quality Function Deployment and Six Sigma: A QFD Handbook*, Prentice Hall, Second Edition, 2009, ISBN: 9780137035441 2. VNA Naikan, *Reliability Engineering and Life Testing*, PHI Learning, 2010, ISBN: 978-8120335936 3. Singiresu S Rao, *Reliability Engineering,* Pearson Education, 2014, ISBN: 978-0136015727				
References	1. Patrick O Connor, *Practical Reliability Engineering,* John Wiley, Student ed., 2009, ISBN:9780470979815 2. 2. B.L. Hansen & P.M. Ghare, *Quality Control and Applications,* Prentice-Hall, 1997, ISBN: 9780137452255				

Course Title	Product Management	Course No	To be filled by the office		
Specialization	HMC	Structure (IPC)	2	0	2
Offered for	B.Tech. and DD All streams	Status (Core / Elective)	Core		
Prerequisite	Entrepreneurship and Management	To take effect from			
Course Objectives	The course provides an introduction to product management with an emphasis on product strategy, product development, product life-cycle management, platform and portfolio management and branding.				
Course Outcomes	This course will equip engineering students with an understanding of · The role of product management in a new or established technology enterprise · Techniques to price, promote, position and track profitability of product				
Contents of the course	Module 1: Introduction to Product Management · Core responsibilities of Product Management within an organization · Typical Product Development Process & Product Life Cycle · Key Product Management Concepts (`Value", "Market", "Minimum Viable Product") (4) Module 2: Product Marketing · Market Research, Market segmentation, Entry strategy · Test marketing, and Tracking New Product Launch · Brand Management (10) Module 3: Product Strategy, Roadmap and Organization · Corporate strategy & Product strategy · Product Platforms, Product Lines &Product Portfolio Management · Risk Management (market, technology, portfolio) · Organization structures for product management & new product development (8) Module 4: Product Life Cycle Management Tools & Product Profitability Assessment (8)				
Textbook	1. Jakki J Mohr and Sanjit Sengupta, *Marketing of High-Technology Products and Innovations*, Pearson Education, 2nd Edition, 2011, ISBN:978-0136049968 2. John Stark, *Product Lifecycle Management: 21st Century Paradigm for Product Realisation*, Springer, 2011, ISBN: 9781447126782 3. Karl T. Ulrich and Steven D. Eppinger, *Product Design and Development*, McGraw-Hill, Sixth Edition, 2016, ISBN:978-0070658110				
References	1. Steven Haines, *Product managers desk reference*, McGraw Hill, 2nd Edition, 2014, ISBN:978-0071591348.				

Course Title	Embedded Systems	Course No	To be filled by the office		
Specialization	Electronics Engineering	Structure (IPC)	3	0	3
Offered for	B.Tech. and DD	Status (Core / Elective)	Core		
Prerequisite	----	To take effect from			
Course Objectives	To provide a hands-on introduction to design of embedded systems hardware and software, and interfacing in real-time to networked cyber-physical systems.				
Course Outcomes	1. Understand the basic elements of embedded systems such as I/O and interfaces 2. Understand embedded system design using the ARM Cortex-M microcontroller with the Launchpad IDE 3. Experiment with programming in assembly language and C on the Launchpad 4. Rapid prototyping of embedded systems using open source microcontrollers (Arduino, Raspberry Pi, and BeagleBone Black) and Arduino shields 5. Introduction to advanced concepts such as networking and wireless communications, real-time operating systems and control, and Internet of Things				
Contents of the course	Introduction to Embedded Systems: history and trends (1) Elements of embedded systems such as GPIO, communication, interrupts, ADC, DAC (10) Implementation of embedded systems: architecture, logic, timing, loading, protocols, and software (3) Embedded systems design using ARM Cortex-M TM4C Launchpad IDE, and projects with sound, video games, and mobile robots (6) Design methodologies, hardware-software co-design (3) Introduction to advanced concepts such as real-time interfacing and operating systems (5) Rapid prototyping of embedded systems with open source microcontrollers and Arduino shields (9) IOT systems design using open source hardware (Intel and Microsoft kits) (8)				
Textbook	1. J. W. Valavano, "Embedded Systems: Introduction to Arm® Cortex(TM)-M Microcontrollers", 5th ed, CreateSpace, 2012				
References	1. J. W. Valavano, "Embedded Systems: Real-Time Interfacing to Arm® Cortex(TM)-M Microcontrollers, 2nd ed, CreateSpace, 2011 2. J. W. Valavano, "Embedded Systems: Real-Time Operating Systems for Arm Cortex M Microcontrollers", CreateSpace, 2012 2. 3. A. McEwen and H. Cassimally, "Designing the Internet of Things", Wiley, 2013				

Course Title	Computer Architecture	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	3	0	3
Offered for	B.Tech. and DD	Status (Core / Elective)	Core		
Prerequisite	Computer Organization and Design	To take effect from			
Course Objectives	The course aims to expose students to the concepts involved in the design of computer systems covering aspects such as instruction sets, pipelining, caches, physical memory, virtual memory, superscalar and out-of-order instruction execution, vector processor and multi-threading				
Course Outcomes	Students will have the ability to design a computer system addressing issues related to Instruction level, data level and thread level parallelisms.				
Contents of the course	Fundamentals of Quantitative, Design and Analysis Computers. (3) Memory Hierarchy Design: Optimizations of Cache Performance, Memory Technology and Optimizations, Virtual Memory and Virtual Machines. (7) Instruction-Level Parallelism and Its Exploitation: ILP Concepts and Challenges, Overcoming Data Hazards with Static and Dynamic Scheduling, Reducing Branch Costs with Advanced Branch Prediction, Static and Dynamic Scheduling, Hardware-Based Speculation, Studies of the Limitations of ILP. (12) Multi-Threading: Exploiting Thread-Level Parallelism to Improve Uniprocessor Throughput (5) Data-Level Parallelism in Vector, SIMD, and GPU Architectures: Vector Architecture, Detecting and Enhancing Loop-Level Parallelism. (5) Thread-Level Parallelism: Centralized Shared-Memory Architectures, Performance of Symmetric Shared-Memory Multiprocessors, Distributed Shared-Memory and Directory-Based Coherence, Synchronization, Models of Memory Consistency, Multicore Processors and Their Performance. (5) Warehouse-Scale Computers to Exploit Request-Level and Data-Level Parallelism: Programming Models and Workloads for Warehouse-Scale Computers, Computer Architecture of Warehouse-Scale Computers, Physical Infrastructure and Costs of Warehouse-Scale Computers, Cloud Computing: The Return of Utility Computing. (5)				
Textbook	1. John L. Hennessy and David A. Patterson, Computer Architecture, Fifth Edition: A Quantitative Approach, The Morgan Kaufmann, 5th Edn, 2012.				
References	1. John P. Shen and Mikko H. Lipasti, Modern Processor Design: Fundamentals of Superscalar Processors, Waveland Press, 1st Edn, 2005, 2. D.M. Harris and S.L. Harris. Digital Design and Computer Architecture, 2nd Edn. Morgan Kaufmann, 2012. 3. M. Johnson. Superscalar Microprocessor Design, Prentice Hall, 1991.				

Course Title	Computer Architecture Practice	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	0	3	2
Offered for	B.Tech. and DD	Status (Core / Elective)	Core		
Prerequisite	----	To take effect from			
Course Objectives	The course aims to be a hands on to the supplementing theory course with exposure to issues related to computer systems design on instruction level ad thread level parallelism.				
Course Outcomes	Students will have the ability to design multi core systems for a given specification using electronic design automation tools.				
Contents of the course	Incrementally design, implement, test, and evaluate a complete multi-core system with an integrated collection of processors, memories. A processor includes – pipeline arithmetic operation, register file, branch predictors, hardware based instruction scheduling and commit, cache design, MESI.				
Textbook	1. John L. Hennessy and David A. Patterson, Computer Architecture, Fifth Edition: A Quantitative Approach, The Morgan Kaufmann, 5th Edn, 2012. 2. Samir Palnitkar, Verilog HDL: A Guide to Digital De sign and Synthesis, Second Edition, Prentice Hall, 2003.				
References	1. John P. Shen and Mikko H. Lipasti, Modern Processor Design: Fundamentals of Superscalar Processors, Waveland Press, 1st Edn, 2005, 2. D.M. Harris and S.L. Harris. Digital Design and Computer Architecture, 2nd Edn Morgan Kaufmann, 2012. 3. M. Johnson. Superscalar Microprocessor Design, Prentice Hall, 1991.				

Course Title	Embedded Systems Practice	Course No	To be filled by the office		
Specialization	Electronics Engineering	Structure (IPC)	0	3	2
Offered for	B.Tech. and DD	Status (Core / Elective)	Core		
Prerequisite	----	To take effect from			
Course Objectives	In this course fundamental practices in the context of embedded systems will be covered. Hands-on experiments will be performed involving TI ARM Cortex-M microcontroller LaunchPad IDE (and booster packs), rapid prototyping of embedded systems using open source microcontrollers (Arduino, Raspberry Pi, BeagleBone Black), wireless networked embedded systems using Arduino shields, and Internet of Things concepts such as smart automation.				
Course Outcomes	At the end of the course, a student will be able to, 1. Understand how embedded systems interfaces operate (GPIO, interrupts, ADC/DAC, etc.) using the ARM Cortex LaunchPad IDE and booster packs 2. Perform experiments in sound, video (gaming) and mobile robots, with LCD displays, stepper and DC motors and RC servos 3. Rapid prototype embedded systems using open source microcontrollers (such as Arduino, Raspberry Pi, BeagleBone Black, and Intel Edison/Galileo). 4. Build wireless networked embedded systems using Arduino shields and modules (e.g., GPS, GSM/GPRS, Bluetooth, RFID, and ZigBee). 5. Conduct experiments in Internet of Things (e.g., using Arduino Yun, Intel and Microsoft Developer Kits)				
Contents of the course	Experiments in GPIO, serial interfacing, interrupts, data acquisition with ADC, sound and video, DAC Experiments in control of RC servos, stepper motors, DC motors, and design of video games and mobile robots Data acquisition and real-time control with Arduino, Raspberry Pi, and BeagleBone Black microcontrollers, shields, and add-on boards Experiments in wireless networked systems, using shields and modules, for GPS, GSM/GPRS, ZibBee, Bluetooth, and RFID Experiments in IOT for smart automation, with Intel and Microsoft development kits				
Textbook	1. IIITDM Kancheepuram –Embedded Systems Practice Manual.				
References	1. Jonathan Valvano and Ramesh Yerraballi, 2014, “Embedded Systems – Shape the World” (ebook). 2. T. Igoe, 2007, “Making things talk”, O’Reilly Press.				

Course Title	Product Design Practice	Course No	To be filled by the office		
Specialization	Design	Structure (IPC)	0	2	2
Offered for	UG and DD students of all branches	Status (Core / Elective)	Core		
Prerequisite	Design Realization, Product Realization	To take effect from			
Course Objectives	Students will develop cross-discipline products and prototype them using product realization tools in a multi- disciplinary team setting.				
Course Outcomes	By the end of the course, the students would be able to • Develop cross disciplinary idea • conceive, design and prototype an innovative idea • work in cross-functional groups and to apply the concepts learnt in theory to a practical problem • manage group projects, maintain timeliness and follow method oriented approach to problem solving				
Contents of the course	This course is an interdisciplinary team based product design and prototyping course. The concept of the course is to provide hands-on learning experience in interdisciplinary fields of engineering and exposure to the context of a "real" product design problems. In this course students will design a product by following the systematic product design process. A team consist of students from different discipline will choose their own innovative product and while designing, students will consider many issues like market opportunities, formal requirements and constraints, the environment in which the product will be used, product look and feel; technical legitimacy, and manufacturing considerations for the products. During the course, students will learn and put in to practice team working, project management and product realization practices commonly found in product developers in industry. Throughout the semester, the student teams have several opportunities to present their progress to their fellow students and faculty.				
Textbooks	1. Carl Liu, Innovative Product Design Practice, Kindle Edition, ASIN: B00B29V9RQ 2. Bjarki Hallgrimsson, Prototyping and Modelmaking for Product Design, 2012, Laurance King Publishing Limited, ISBN-13: 978-1856698764.				

Course Title	Human Computer Interaction	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	3	0	3
Offered for	B.Tech. and DD	Status (Core / Elective)	Core		
Prerequisite	----	To take effect from			
Course Objectives	The course focuses on fundamental principles relating to the design, implementation and evaluation of interactive applications. User centric design approaches that contribute to the development of usable interface and interaction are focused.				
Course Outcomes	Students gain a sound understanding of the interdisciplinary nature of HCI and are equipped with skill sets required for the creation of used, useful and usable applications.				
Contents of the course	Psychological theories of human behavior – Frameworks for HCI and Models – Interaction Paradigms - Interaction Design – Navigation Design (12) Usability Engineering – Life cycle model – Design rules for enhanced usability – Implementation Support (10) Evaluation Techniques – Universal Design – User Support Systems (10) Cognitive models – Dialog notations and design – Web Usability – Guidelines (10)				
Textbook	1. Alan Dix, J Finlay, G D Abowd, R Beale Human Computer Interaction, 3rd Edition, Prentice Hall				
References	1. Jakob Nielsen, Usability Engineering, Morgan Kauffman, 1993 2. Handbook of Human Computer Interaction, 2nd Edition, Elsevier, 1997. 3. Articles from Nielsen Norman Group relating to Usability and User Experience				

Course Title	Innovation Management	Course No	To be filled by the office		
Specialization	HMC	Structure (IPC)	2	0	2
Offered for	B. Tech. and DD All streams	Status (Core / Elective)	Core		
Prerequisite	Entrepreneurship and Management	To take effect from			
Course Objectives	The objective of this course is to help engineers understand the innovation challenge from the entrepreneur and manager's perspective, i.e., both at a strategic level and organizational level. In other words, how do entrepreneurs and managers build organizations and ecosystems that can continuously generate and commercialize innovations, and how can they protect and enhance competitive advantage				
Course Outcomes	At the end of the course, students will have a familiarity with: · Topics in strategic innovation management, such as innovation networks, idea brokering, open innovation; · Innovation processes and structures such as R&D team, the pros and cons of various R&D organizational structures, and challenges of innovation in large and small firms; · Skills to identify, evaluate, and resolve a variety of issues relating to poor innovative performance in large firms as well as entrepreneurial firms.				
Contents of the course	Module 1: Exploring innovations · Processes used to explore innovations along the technology, market and strategy dimensions as the innovation moves from idea to market. · Introduction to concepts such as Blue Ocean Strategy, Value Network, Disruptive Innovation, Open Innovation (8) Module 2: Executing innovations · Structures and incentives to effectively allow talented individuals from different functions to execute innovation processes · Roles such as Chief Innovation or Technology Officer or Technology Evangelist(8) Module 3: Exploiting innovations · Strategies to effectively exploit the value of innovation, including innovation platforms that include multiple products, portfolios, standards and business models (8) Module 4: Renewing innovations · Processes, structures and strategies for exploring, executing and exploiting innovations that established firms can use to renew their innovation foundations in the face of potentially disruptive innovations. (8)				
Textbook	1. Paul Trott, *Innovation Management and New Product Development*, Pearson, Fifth Edition, 2011, ISBN:9781447916079 2. Joe Tidd and John Bessant, *Managing Innovation: Integrating Technological, Market and organizational change*, Wiley, 2009, ISBN:978-1-118-53859-3. 3. Burgelman R. Christensen C., Maidique M., Wheelwright S., *Strategic Management of Technology and Innovation*. McGraw Hill, 2007, ISBN: 9780071232302				
References	1. Christensen, Clayton M., *The innovator's solution: creating and sustaining successful growth*, Harvard Business Press, 2003, ISBN: 9781578518524 2. Forbers, Naushad and David Wield, *From Followers to Leaders - Managing technology and innovation*, Routledge, 2002, ISBN:9780415251754				