SEMESTER I

<table>
<tr><td>Course Title</td><td>Calculus</td><td>Course No
(will be assigned)</td><td colspan="4">MAT104T</td></tr>
<tr><td>Department</td><td>Sciences</td><td>Structure (LTPC)</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>UG</td><td>Type</td><td colspan="2">Core</td><td colspan="2"></td></tr>
<tr><td>Pre-requisite</td><td>Nil</td><td>To take effect from</td><td colspan="4"></td></tr>
<tr><td>Objectives</td><td colspan="6">The course will introduce the student to basic concepts in Calculus such as convergence, differentiation & integration and its applications.</td></tr>
<tr><td>Contents of the course</td><td colspan="6">Limit and Continuity of functions defined on intervals, Intermediate Value Theorem, Differentiability, Rolle’s Theorem, Mean Value Theorem, Taylor’s Formula. (5)

Sequences and series. (7)

Definite integral as the limit of sum – Mean value theorem – Fundamental theorem of integral calculus and its applications (9)

Functions of several variables – Limit and Continuity, Geometric representation of partial and total increments Partial derivatives – Derivatives of composite functions. (8)

Directional derivatives – Gradient, Lagrange multipliers – Optimization problems. (7)

Multiple integrals – Evaluation of line and surface integrals. (6)</td></tr>
<tr><td>Textbook</td><td colspan="6">1. Thomas. G.B, and Finney R.L, Calculus, Pearson Education, 2007.</td></tr>
<tr><td>References</td><td colspan="6">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.</td></tr>
</table>

Course Title	Engineering Mechanics	**Course No** ***(will be assigned)***	PHY108T			
Department	Sciences	**Structure (LTPC)**	3	0	0	3
Offered for	UG	**Type**	Core			
Pre-requisite	Nil	**To take effect from**				
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 strain); 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	Computational Engineering	**Course No** ***(will be assigned)***	COM105T			
Department	CSE	**Structure (LTPC)**	3	0	0	3
Offered for	UG	**Type**	Core			
Pre-requisite	Nil	**To take effect from**				
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	Concepts in Engineering Design	**Course No** ***(will be assigned)***	DES101T			
Department	Sciences	**Structure (LTPC)**	3	0	0	3
Offered for	UG	**Type**	Core			
Pre-requisite	Nil	**To take effect from**				
Objective	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 today's 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)***	INT107T			
Department	Sciences	**Structure (LTPC)**	2	0	0	2
Offered for	UG	**Type**	Core			
Pre-requisite	Nil	**To take effect from**				
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, analyze 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. Leech, Geoffrey & Jan Svartvik, A Communicative Grammar of English, Longman, 2003					

Course Title	Earth, Environment & Design	**Course No** ***(will be assigned)***	DES103T			
Department	Sciences	**Structure (LTPC)**	2	0	0	0
Offered for	UG	**Type**	Core			
Pre-requisite	Nil	**To take effect from**				
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 eco-sensitive 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	Engineering Skills Practice	**Course No** ***(will be assigned)***	INT110P			
Department	Sciences	**Structure (LTPC)**	0	0	3	2
Offered for	UG	**Type**	Core			
Pre-requisite	Nil	**To take effect from**				
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	Materials and Mechanics Practice	**Course No** ***(will be assigned)***	PHY109P			
Department	Sciences	**Structure (LTPC)**	0	0	3	2
Offered for	UG	**Type**	Core			
Pre-requisite	Nil	**To take effect from**				
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	Computational Engineering Practice	**Course No** ***(will be assigned)***	COM105P			
Department	CSE	**Structure (LTPC)**	0	0	3	2
Offered for	UG	**Type**	Core			
Pre-requisite	Nil	**To take effect from**				
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, 7^{th} 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	Engineering Graphics	**Course No (will be assigned)**	INT109P			
Department	Mechanical	**Structure (LTPC)**	1	0	3	3
Offered for	UG	**Type**	Core			
Pre-requisite	Nil	**To take effect from**				
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 & 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.					

SEMESTER II

Course Title	Differential Equations	**Course No** ***(will be assigned)***	MAT105T			
Department	Sciences	**Structure (LTPC)**	3	0	0	3
Offered for	UG	**Type**	Core			
Pre-requisite	Nil	**To take effect from**				
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, 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 Electromagnetics	**Course No** ***(will be assigned)***	PHY107P			
Department	Sciences	**Structure (LTPC)**	3	0	0	3
Offered for	UG	**Type**	Core			
Pre-requisite	Nil	**To take effect from**				
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	Science and Engineering of Materials	**Course No** ***(will be assigned)***	INT108T			
Department	Mechanical	**Structure (LTPC)**	3	0	0	3
Offered for	UG	**Type**	Core			
Pre-requisite	Nil	**To take effect from**				
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	Basic Electrical and Electronics Engineering	**Course No** ***(will be assigned)***	EC101T			
Department	ECE	**Structure (LTPC)**	3	0	0	3
Offered for	UG	**Type**	Core			
Pre-requisite	Nil	**To take effect from**				
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 two port networks.					
Course Outcomes	At the end of this course, the students will be able to 1. Design the electric circuits with passive components. 2. Analyse the voltage and current of an electric circuit. 3. Understand the PN junction diode and BJT.					
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. (6 hours) 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 hours) 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 hours) RC and RL circuits: natural, step and sinusoidal steady state responses, series and parallel RLC circuits, natural, step and sinusoidal steady state responses. (5 hours) AC signal measures: complex, apparent, active and reactive power, power factor. (2 hours) Introduction to three phase supply: three phase circuits, star-delta transformations, balanced and unbalanced three phase load, power measurement, two wattmeter method. (3 hours)					

	Semiconductor diodes and application: PN diodes, rectifiers and filters, clipping and clamping circuits, voltage multiplier circuits. (6 hours)
Textbook	1. Hayt. W. W, Kemmerly. J.E, and Durbin. S.M, Engineering Circuits Analysis, Tata McGraw Hill, 2008.
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	Industrial Design Sketching	**Course No** ***(will be assigned)***	DES104P			
Department	Mechanical	**Structure (LTPC)**	0	0	3	2
Offered for	UG	**Type**	Core			
Pre-requisite	Nil	**To take effect from**				
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	Measurements and Data Analysis Practice	**Course No** ***(will be assigned)***	INT111P			
Department	Sciences	**Structure (LTPC)**	0	0	3	2
Offered for	UG	**Type**	Core		Elective	
Pre-requisite	Nil	**To take effect from**				
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	Engineering Electromagnetics Practice	**Course No** ***(will be assigned)***	PHY107P			
Department	Sciences	**Structure (LTPC)**	0	0	3	2
Offered for	UG	**Type**	Core			
Pre-requisite	Nil	**To take effect from**				
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 the concept of phenomena such as interference, diffraction etc. related to electromagnetic waves will be done here and these methods will be applied to measure some unknown physical quantities such as wavelength of a light, diameter of a very thin wire, very small aperture for light etc.					
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	Design Realization	**Course No** ***(will be assigned)***	DES105P			
Department	Mechanical	**Structure (LTPC)**	0	0	3	2
Offered for	UG	**Type**	Core			
Pre-requisite	Nil	**To take effect from**				
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.					

SEMESTER III

Course Title	Fundamentals of Data Structures	**Course Number**	CS208T
Department	ECE	**Structure (IPC)**	2-3-4
Offered to	B.Tech (ECE)	**Status (Core/ Elective)**	Core
Prerequisite	Computational Engineering	**Effective from**	
Course Aim	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 problems.		
Course Outcomes	At the end of the course, students will be able to 1. design efficient data structure which will be used by efficient algorithms to solve real problems.		
Contents of the course	Encapsulation & Operator overloading - Inheritance & Polymorphism - applications Arrays: Linear and Binary search-Pointer based implementation of list, stack and queue - Application of linked lists – Polynomial manipulations - Representing sets using lists and implementation of set theoretic operations - Expression conversion and evaluation of postfix expressions - Binary trees - binary search trees, - Heap, Graph Algorithms – Shortest path, minimum spanning tree.		
Textbooks	1. M. A. Weiss, “Data Structures and Algorithm Analysis in C++,” 2nd Edition, Pearson Education, 2002.		
References	1. T. H. Cormen, C. E. Leiserson, and R. L. Rivest, “Introduction to Algorithms,” 2nd Edition, Prentice Hall India, 2001. 2. Aho, Hopcroft, and Ullmann, “Data Structures and Algorithms,” Addison Wesley, 1983.		

Course Title	Signals and Systems	**Course Number**	EC201T
Department	ECE	**Structure (IPC)**	3-0-3
Offered to	B.Tech (ECE)	**Status (Core/ Elective)**	Core
Prerequisite	Nil	**Effective from**	
Course Aim	The primary goal of this course is to introduce the idea of signals and systems: their analysis and characterizations. This course is a foundation for various other courses such as Analog and Digital Communications, Control theory, Image processing, Power spectral estimations, etc.		
Course Outcomes	At the end of this course, the student will be able to 1.Understand various properties of continuous time signals. 2. Analyze the frequency spectrum of continuous time signals. 3. Describe a LTI system by impulse/frequency response. 4. Analyze magnitude/phase response of various LTI systems. 5. Analyze systems commonly used in Communications, Control, and Signal Processing.		
Contents of the course	1. Introduction to Continuous/Discrete time Signals and Systems: The unit impulse and unit step functions, Continuous-time signals, Transformations of the independent variables, Exponential and Sinusoidal signals, Continuous-time systems and basic system properties. (8 hours) 2. Linear Time-invariant Discrete/Continuous Systems: Continuous-time Linear Time-invariant (LTI) system, Discrete-time LTI system, Properties of LTI systems, System representation through linear constant coefficient differential equations. (5 hours) 3. Discrete/Continuous Fourier Series Representation of Periodic Signals: Fourier series representation of continuous/discrete time periodic signals, Convergence of the Fourier series, Properties of continuous/discrete time Fourier series, Fourier series and LTI systems, Filtering, Examples of continuous-time filters described by differential equations. (7 hours) 4. Discrete/Continuous-time Fourier Transform: Representation of aperiodic signals, The Fourier transform for periodic signals, Properties of the continuous-time Fourier transform, Convolution and multiplication properties and their effect in the frequency domain, magnitude and phase response. (8 hours) 5. Laplace Transform: The Laplace transform for continuous-time signals and systems, the notion of Eigen value and Eigen functions of LTI systems, Region of convergence, System functions, Poles and zeros of system functions and signals, Properties of the Laplace		

	transform, Analysis and characterization of LTI systems using the Laplace transform, The unilateral Laplace transform. (6 hours) 6. Z-transform: Introduction of z-transform, Properties of the region of convergence of the z-transform, The inverse z-transform, Properties of the z-transform, solving the difference equations using Z-transform. (6 hours)
Textbooks	1. A. V. Oppenheim, A. S. Willsky, and S. H. Nawab, "Signals and Systems," 2nd Edition, Prentice Hall, 2003.
References	1. S. Haykin and B. V. Veen, "Signals and Systems" 2nd Edition, Wiley, 2007. 2. B.P. Lathi, "Principles of Linear Systems and Signals," Oxford University Press, 2nd Edition, 2009.

Course Title	Analog Circuits	**Course Number**	EC202T
Department	ECE	**Structure (IPC)**	3-0-3
Offered to	B.Tech. (ECE)	**Status (Core/ Elective)**	Core
Prerequisite	Electron Devices	**Effective from**	
Course Aim	The goal of this course is to provide a good understanding on the design and implementation of analog circuits for various applications such as amplification, filtering, frequency generation etc.		
Course Outcomes	At the end of the course, the students will be able to 1. Understand analog circuits. 2. Analysis and design of amplifiers viz. VCVS, VCCS, CCVS, CCCS. 3. Analysis and design of analog circuits with operational amplifiers.		
Contents of the course	1. Device Models: (diode, BJT, MOSFET); Small signal analysis of nonlinear circuits, small signal equivalent of diode, BJT, MOSFET. (6 hours) 2. Biasing: Adding dc bias to ac signals, Concept of ac coupling, current mirrors, Cascode current mirrors. (7 hours) 3. Basic transistor Amplifiers: small signal and large signal (low frequency) characteristics, VCVS, VCCS, CCVS, CCCS, high frequency effects. (8 hours) 4. Differential pair: Need of active load, differential amplifier. (5 hours) 5. OpAmp internal circuitry: 2-stage plus buffer example, Miller compensation of a 2-stage OpAmp, Stability, frequency compensation. (8 hours) 6. OpAmp circuits: Amplifier Circuits, Filters, oscillators. (8 hours)		
Text Books	1. B. Razavi, “Fundamentals of Microelecronics,” Wiley Student Edition, 2010. 2. S. Franco, “Design with Operational Amplifiers and Analog Integrated Circuits,” McGraw-Hill Series in Electrical and Computer Engineering, 4th Edition, 2015.		
References	1. Sedra and Smith, “Microelectronic Circuits,” 7 th Edition, Oxford University Press. 2. D. A. Newman, “Electronic circuits,” 4 th Edition, TMH.		

Course Title	Analog Circuits Practice	**Course Number**	EC202P
Department	ECE	**Structure (IPC)**	0-3-2
Offered to	B.Tech. (ECE)	**Status (Core/ Elective)**	Core
Prerequisite	Electron Devices	**Effective from**	
Course Aim	The goal of this course is to provide a good understanding on the design and implementation of analog circuits for various applications such as amplification, filtering, frequency generation etc.		
Course Outcomes	At the end of the course, the students will be able to 1. Design and build analog circuits. 2. Design and build analog circuits using op amp and other analog ICs.		
Contents of the course	1. Half wave and full wave rectifiers design 2. Diode based clipper and clamper circuits design 3. Voltage regulator design using Zener diode 4. RC Circuit Analysis 5. BJT voltage transfer characteristics analysis 6. Operation amplifier analysis 7. Circuits using Op-Amps, Filters, and Oscillators 8. Common emitter amplifier design 9. Analysis of common source characteristics of NMOS transistor 10. Basic NMOS common source audio amplifier design 11. Power Supply analysis		
Text Books	1. B. Razavi, “Fundamentals of Microelecronics,” Wiley Student Edition, 2010. 2. S. Franco, “Design with Operational Amplifiers and Analog Integrated Circuits,” McGraw-Hill Series in Electrical and Computer Engineering, 4th Edition, 2015.		
References	1. Sedra and Smith, “Microelectronic Circuits,” 7 th Edition, Oxford University Press. 2. D. A. Newman, “Electronic circuits,” 4 th Edition, TMH.		

Course Title	Digital Logic Circuits	**Course Number**	EC203T
Department	ECE	**Structure (IPC)**	3-0-3
Offered to	B.Tech. (ECE)	**Status (Core/ Elective)**	Core
Prerequisite	Nil	**Effective from**	
Course Aim	The goal of this course is to provide a good understanding on the design and implementation of digital circuits and systems.		
Course Outcomes	At the end of this course, the students will be able to 1. Learn digital circuits 2. Design Combinational circuits 3. Design sequential circuits 4. Formulate logic and design circuits for practical proems.		
Contents of the course	1. Representation of Data: Introduction, Data representations, Number systems, conversions and codes. (5 hours) 2. Switching Theory: Laws and theorems of Boolean algebra, switching functions, truth table and algebraic form, realization using logic gates. (5 hours) 3. Digital Logic and Implementation: K-Maps, QM method, SOP, POS; NAND and NOR implementation, Digital Circuit Characterization. (5 hours) 4. Combinational Circuit Design: Design Procedure, Multiplexer, Decoder, Encoder, Comparator, Seven-segment display, Parity generator, Design of large circuits, Ripple Carry Adder, Carry look ahead adder, carry save adder, carry save array multiplier, Wallace tree multiplier, Restoring/Non Restoring division techniques. (10 hours) 5. Asynchronous and Synchronous Sequential Circuit Design; Design of sequential modules – SR, D, T and J-K Flip-flops, applications, Clock generation, Clock dividers, Registers, and Counters. (8 hours) 6. Design using State machines: Moore and Mealy machines, Design Examples. (5 hours) 7. Issues at the Digital Circuits : Glitches, Glitch free circuit design, Static and Dynamic Hazards, Hazard resolution techniques, Race, and Cycles. (6 hours)		
Textbooks	1. C. H. Roth, Jr., “Fundamentals of Logic Design,” 7th Edition, Cengage Learning, 2013. 2. S. Brown and Z. Vranesic, “Fundamentals of Digital Logic with VHDL Design,” TMH, 3rd Edition.		
References	1. J. F. Wakerly, “Digital Design- Principles and Practices,” 3rd Edition, Pearson		

	2. M. M. Mano, “Digital Design,” PHI. 3. T. L. Floyd and R. P. Jain, “Digital Fundamentals,” 8th Edition, Pearson. 4. Taub and Schilling, “Digital Principles and Applications,” TMH. 5. V. A. Pedroni, “Digital Electronics and Design with VHDL,” Elsevier. 6. R. J. Tocci, N. S.Widmer, and G. L.Moss “Digital Systems Principles and applications,” 10th Edition, Pearson Prentice Hall Edition.

Course Title	Digital Logic Circuits Practice	**Course Number**	EC203P
Department	ECE	**Structure (IPC)**	0-3-2
Offered to	B.Tech. (ECE)	**Status (Core/ Elective)**	Core
Prerequisite	Nil	**Effective from**	
Course Aim	The goal of this course is to provide a hands-on experience in design and implementation of digital circuits and systems. This includes formulating the logic for a given problem, minimizing or optimizing the logic using different approaches and realizing it using gates and other digital ICs. This is done in three phases: Spice simulation of circuit, experimental verification and Verilog/VHDL implementation.		
Course Outcomes	At the end of this course, the students will be able to 1. Understand digital circuits 2. Design Combinational circuits 3. Design sequential circuits 4. Formulate logic and design circuits for practical problems		
Contents of the course	1. Formulating Boolean expressions and truth tables from practical statements, designing logic diagrams, simplifying using k-map, designing NAND-NAND & NOR-NOR diagrams & verifying the same by siulation and experiment. Combinational circuits: code converters, arithmetic circuits, mux/demux, encoder/decoder, comparators etc. 2. Sequential circuits including flip flops, shift registers, counters, sequence generators etc. 3. Simple design examples with Moore and Mealy machines 4. Digital circuits design using HDL.		
Textbooks	1. C. H. Roth, "Fundamentals of Logic Design," 5th Edition, Thomson Books/Cole. 2. S. Brown and Z. Vranesic, "Fundamentals of Digital Logic with VHDL Design," TMH, 3rd Edition. 3. Samir Palnitkar: Verilog HDL - Guide to Digital design and synthesis, Pearson Guide to Digital design and synthesis, Pearson Education, 3rd Edn, 2003.		

Course Title	Linear Algebra	**Course Number**	MAT204T
Department	Sciences	**Structure (IPC)**	3-0-3
Offered to	UG	**Status (Core/ Elective)**	Core
Prerequisite	Nil	**Effective from**	
Course Aim	To impart knowledge of basic concepts and applications of Linear Algebra		
Course Outcomes	At the end of the course, the students will be able to 1. Show that they get clear understanding of methods of Linear Algebra.		
Contents of the course	1. Linear System of Equations: Gaussian Elimination- echelon forms - existence, uniqueness and multiplicity of solutions of linear equations. (6 hours) 2. Vector Spaces: Definition-linear dependence and independence-spanning sets, basis, and dimension-definition of a subspace-intersection and sum of subspaces-direct sums. (8 hours) 3. 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 hours) 4. Inner Products: Definition-induced norm-orthogonality-Gram-Schmidt orthogonalization process-orthogonal projections-unitary transformations and isometry. (8 hours) 5. Eigen Decomposition: Eigenvalues and eigenvectorsp-characteristic polynomials and eigen spaces-diagonalizability conditions-invariant subspaces-spectral theorem. (10 hours)		
Textbooks	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	Sociology of Design	**Course Number**	MAN202T
Department	Sciences	**Structure (IPC)**	3-0-3
Offered to	B.Tech. (ECE)	**Status (Core/ Elective)**	Core
Prerequisite	Nil	**Effective from**	
Course Aim	Design as a Social Activity – Level 1		
Course Outcomes	This course will help students understand 1. Design as a social activity involving people, their relationships & values - How designs can emerge out of or be constrained by social patterns of relating 2. How technology can influence interactions among people, cooperative work, ethical issues around technology interventions 3. Exposure to techniques like ethnomethodology		
Contents of the course	Basics concepts of sociology (behavior, interaction, language) (6 hours) 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 hours) 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 hours)		
Textbooks	1. Manuel Castells (1996); The Rise of Network Society. 2. Herbert Blumer (1986); Symbolic Interactionism: Perspective and Method.		
References	1. Herkert, J. (ed.), Social, Ethical, and Policy Implications of Engineering: Selected Readings. New York, NY: IEEE Press, 2000. 2. Heath, C. and Luff, P. (2000); Technology in Action, Cambridge: Cambridge Univ Press. 3.Werner Ulrich (1983), Critical Systems Heuristics, John Wiley,		

SEMESTER IV

Course Title	Digital Signal Processing	**Course Number**	EC204T
Department	ECE	**Structure (IPC)**	3-0-3
Offered to	B.Tech. (ECE)	**Status (Core/ Elective)**	Core
Prerequisite	Signals and Systems	**Effective from**	
Course Aim	The primary goal of this course is to introduce discrete-time signals and systems: their analysis and characterizations. This course is a foundation for various other courses such as Analog and Digital Filters, Digital Communications, Control theory, Image processing, Power spectral estimations, etc.		
Course Outcomes	At the end of the course, the students are expected to 1. Understand various properties of discrete-time signals 2. Analyze discrete time LTI systems, and their impulse responses 3. Synthesize discrete signals from analog signals 4. Reconstruct analog signals from discrete signals 5. Design the digital filters.		
Contents of the course	1. Review of Discrete-time Signals and Systems: Discrete-time signals: sequences, discrete-time systems, Linear time-invariant (LTI) systems, Properties of LTI systems, Linear constant coefficient difference equations, Frequency domain representation of discrete-time signals and systems, Representation of sequences by Fourier transforms, Symmetry properties of Fourier transform, Fourier transform theorems, Discrete-time random signals. (10 hours) 2. Transform Analysis of Linear Time Invariant Systems: The frequency response of LTI systems, System functions for systems characterized by linear constant-coefficient difference equations, Frequency response of rational system functions, Relationship between magnitude and phase, All-pass systems, Minimum phase systems. (8 hours) 3. Fast Fourier Transform: Introduction of the Discrete Fourier Transform (DFT), TheFourier transform of periodic signals, Properties of DFT, Linear convolution using the DFT. Efficient computation of the DFT, The Goertzel algorithms, Radix-2 decimation-in-time and decimation-in- frequency Fast Fourier Transform algorithms. (6 hours)		

	4. Structures for Discrete-Time Systems: Block Diagram Representation of Linear Constant-Coefficient Difference Equations, Signal Flow Graph Representation, Direct Forms, Cascade Form. (6 hours) 5. Filter Design Techniques: Analog filter design, Butterworth, Chebyshev filter technique. FIR filter design using Windowing and frequency sampling techniques. IIR filter design using impulse invariance and bilinear transformation, FIR and IIR filter structures. (10 hours)
Textbooks	1. A.V. Oppenheim, R.W. Schafer, and J. R. Buck, "Discrete-Time Signal Processing," Pearson Education, 3rd Edition, 2010.
References	1. S. K. Mitra, "Digital Signal Processing: A Computer-Based Approach", 4th Edition, Tata Mcgraw Hill Publication, 2013. 2. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Fourth edition, Pearson, 2007.

Course Title	Digital Signal Processing Practice	**Course Number**	EC204P
Department	ECE	**Structure (IPC)**	0-3-2
Offered to	B.Tech. (ECE)	**Status (Core/ Elective)**	Core
Prerequisite	Signals and Systems	**Effective from**	
Course Aim	The primary goal of this lab is to have a hands-on experience in digital signal processing. In this practice course, various signals and systems are analyzed through Fourier transforms. This practice course is a precursor to other signal processing practice courses like Image Processing, Detection/Estimation Theory etc.		
Course Outcomes	At the end of this course, the students will be able to 1. Understand various properties of signals and systems 2. Apply various operations (filtering) on signals 3. Become aware of various applications of Signal Processing		
Contents of the course	Convolution, DFT, FFT, spectraanalysis of a digital signal using DTFT, Sampling, quantization, reconstruction, companding, noise cancellation, FIR filter design, IIR filter design.		
Textbooks	1. S. K. Mitra, "Digital Signal Processing: A Computer-Based Approach", Fourth edition, Tata Mcgraw Hill Publication, 2013. 2. E. Ifeachor, B. W. Jervis, "Digital Signal Processing: A Practical Approach" Second edition, Pearson, 2002. 3. S. W. Smith, "Digital Signal Processing: A Practical Guide for Engineers and Scientists", 3rd Edition, Newnes (an imprint of Butterworth-Heinemann Ltd.), 2002.		
References	1. Manuals of TI TMS320C67XX DSP Starter Kit. 2. A.V. Oppenheim, R.W. Schafer, and J. R. Buck, "Discrete-Time Signal Processing," Pearson Education, 3rd Edition, 2010.		

Course Title	Electrical Drives Practice	**Course Number**	EC205I
Department	ECE	**Structure (IPC)**	1-3-3
Offered to	B.Tech. (ECE)	**Status (Core/ Elective)**	Core
Prerequisite	Basic Electrical and Electronics Engineering	**Effective from**	
Course Aim	In this course fundamental electromechanical, power electronic, and control theory in the context of electric drive systems will be covered. The capabilities and limitations of different types of electric machines (e.g., permanent magnet, induction) in various drive applications will be covered.		
Course Outcomes	At the end of the course, the students will be able to 1. Understand how power electronic converters and inverters operate. 2. Possess an understanding of feedback control theory. 3. Analyze and compare the performance of DC and AC machines. 4. Design control algorithms for electric drives which achieve the regulation of torque, speed, or position in the above machines. 5. Develop Simulink models which dynamically simulate electric machine and drive systems and their controllers.		
Contents of the course	1. Experiments conducted in this course bring out the basic concepts of different types of electrical machines and their performance. 2. Experiments are conducted to introduce the concept of control of conventional electric motors such as DC motor, AC Induction motor and also special machines such as Stepper motor, Permanent magnet brushless motors, Servo motor. 3. Speed-Torque characteristics of various types of load and drive motors are also discussed.		

	4. The working principle of various power electronic converters is also studied by conducting experiments.
References	1. R. Krishnan, “Electric Motor Drives: Modeling, Analysis, and Control,” Prentice Hall, 2001. 2. N. Mohan, “Electric Drives: An Integrative Approach,” MNPERE, 2001.

Course Title	Mechanical Design of Electronic Systems	**Course Number**	EC206T
Department	ECE	**Structure (IPC)**	3-0-3
Offered to	B.Tech. (ECE)	**Status (Core/ Elective)**	Core
Prerequisite	Nil	**Effective from**	
Course Aim	In this course students will learn the fundamentals of Thermodynamics, fluid flow principles and heat transfer concepts and their applications to electronic equipment and digital devices.		
Course Outcomes	At the end of this course, the students will be able to 1. Perform the mechanical design of electronic systems including packaging, managing thermal stress and heat dissipation.		
Contents of the course	1. Thermodynamics in electronics - System & control volume - State & process - Forms of work, heat and interaction - Thermodynamic laws and equilibrium - Enthalpy and Entropy – Cyclic & non-cyclic process – Concept of total energy – Derivation of general energy equation for control volumes – Steady & unsteady flow process – Thermal efficiency and COP – Irreversible process. (10 hours) 2. Fluid Mechanics: The concept of a fluid – Themophysical properties of fluids - Properties of velocity field - Bernoulli's Equation – Laminar and Turbulent flows – Fluid friction and Boundary layers - Flow in plates, across bodies , inside channels - Effect of roughness. (8 hours) 3. Heat transfer: Conduction heat transfer – General conduction equation –One dimensional steady state conduction – Fins and extended surfaces – Contact resistance - Transient conduction of lumped and distributed systems – Convective heat transfer – Dimensionless group for convection – Forced convection – Elements of free convection – Elements of radiation heat transfer. (10 hours) 4. Importance of thermal and fluid management in electronics – Resistance heating in electronics - Heat generation in printed circuit boards – Estimation of Cooling loads in devices and power transmission mediums – Thermal resistance concepts – - Estimation of Junction temperature – Heat frames - Thermal conduction modules - Air and liquid cooled heat sinks – Thermoelectric power generation and refrigeration – Dielectric heating – Heat pipes and vortex tubes		

	and their applications in electronic cooling - cooling fans - thermal stresses in electronics. (14 hours)
Textbooks	1. Nag. P.K, Engineering Thermodynamics, Tata McGraw Hill, 2005. 2. Jones. J.B and Shapiro. H.N, Fundamentals of Engineering Thermodynamics, John Wiley, 1999.
References	1. Moran. M.J. and Shapiro. H.N, Fundamentals of Engineering Thermodynamics, John Wiley, 2003. 2. Sonnag. R.E, Borgnakke. C and Van Wyan. G.J, Fundamentals of Thermodynamics, 6 Edn, John Wiley, 2003. 3. Spalding. D. B. and Cole. E.H, Engineering Thermodynamics, Edward Arnold, 1976.

Course Title	Power Electronics	**Course Number**	EC207T
Department	ECE	**Structure (PEC)**	3-0-3
Offered to	B. Tech. (ECE)	**Status (Core/ Elective)**	Core
Prerequisite	Electron Devices	**Effective from**	
Course Aim	To introduce students to the basic theory of power semiconductor devices and passive components, their practical application in power electronics.		
Course Outcomes	At the end of this course, the students will be able to 1. Understand basic operation of various power semiconductor devices and passive components 2. Understand the basic principle of switching circuits. 3. Design AC/DC rectifier, DC/DC converter and DC/AC inverter circuits. 4. Understand the role power electronics play in the improvement of energy usage, efficiency and the development of renewable energy technologies.		
Contents of the course	1. Introduction to power electronics; applications and role of power electronics. (2 hours) 2. Introduction to power semiconductor devices, operating characteristics of Power Diode, SCR, Power BJT, Power MOSFET and IGBT; Driver circuits and Snubber circuits. (8 hours) 3. Introduction to AC/DC rectifiers, principle of operation of phase controlled rectifiers, single phase and three phase AC-DC line commutated converters, dual converter, and introduction to unity power factor converters. Applications: DC motor drives and Battery chargers. (9 hours) 4. Introduction to DC/DC converters, Principle of operation of DC/DC (Buck, Boost, Buck-Boost, Cuk, Fly-back and Forward) converters. Applications: Power supply, DC motor drives and SMPS. (11 hours) 5. Introduction to DC/AC inverters, PWM techniques, Principle of operation of single phase and three phase DC-AC inverters, Applications: AC motor drives, UPS, active filters, CFL, renewable power generation, induction and dielectric heating. (12 hours)		
References	1. N. Mohan, T. Undeland, and W. Robbins, “Power Electronics: Converters, Applications, and Design,” 3rd Edition, Wiley, 2003. 2. M. Rashid, “Power Electronics: Circuits, Devices & Applications,” Prentice Hall, 3rd Edition, 2003.		

	3. J. P. Agrawal, “Power Electronic Systems: Theory and Design,” Pearson, 2013. 4. Batarseh, “Power Electronic Circuits,” John Wiley, 2004. 2. R. W. Erickson and D.Maksimovic , “Fundamentals of Power Electronics,” 2 nd Edition, Springer, 2001. 5. R. W. Erickson and D. Maksimovic , “Fundamentals of Power Electronics,” 2 nd Edition, Springer, 2001.

Course Title	Engineering Economics	**Course Number**	MAN203T
Department	Sciences	**Structure (IPC)**	2-0-2
Offered to	UG	**Status (Core/ Elective)**	Core
Prerequisite	Nil	**Effective from**	
Course Aim	Help students learn basics of economics and cost analysis to make economically sound design decisions.		
Course Outcomes	This course will help students understand: 1. the basics of micro-economics and cost analysis 2. Techniques to make economically sound decisions		
Contents of the course	Engineering Economic Decisions 1. Time is Money 2. Understanding Financial Statements 3. Cost Concepts and Behaviors 4. Understanding Money and Its Management 5. Principles of Investing 6. Present Worth Analysis 7. Annual Equivalent Worth Analysis 8. Rate of Return Analysis 9. Depreciation 10. Capital Budgeting Decisions		
Textbooks	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	Probability Theory and Statistics	**Course Number**	MAT205T
Department	Sciences	**Structure (IPC)**	3-0-3
Offered to	B.Tech. (ECE)	**Status (Core/ Elective)**	Core
Prerequisite	Nil	**Effective from**	
Course Aim	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 1. Apply the knowledge in solving engineering problems.		
Contents of the course	1. Introduction to Probability: Sets, Events, Axioms of Probability, Conditional Probability and Independence, Bayes Theorem and MAP Decision Rule. (6 hours) 2. Random Variables: Definitions, Cumulative Distribution Functions, mass and density functions, joint and conditional distributions, Functions of Random Variables. (7 hours) 3. Expectations: Mean, Variance, Moments, Correlation, Chebyshev and Schwarz Inequalities, Moment-generating and Characteristic Functions, Chernoff Bounds, Conditional Expectations. (6 hours) 4. Random Vectors: Jointly Gaussian random variables, Covariance Matrices, Linear Transformations, Diagonalization of Covariance Matrices. (4 hours) 5. Law of Large Numbers, Central Limit Theorem (3 hours) 6. Statistics: Estimation, Properties of Estimation, Method of Estimation: Method of moments, Maximum Likelihood Estimation. Interval Estimation, Confidence Interval. (6 hours) 7. Inference-Testing of Hypothesis: Different type of Hypothesis, Acceptance Region, Critical Region, Test function, Type-I and Type-II Errors, Level of Significance, Power of the Test, Uniformly Most Powerful Test, Neyman-Persons Lemma. (5 hours) 8. Exact Sampling Distribution: Chi-Square Distribution, Chi-Square test for goodness of fit, Students t− Distribution, t−test for single mean, t−test for difference of means, F-distribution, F−test for		

	equality of population variance. (5 hours)
Textbooks	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. 3. P. L. Meyer, Introductory Probability and Statistical Applications, Oxford & IBH Publishers, 2017
References	1. J. S. Milton and J. Arnold, Introduction to Probability and Statistics, Tata McGraw Hill Education Private Limited, 4th Edition, 2006. 2. S. M. Ross, Introduction to Probability & Statistics for Engineers and Scientists, 5th Ed., Academic Press, 2014. 3. Introduction to Probability and Statistics, V.K.Rohatgi, A.M.E.Saleh 4. S. Kay, Intuitive Probability and Random Processes Using MATLAB, Springer, 2008. 5. R. M. Gray and Control L. D. Davisson, "An Introduction to Statistical Signal Processing," Cambridge University Press, 2004.

SEMESTER V

Course Title	Microprocessors and Microcontrollers	**Course Number**	EC301T
Department	ECE	**Structure (IPC)**	3-0-3
Offered to	B.Tech. (ECE)	**Status (Core/ Elective)**	Core
Prerequisite	Digital Logic Design	**Effective from**	
Course Aim	The goal of this course is to provide a good understanding of the components of a fast computing system, structure and functionalities of different architectures, and programming of microprocessors and microcontrollers.		
Course Outcomes	At the end of the course the students will be able to 1. Learn the functional behavior of a microprocessor using assembly instructions. 2. Learn to develop suitable computing architectures for certain applications. 3. Use microprocessors and microcontrollers for building real time systems.		
Contents of the course	1. Introduction to Computer Organization/Architecture, Need for Processors, Evolution of processors. (1 hour), Basic data path of the processor, Arithmetic Logic Unit Design (fixed/floating point adders, multipliers, dividers), Circuit pipelining. (4 hours) 2. Harvard Versus Von-Neumann, RISC versus CISC, Register File, General Instruction Types, Addressing Modes, and instruction pipelining, Data Hazards, Control Hazards, Structural Hazards, Hazard Resolution Techniques, Instruction and data level parallelism, VLIW, Superscalar, SIMD processors. (12 hours) 3. Memory: Main memory Technologies (SRAM, DRAM), Cache memory organization, improving cache performance, cache coherence techniques, Virtual Memory Organization, Secondary storage devices. (8 hours) 4. Control Unit: Hardwired Implementation and Micro programmed Control (3hours) 5. 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. (6 hours) 6. 8086 and ARM 7 architectures, addressing modes, instructions,		

	and interfaces. (10 hours)
Textbooks	1. D. A. Patterson and J. L. Hennessy, Computer Organization and Design - ARM, Morgan Kaufmann, 2010. 2. J. Stokes, Inside The Machine: An Illustrated Introduction to Microprocessors and Computer Architecture, No Starch Press, Inc 2007, ISBN-13: 978-1-59327-104-6. 3. B. B. Brey, Intel Microprocessors, 8th edition, Prentice Hall, 2008. 4. S. Furber, ARM System-on-chip Architecture, 13th impression, Pearson, 2012.
References	1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, and Naraig Manjikian, Computer Organization and Embedded Systems, McGraw Hill Publications, Sixth Edition, 2012. 2. J. W. Valavano, Embedded Systems: Introduction to Arm Cortex-M Microcontrollers, 2nd edition, Create Space, 2012. ISBN: 978-1477508992.

Course Title	Microprocessors and Microcontrollers Practice	**Course Number**	EC301P
Department	ECE	**Structure (IPC)**	0-3-2
Offered to	B.Tech. (ECE)	**Status (Core/ Elective)**	Core
Prerequisite	Digital Logic Design	**Effective from**	
Course Aim	The goal of this course is to help the students to understand and exploit the microprocessors and microcontrollers to build simple systems.		
Course Outcomes	At the end of the course, the students will be able to 1. Program and use microprocessor 8086 for real time applications 2. Program and use ARM7 for real time applications		
Contents of the course	1. 8086 programming : Assembly code for simple addition, simple subtraction, simple multiplication, division, multiply accumulation, matrix addition/subtraction/multiplication, finding the odd-even, addition of N numbers, convolution, find the largest of N numbers, and so on. Accessing the peripherals (Switches, LEDs, Keypad, seven segment display, buzzer, relay, ADC, and temperature sensor) of 8086 development boards. Real time applications (traffic light control, stepper motor control, logic control, and so on) using 8086 and 8051 development boards. 2. ARM7 programming : Accessing the peripherals (Switches, LEDs, Keypad, seven segment display, buzzer, relay, ADC, and temperature sensor) of ARM7-LPC2148 development board, Assembly code for simple addition, simple subtraction, simple multiplication, division, multiply accumulation, matrix addition/subtraction/multiplication, finding the odd-even, addition of N numbers, convolution, find the largest of N numbers, and so on. 3. Project Work (Individual or 2-per group with respect to the availability of boards): Any project work using the programming skills obtained from the aforementioned topics with 8086 or ARM7 development boards. The title and objective of the projects will be chosen or formed by the students.		
Textbooks	1. S. Furber, ARM System-on-chip Architecture, 13th impression,		

	Pearson, 2012. 2. Kenneth J. Ayala, The 8086 Microprocessor: Programming and Interfacing The PC, Delmar Publishers, 2007. 3. A. K. Ray, K. M. Bhurchandi, Advanced Microprocessors and Peripherals, TMH, 2007. 4. A. N. Sloss, D. SControl ymes, C. Wright, ARM System Developer's Guide, Morgan Kaufmann, 2004.

Course Title	Analog and Digital Communication Techniques	**Course No**	EC302T
Department	ECE	**Structure (IPC)**	3-0-3
Offered for	B.Tech. (ECE)	**Status (Core / Elective)**	Core
Prerequisite	Signals and Systems	**Effect from**	
Course Aim	1. Understanding of Analog and Digital Communication Systems in detail with its concepts, techniques and application usage. 2. This course included basics of communication Systems, Analog signal transmission and reception; and Digital signal transmission and reception. 3. This course also provides the source and error control coding techniques, Spread spectrum techniques along with multiuser communication techniques with real time applications like GSM, CDMA, Wi-Fi and Bluetooth. 4. Every topic is to be explained with its function either with demonstration and/or simulation using suitable software.		
Course Outcomes	At the end of this course, the students will be able to 1. Develop a Analog and Digital Communication System with detailed knowledge.		
Contents of the course	1. Introduction to Communication Systems: Communication Systems, Design Challenges: Channel Distortions and Noises, Message Sources, Channel Effect, Signal-To-Noise Ratio, Information Capacity, Modulation and Detection. (2 hours) 2. Analog Communication: Modulation Types, Need for Modulation. Theory of Amplitude Modulation – Evolution and Description of SSB Techniques – Theory of Frequency and Phase Modulation – Comparison of Analog Communication Systems (AM – FM – PM). (7 hours) 3. Pulse and Data Communication: Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) – Comparison of various Pulse Communication System (PAM – PTM – PCM). Data Communication: History of Data Communication – Standards Organizations for Data Communication- Data Communication Circuits – Data Communication Codes – Data communication Hardware – serial and parallel interfaces. (5 hours)		

	4. Digital Communication: Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK)–Phase Shift Keying (PSK) – BPSK – QPSK – Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK – FSK – PSK – QAM). (8 hours) 5. Source and Error Control Coding: Entropy, Source encoding theorem, Shannon Fano coding, Huffman coding, mutual information, channel capacity, Error Control Coding, linear block codes, cyclic codes – ARQ Techniques. (6 hours) 6. Spread Spectrum Communications: Frequency Hopping Spread Spectrum (FHSS) Systems, Multiple FHSS User Systems and Performance, Applications of FHSS, Direct Sequence Spread Spectrum, Resilient Features of DSSS, Code Division Multiple-Access (CDMA) of DSSS, Multiuser Detection (MUD), Applications of DSSS-CDMA Systems. (7 hours) 7. Multi-user Radio Communication: Global System for Mobile Communications (GSM), Code division multiple access (CDMA), Cellular Concept and Frequency Reuse – Channel Assignment and Handover Techniques, IEEE 802.11, IEEE802.15. (5 hours)
Textbook	1. N. S. Nise, “Control Systems Engineering,” Wiley, 2014. 2. B.C. Kuo, “Automatic Control Systems”, 8th Edition, John Wiley.
References	1. I. J. Nagrath and M. Gopal, “Control System Engineering,” New Age International publishers, 2008. 2. J. J. Distefano, A. R. Stubberud, and I. J. Williams, “Control Systems,” Shaum’s outline Series, 3rd Edition, McGraw Hill.

Course Title	Analog and Digital Communication Techniques Practice	**Course No**	EC302P
Department	ECE	**Structure (IPC)**	0-3-2
Offered for	B.Tech. (ECE)	**Status (Core / Elective)**	Core
Prerequisite	Signals and Systems	**Effect from**	
Course Aim	The primary goal of this course is to have a hands on experience with the analog and communication systems. This course is fundamental to other advanced communication courses like Coding Theory, Wireless Communications, and many others.		
Course Outcomes	At the end of the course the students will be able to 1. Perform various analog and digital modulations 2. Evaluate the performance of various communication systems 3. Analyze/Understand BER of various digital communication systems		
Contents of the course	1. Amplitude Modulation/Demodulation : DSB-FC, DSB-SC, SSB. 2.Frequency Modulation/Demodulation, Phase Modulation/Demodulation. 3. Delta modulation/Demodulation and PCM. 4. BPSK, QPSK, PAM, MPSK, MQAM, FSK, modulation and demodulation/detection. 5. FoM and PSD computations 6. Spread Spectrum Implementations.		
Textbooks	1. B. P. Lathi and Z. Ding, “Modern Digital and Analog Communication Systems,” 4th Edition, Oxford University Press, 2011. 2. S. Haykin, “Communication Systems,” 4th Edition, Wiley, 2006.		
References	1. J. M. Wozencraft and I. M. Jacobs, “Principles of Communication Engineering,” Wiley, 1965. 2. J. R. Barry, E. A. Lee, and D. G. Messerschmitt, “Digital Communication,” 3rd Edition, Springer, 2004.		

Course Title	Control Systems	**Course No**	EC303T
Department	ECE	**Structure (IPC)**	3-0-3
Offered for	B.Tech. (ECE)	**Status (Core / Elective)**	Core
Prerequisite	Signals and Systems	**Effect from**	
Course Aim	This course deveControl lops the fundamentals of feedback control using linear transfer function and state space system models. Topics covered include analysis in time and frequency domains; design in the s-plane and in the frequency domain. Students have to complete an extended design case study.		
Course Outcomes	This course will teach fundamentals of control design and analysis using state-space methods. By the end of the course, a student should be able to design controllers using classical and modern control methods and evaluate whether these controllers are robust to some types of modelling errors and nonlinearities. They will learn to: 1. Design controllers and analyse using classical tools. 2. Understand impact of implementation issues (nonlinearity, delay). 3. Indicate the robustness of control design. 4. Linearize a nonlinear system, and analyse stability.		
Contents of the course	1. Introduction: Scope of control, Parts of a control system, Multidisciplinary nature, Scope of present course. (2 hours) 2. Mathematical modelling of physical systems: Differential equation, Transfer function, and State variable representations; Examples, Equivalence between the elements of different types of systems. (6 hours) 3. Linear systems and their s-domain representations: Linearity and linearization, Transfer function and its interpretation in terms of impulse and frequency responses, Block-diagram and signal flow graph manipulations. (8 hours) 4. Characterization of systems: Stability -- concept and definition, poles, Routh array, internal stability of coupled systems, Time domain response and Frequency domain response; Link between time and frequency domain response features. (8 hours) 5. Closed loop operation - Advantages: Sensitivity, Disturbance and noise reduction, Structured and unstructured plant uncertainties. (3 hours) 6. Analysis of closed loop systems: Stability and relative stability using root-locus approach, Nyquist stability criterion, Steady state errors and system types. (7 hours) 8. Compensation techniques: Performance goals, specifications, PID, lag-lead and algebraic approaches for controller design. (8 hours) 7. Case study of a closed loop system to design controller for any system. (could be a design (simulation/hardware) project done along with the course)		

Textbook	1. N. S. Nise, “Control Systems Engineering,” Wiley, 2014. 2. B.C. Kuo, “Automatic Control Systems”, 8th Edition, John Wiley.
References	3. I. J. Nagrath and M. Gopal, “Control System Engineering,” New Age International publishers, 2008. 4. J. J. Distefano, A. R. Stubberud, and I. J. Williams, “Control Systems,” Shaum’s outline Series, 3rd Edition, McGraw Hill.

Course Title	Electronic Manufacturing and Prototyping	**Course No**	EC303I
Department	ECE	**Structure (IPC)**	1-3-3
Offered for	B.Tech. (ECE)	**Status (Core / Elective)**	Core
Prerequisite	Analog Circuits	**Effect from**	
Course Aim	To understand the manufacturing and assembling aspects of Electronic components in systems.		
Course Outcomes	At the end of this course, the students will be able to 1. Design optimized layout for printed circuits boards and multi-layer PCBs.		
Contents of the course	1. Overview of electronic systems manufacturing and packaging , Introduction to IC manufacturing and realization of passive components in ICs and VLSI, Surface Mount Technology, Thermal budget and Current trends 2. An overview on CAD based manufacturing process of PCB, Industry standards for design, Mechanical and Electrical aspects of PCB design, Design for manufacturability, Design consideration for special circuits, PCB design flow- Schematic -layout - PCB design using created library -PCB printing using PCB prototyping machine- Testing and debugging of PCB 3. Experiments - Design and development of PCBs using different simulator tools and prototyping.		
Textbook	1. R. T. Rao, Fundamentals of Microsystems Packaging, McGraw Hill, 2001, ISBN- 10: 0071371699, ISBN-13: 978-0071371698. 2. J. Axelson, Making Printed Circuit Boards, TAB/McGraw Hill, 1993, ISBN- 10: 0070027994, ISBN-13: 978-0070027992.		
References	1. R. K. Ulrich, W. D. Brown, Advanced Electronic Packaging, : IEEE Press Series on Microelectronic Systems, 2 nd edition, 2006, Wiley-IEEE Press; ISBN-10: 0471754501, ISBN-13: 978-0471754503. 2. J. Varteresian, Fabricating Printed Circuit Boards (Demystifying Technology) 1st edition, Newnes, 2002. ISBN-10: 1878707507, ISBN-13: 978-1878707505.		

	3. R. A. Reis, Electronic project design and fabrication, 6th edition, Prentice Hall, 2004, ISBN-10: 0131130544, ISBN-13: 978-0131130548. 4. K. Mitzner Complete PCB Design Using OrCad Capture and Layout, Elsevier, 2009, ISBN :9780750689717. 5. J. H. Lau, C. P. Wong, J. L. Prince, Electronic Packaging: Design, Materials, Process, and Reliability Electronic Packaging and Interconnection Series, 1 st edition, McGraw- Hill Professional, 1998. ISBN-10: 0070371350, ISBN-13: 978-0070371354.

Course Title	Sensing Instrumentation Practice	**Course No**	EC304I
Department	ECE	**Structure (IPC)**	1-3-3
Offered for	B.Tech. (ECE)	**Status (Core / Elective)**	Core
Prerequisite	Nil	**Effect from**	
Course Aim	To familiarize the students with different sensors and their signal conditioning circuits required for different applications.		
Course Outcomes	By the end of the course, the students would be able to build systems which would sense the different physical signals and also process the signals in the required analog or digital formats.		
Contents of the course	Transducers, transducer sensing and functions, Passive and active – Resistance, inductance and capacitance, Strain Gauges, Hall Effect sensors, Optical sensors. Measurement of non-electrical quantities such as displacement, velocity, acceleration, pressure, force, flow and temperature, calibration of sensors, Data acquisition and detection techniques, Signal conversion, PC-based Instrumentation System. Practice includes experiments from following topics: Signal generation – Instrumentation amplifiers – Signal conversion and processing –Characteristics of Transducers - Calibration of sensors – Measurement of physical quantities		
Textbook	1. Alan S. Morris, Measurement and Instrumentation Principles, Elsevier, 2001. 2. Sawhney. A. K, Course in Electrical & Electronics Measurement & Instrumentation, Dhanpat Rai, 2007.		
References	1. Bruce Mihura, LabVIEW for Data Acquisition (National Instruments Virtual Instrumentation Series), Prentice Hall, 2001. 2. Howard Austerlitz, Data acquisition techniques using PCs, Academic Press, 2nd Ed. 2002.		

Course Title	Entrepreneurship and Management Functions	**Course No**	MAN301T
Department	Sciences	**Structure (IPC)**	3-0-3
Offered for	UG	**Status (Core / Elective)**	Core
Prerequisite	Nil	**Effect from**	
Course Aim	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 1. Understand the market & competition 2. 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 Module 2: Strategy & Planning, understanding industry dynamics & competition (Porter's Framework), Understanding the industry value chain and firm positioning 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) 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 Module 5: Management Information & Decision Making Module 6: Legal and Regulatory environment		
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.

SEMESTER VI

Course Title	Design for Quality and Reliability	**Course Number**	DES302T
Department	Sciences	**Structure (IPC)**	3-0-2
Offered to	UG	**Status (Core/ Elective)**	Core
Prerequisite	Measurements and Data Analysis Lab (Probability and Statistics)	**Effective from**	
Course Aim	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. Module 2: Concepts of Reliability, Basic concepts of repairable and non-repairable systems, Reliability, Availability and Maintainability. Module 3: Failure data analysis, Fitting discrete and continuous distributions to failure data sets, Weibull analysis, estimation of important reliability parameters. Module 4: Calculation of System Reliability from Component reliabilities, Markov modeling of repairable and non-repairable		

	systems, Reliability Logic Diagrams, Fault-tree analysis. Module 5: Preventive and Predictive maintenance Failure Modes and Effects Analysis.
Textbooks	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. B.L. Hansen & P.M. Ghare, Quality Control and Applications, Prentice-Hall, 1997, ISBN: 9780137452255

Course Title	VLSI System Design	**Course Number**	EC305T
Department	ECE	**Structure (IPC)**	3-0-3
Offered to	B.Tech. (ECE)	**Status (Core/ Elective)**	Core
Prerequisite	Digital Logic Design	**Effective from**	
Course Aim	This course is to provide a good understanding in the analysis and design of CMOS logic circuits. It gives the importance of physical design and also treats the essentials of high speed logic circuits. Also provides a system level perspective to the students in designing complex VLSI circuits.		
Course Outcomes	At the end of the course the students will be able to 1. Design the digital systems using Verilog or VHDL. 2. Estimate the circuit/system performance, area, and power dissipation. 3. Implement the low power and high throughput techniques on digital VLSI circuits. 4. Develop the Custom IPs to integrate into Digital Systems using EDA.		
Contents of the course	1. Introduction to VLSI Design, Need for VLSI Design, Various VLSI design flows, Basic classifications of VLSI design (2 hours) 2. Digital Arithmetic Circuits, Fixed Point/Floating Point/Galois Field Arithmetic, RTL Design using Verilog HDL. (6 Hours) 3. Introduction to Hardware-Software Co-design, Custom IPs, High level synthesis, and formal hardware verification. (4 hours) 4. MOS Transistors, Operation of MOSFET, CMOS Logic - Inverter, Logic Gates, Pass Transistors and Transmission Gates, Tri states, Multiplexers, Sequential Circuits, and Pass Transistor Logic (4 hours) 5. CMOS Fabrication and Layout - Inverter Cross-section, Fabrication process, Layout Design Rules, Gate Layouts, Stick Diagrams. (4 hours) 6. Delay: Timing optimization, Transient response, RC Delay Model, Linear Delay Model, Logical Effort of Paths. Statistical timing analysis. (4 hours) 7. Power: Sources of Power Dissipation, Dynamic Power, Static Power, Energy-Delay Optimization, Low Power Architectures. (4 hours) 8. Testing : Testers, text fixtures, and Test Programs, BIST, Scan		

	Chains, Design for Testability, Fault tolerant designs (6 hours) 9. CMOS chip design options: Full custom ASICs, Std. Cell based ASICs, Gate Array based ASICs, Programmable logic structures-PLA, PAL, PROM, FPGA (6 hours) 10. Introduction to Physical Design: Floor plan, power plan, placement, routing, physical verification (2 hours)
Textbooks	1. Weste and Eshraghian: Principles of CMOS VLSI design, Addison Wesley, 4th Edn, 2011. 2. Samir Palnitkar: Verilog HDL - Guide to Digital design and synthesis, Pearson Education, 3rd Edn, 2003.
References	1. CMOS Digital Integrated Circuits Analysis, Sung-Mo (Steve) Kang, 2011, TMH 2. Introduction to VLSI Systems: A Logic, Circuit, and System Perspective, Ming Lo Bin, 2011, CRC Press, ISBN 9781439868591 3. CMOS Logic Circuit Design, John P Uyemura, 2009, Springer 4. Verilog for Digital Design, Frank Vahid, Roman Lysecky, Wiely, 2007 5. Digital VLSI Design with Verilog, A Textbook from Silicon Valley Polytechnic Institute, Williams, John Michael, 2014 Springer 6. Digital Design and Verilog HDL fundamentals, Joseph Cavanagh, 2007, CRC Press, ISBN9781420074154

Course Title	VLSI System Design Practice	**Course Number**	EC305P
Department	ECE	**Structure (IPC)**	0-3-2
Offered to	B.Tech. (ECE)	**Status (Core/ Elective)**	Core
Prerequisite	Digital Logic Design	**Effective from**	
Course Aim	This lab course is intended to give exposure to the design of different functional components of a digital system using Verilog HDL and FPGA development boards.		
Course Outcomes	At the end of the course the students will be able to 1. Design the digital systems using Verilog or VHDL. 2. Estimate the circuit/system performance, area, and power dissipation. 3. Implement the low power and high throughput techniques on digital VLSI circuits. 4. Develop the Custom IPs to integrate into Digital Systems using EDA.		
Contents of the course	1. Introduction to RTL Design: Basic combinational (half adder, full adder, multiplexer, decoder, and so on) and sequential circuits design (Flip-flops and counters) using Verilog HDL with Xilinx Vivado or iverilog open source compiler with gtk waveform generator. 2. Familiarity of Arithmetic Circuits: 32-bit Ripple carry adder, recursive doubling based carry look ahead adder, Braun multiplier, Wallace tree multiplier, non restoring based division, IEEE-754 floating point adder/Subtractor/multiplier/divider, CORDIC, Galois prime field addition/multiplication/multiplicative inverse/exponentiation. 3. Advanced VLSI circuit design concepts: Pipelining, clock gating to reduce the switching power dissipation, hardware reuse strategy (folded hardware) to reduce the area, fault tolerant digital circuit design, formal hardware verification using equivalence check, high level synthesis with Xilinx Vivado HLS, and performance analysis of RTL design & high level synthesis based digital system using Xilinx Vivado. 4. Hardware-Software Co-design: Design flow of hardware-software co-design using ZYNQ7000 board with Xilinx Vivado, Custom IP design (arithmetic circuits as mentioned above), hardware-software		

	partitioning, and performance analysis of various hardware-software co-design techniques. 5. Project Work (Individual): Basic 32-bit Processor Design (Harvard Architecture with Microprogramming based Controller) that includes the functional units such as logic unit, fixed/floating point adder, multiplier, and divider. Here, two separate memories are used for data and instruction.
Textbooks	1. Weste and Eshraghian: Principles of CMOS VLSI design, Addison Wesley, 4th Edn, 2011. 2. Samir Palnitkar: Verilog HDL - Guide to Digital design and synthesis, Pearson Education, 3rd Edn, 2003.
References	1. CMOS Digital Integrated Circuits Analysis, Sung-Mo (Steve) Kang, 2011, TMH 2. Introduction to VLSI Systems: A Logic, Circuit, and System Perspective, Ming Lo Bin, 2011, CRC Press, ISBN 9781439868591 3. CMOS Logic Circuit Design, John P Uyemura, 2009, Springer 4. Verilog for Digital Design, Frank Vahid, Roman Lysecky, Wiely, 2007 5. Digital VLSI Design with Verilog, A Textbook from Silicon Valley Polytechnic Institute, Williams, John Michael, 2014 Springer 6. Digital Design and Verilog HDL fundamentals, Joseph Cavanagh, 2007, CRC Press, ISBN9781420074154

Course Title	Data Communication and Networking	**Course Number**	EC306T
Department	ECE	**Structure (IPC)**	3-0-3
Offered to	ECE	**Status (Core/ Elective)**	Free Elective
Prerequisite	Nil	**Effective from**	
Course Aim	To introduce the basic terminology of networking. To study the various layers and their roles.		
Course Outcomes	At the end of this course, the students will be able to 1. Understand a transmission of a data in a network 2. Acquire knowledge of various layers.		
Contents of the course	1. Overview of Data Communication and Networking: Introduction; Data communications: components, data representation (ASCII, ISO etc.), direction of data flow (simplex, half duplex, full duplex); network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN, WAN); Internet: brief history, Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study. (4 hours) 2. Physical Layer: Overview of data (analog & digital), signal (analog & digital), transmission (analog & digital) & transmission media (guided & unguided); Circuit switching: time division & space division switch, TDM bus; Telephone Network; ATM, B-ISDN. (8 hours) 3. Data link Layer: Types of errors, framing (character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ, HDLC. (6 hours) 4. Medium Access sub layer: Point to Point Protocol, LCP, NCP, Token Ring; Reservation, Polling, Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA Traditional Ethernet, fast Ethernet (in brief). (6 hours) 5. Network layer: Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing: IP addressing, subnetting; Routing: techniques, static vs. dynamic routing, Unicast		

	Routing Protocols: RIP, OSPF, BGP; Other Protocols: ARP, IP, ICMP, IPV6. (8 hours) 6. Transport layer: Process to Process delivery; UDP; TCP; Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm. (4 hours) 7. Application Layer: Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW; Security: Cryptography (Public, Private Key based), Digital Signature, Firewalls. (6 hours)
Textbooks	B. A. Forouzan, Data Communications and Networking, 4th edition, Tata McGraw Hill 2012, ISBN: 0072967757 A. S. Tanenbaum, Computer Networks, 4th edition, Pearson, 2013, ISBN: 978-0132126953
References	W. Stallings, Data and Computer Communications, 5th edition, Pearson, 5th edition, 2013, ISBN: 978-0133506488.

Course Title	Embedded Systems	**Course Number**	EC307I
Department	ECE	**Structure (IPC)**	1-3-3
Offered to	B.Tech. (ECE)	**Status (Core/ Elective)**	Core
Prerequisite	Microprocessors and Microcontrollers	**Effective from**	
Course Aim	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 Launch Pad IDE (and booster packs), rapid prototyping of embedded systems using open source microcontrollers (Arduino, Raspberry Pi, Beagle Bone 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 Launch Pad 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, Beagle Bone 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	Classifications of real time embedded systems, characteristics of embedded systems, components of embedded systems, applications of embedded systems. 1. Experiments in GPIO, serial interfacing, timer interrupts, data acquisition with ADC, sound and video, DAC 2. Experiments in control of RC servos, stepper motors, DC motors, and design of video games and mobile robots		

	3. Data acquisition and real-time control with Arduino, Raspberry Pi, and Beagle Bone Black microcontrollers, shields, and add-on boards 4. Experiments in wireless networked systems, using shields and modules, for GPS, GSM/GPRS, Zig Bee, Bluetooth, and RFID 5. Experiments in IOT for smart automation, with Intel and Microsoft development kits 6. Experiments with various bus interconnects such as I2C, UART, SPI, and so on. 7. Experiments using RTOS concepts such as multi-task application with various priority, MUTEX using Semaphore, inter-task communication using FIFO, MBOX, and so on.
Textbooks	IIITDM Kurnool –Embedded Systems Practice Manual.
References	1. Jonathan Valvano and Ramesh Yerraballi, 2014, "Embedded Systems – Shape the World" (ebook). 2. J. W. Valavano, Embedded Systems: Introduction to Arm Cortex-M Microcontrollers, 2nd edition, Create Space, 2012. ISBN: 978-1477508992. 3. J. W. Valavano, Embedded Systems: Real-Time Operating Systems for Arm Cortex M. 4. Microcontrollers, 2nd edition, Create Space, 2012. ISBN: 978-1466468863. 5. A. McEwen and H. Cassimally, Designing the Internet of Things, 1st edition, Wiley, 2013. ISBN: 978-8126556861.

Course Title	Product Design Practice	**Course Number**	EC308P
Department	Electronics and Communication Engineering	**Structure (IPC)**	0-3-2
Offered to	B.Tech.	**Status (Core/ Elective)**	Core
Prerequisite	Design Realization, Product Realization	**Effective from**	July 2020
Course Aim	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 [1] Develop cross disciplinary idea [2] Conceive, design and prototype an innovative idea [3] Work in cross-functional groups and to apply the concepts learnt in theory to a practical problem [4] Manage group projects, maintain timeliness and follow method-oriented approach to problem solving		
Contents of the course	This course is an inter-disciplinary 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.		

Text Books	[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.