Bachelor of Technology Program in Electrical Engineering

July 2015

Indian Institute of Technology Jodhpur

Bachelor of Technology (B.Tech.) Program in Electrical Engineering

Curriculum

Cat.	Course Title	L-T-P	Credits	Cat.	Course Title	L-T-P	Credits
I Semester				***II Semester***			
H	ME111 System Exploration--Drawing	3-0-3	4	H	ME121 System Exploration--Workshop	3-0-3	4
H	CS111 Computer Programming	3-1-3	5	H	EE121 Basic Electronics Engineering	3-1-3	5
B	MA111 Linear Algebra and Calculus	4-1-0	5	H	ME122 Engineering Mechanics	3-1-3	5
B	PH111 Electromagnetism and Optics	3-1-3	5	B	MA121 Complex Analysis & Differential Equation	4-1-0	5
C	EE111 Physics of Semiconductor Devices	3-0-0	3	C	EE122 Electromagnetic Theory	3-1-0	4
L	HS111 English/Foreign Language	3-0-0	3	L	*HS121 Right, Responsibilities, Law and Constitution	3-0-0	3
S	*PE111 Physical Exercises I		0	S	*PE121 Physical Exercise II		0
	Total	**31**	**25**		**Total**	**32**	**26**
III Semester				***IV Semester***			
H	*EE221 Basic Electrical Engineering	3-1-3	5	H	EE221 Electrical Machines	3-0-3	4
B	CY211 Chemistry	3-0-3	4	B	MA221 Probability Statistics and Random Processes	4-1-0	5
B	ME211 Thermodynamics	3-1-0	4	C	EE222 Digital Logic and Design	3-0-3	4
C	*EE212 Circuit Theory Unable to find	3-1-0	4	C	EE223 Power System	3-0-3	4
C	EE213 Signals and Systems	3-1-0	4	P	*EE298 B.Tech. Project	0-0-9	3
L	*HS211 Economics Unable to find	3-0-0	3	L	*HS221 Management	3-0-0	3
	Total	**28**	**24**		**Total**	**35**	**23**
V Semester				***VI Semester***			
C	EE311 Power Electronics	3-0-3	4	C	EE321 Information Theory and Coding	3-1-0	4
C	EE312 Microprocessors and Microcontrollers	3-0-3	4	C	EE322 Digital Signal Processing	3-1-0	4
C	EE313 Communication System	3-1-0	4	C	EE323 Microwave Engineering	3-0-0	3
C	EE314 Analog Electronics	3-1-0	4	C	EE324 Control Systems	3-0-3	4
P	EE398 B.Tech. Project	0-0-9	3	P	EE399 B.Tech. Project	0-0-9	3
L	*HS311 Psychology	3-0-0	3	L	*HS221 Writing in Newspaper Column	3-0-0	3
	Total	**32**	**22**		**Total**	**29**	**21**
VII Semester				***VIII Semester***			
E	*Elective	3-0-0	3	E	*Elective	3-0-0	3
E	*Elective	3-0-0	3	E	*Elective	3-0-0	3
E	*Elective	3-0-0	3	E	*Elective	3-0-0	3
P	EE498 B.Tech. Project	0-0-18	6	P	EE499 B.Tech. Project	0-0-18	6
L	*HS411 Leadership	3-0-0	3	L	*HS421 Development of India	3-0-0	3
	Total	**30**	**18**		**Total**	**30**	**18**
					GRAND TOTAL	**247**	**177**

**information is yet to be furnished.*

S. No.	Category	Course Category Title	Total Courses	Total Credits
1	H	*Hands-on Experience*	7	32
2	B	*Basics*	6	28
3	C	*Compulsory*	14	54
4	E	*Electives*	6	18
5	*P*	*Hands-On Project*	5	21
6	L	Life Skills	8	24
7	S	*Games & Sports/Social Service*	2	0
		Total	**48**	**177**

I Semester

Course Title	**System Exploration - Drawing**	Course No.	**ME111**
Focus Group	Mechanical Engineering	L-T-P[C]	3-0-3[4]
Offered for	B.Tech.	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objectives

1. To inculcate how to expresses ideas of technical nature with a pragmatic intention.
2. To explore from the first idea and intuitive concepts to the final development and evaluation of the quality of a product.
3. Helping students understand the role of engineering graphics in a product design process.

Learning Outcomes

1. To distinguish between the different types of projections, indicate the dimensions and tolerance of technical products, read print, and change drawings according to specific requirements.
2. To visualize, and communicate product design using graphics.
3. To enable, optimize and digitize manufacturing of devices and components through graphic modeling.

Contents

1. Lettering Two dimensional geometrical constructions Conics Representation of three-dimensional objects Principles of projections Standard codes Projection of points.
2. Projection of straight lines Projection of planes - Projection of solids Auxiliary projections
3. Spatial geometry for design and analysis-Sections of solids and development of surfaces
4. *Conversion of Projections:* Orthographic projection Isometric projection of regular solids and combination of solids.
5. Pictorial representation-Axonometric projection, Oblique projections and Perspective projections
6. General dimensioning practices, limit dimensioning and cylindrical fits, tolerances of location/form/profile/orientation, designation of surface texture.
7. Plan, Elevation and section of single storied residential (or) office building with flat/ with electrical wiring diagram
8. Fundamental practices of computer aided design and drafting
9. Introduction to AutoCAD/ Solid works Commands, Applied geometry using CAD, Technical Sketching, Editing techniques and commands in CAD
10. Orthographic projection; graphical analysis, Sectional views, Basic dimensioning methods, Primary and secondary auxiliary views in descriptive geometry
11. Definition of point, line, plane, Pictorial drawings, 3D drawings, Solid Modeling,
12. Electronic drawings, typical block diagrams, control circuit layouts, Wiring diagrams, connection layout diagrams, printed circuits.

Reference Books

1. Luzzader, W. J. & Duff, J. M., (2008), *Fundamentals of Engineering Drawing*, Prentice Hall
2. Bhatt, N. D., (2002), *Elementary Engineering Drawing*, Charotar Publishing
3. Bethune, J. D., (2007), *Engineering Graphics with Autocad,* Prentice Hall

Course Title	**Computer Programming**	Course No.	**CS111**
Focus Group	Computer Science and Engineering	L-T-P [C]	3-1-3 [5]
Offered for	B.Tech.	Type	Hands-on Experience for CSE
Pre-requisite		To take effect from	July 2014

Objectives

1. To understand computer programming and its roles in problem solving
2. To understand and develop well-structured programs using C language
3. To learn the basic data structures through implementing in C language

Learning Outcomes

1. Problem solving through computer programming
2. Familiarity of programming environment in Linux operating system
3. Ability to use different memory allocation methods
4. Ability to deal with different input/output methods
5. Ability to use different data structures

Contents

1. Introduction to digital computers, Number systems - binary, octal, hexa, and conversion between the number systems, binary arithmetic
2. Introduction to programming, Problem solving and expression of solution through flow chart and algorithm
3. Parts of a program - primitive data types, variables, operators and their precedence, expressions, input/output, conditionals and branching, looping statements
4. Functions, Storage classes - scope and life time, recursion
5. Arrays, Pointers, User defined data types - structures, unions, Dynamic allocation, File Handling, Linear data structures List, Stack, and Queue, Time and space requirements
6. *Lab:* (i) Understanding Linux working environment, Practicing Linux commands related to file system, file handling, editors, gcc compiler, gdb debugger; (ii) Basic data types, variables, input and output statements; (iii) Conditional and control structures; (iv) Arrays (one and two dimensional); (v) Functions and Recursion; (vi) Structures, Unions and Enumeration; (vii) Pointers; (viii) File handling; (ix) Dynamic memory allocation; (x) Linked Structures

Reference Books

1. Kernighan, B. W., & Ritchie, D. M., *The C Programming Language*, Prentice Hall of India
2. Balaguruswamy, E., *Programming in ANSI C*, Tata McGraw Hill
3. Gottfried, B., *Schaum's Outline of Programming with C*, McGraw Hill
4. Lipschutz, S., *Data Structures, Schaum's Outlines Series*, Tata McGraw Hill
5. Horowitz, E., Sahni, S., and Anderson-Freed, S., *Fundamentals of Data Structures in C*, W. H. Freeman & Company
6. Dromey, R. G., *How to Solve it by Computer*, Prentice-Hall of India

Course Title	**Linear Algebra and Calculus**	Course No.	**MA111**
Focus Group	Mathematics	L-T-P [C]	4-1-0 [5]
Offered for		Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objectives

1. To train the undergraduate students towards basic understanding of Mathematics.
2. To provide student with sufficient knowledge in calculus, which can be used by the students in their respective fields.
3. To develop a working knowledge of central ideas of Linear Algebra.

Learning Outcomes

1. Understanding of different structures and their properties like, Dependence, Basis and Dimension.
2. Linear transformations between two structures and its representation by Matrices.
3. Integration in higher dimension and Vector Calculus.

Contents

1. *Linear Algebra:* Fields, Matrices, Elementary Matrices, Row-reduced Echelon Form, System of Linear equations, Vector spaces, Subspaces, Linear Independent set, Basis, Dimension, Direct sum, Quotient spaces, Linear Transformations, Range Space, Null Space, Rank-Nullity Theorem, Algebra of Linear Transformations, Inner product space, Orthogonal sets, Cauchy-Swartz Inequality, Orthonormal sets, Gram-Schmidt Orthogonalization Process. Eigenvalues and eigenvectors of a linear operator, Characteristic polynomials, Minimal polynomial, Cayley-Hamilton theorem, Diagonalization, Singular value Decomposition.
2. Sequences, Series, Power series, Limit, Continuity, Differentiability, chain Rule, Partial Derivatives, Gradient, Directional Derivative, Mean value theorems and applications; Linear Approximation, fundamental theorems of calculus, Newton and Picard method; Taylors theorem, Approximation by polynomials, Bisection method, false position method, fixed point method, Newton-Raphson method, secant method, Critical points, convexity, maxima and minima, Trapezoidal and Simpsons rule, Curve tracing, length, Area, Volume, Double and triple integrals, Differentiability of vector functions, arc length, Curvature, Continuity and Differentiability of vector functions, Vector Calculus, Greens Theorem, Gauss Theorem, Stokes Theorems.

Reference Books

1. Hoffman, K. & Kunze, R., *Linear Algebra*, 2nd Edition, Prentice Hall of India
2. Strang, G., *Linear Algebra and its Applications*, 4th Edition
3. Ghorpade, S. R. & Limaye, B. V., (2006), *A Course in Calculus and Real Analysis,* Springer Verlag
4. Ghorpade, S. R. & Limaye, B. V., (2009), *A Course in Multivarible Calculus and Analysis,* Springer Verlag
5. Thomas, G. B. & Finney, R. L., (1992), *Calculus and Analytic Geometry,* 9th Edition, Addison Wesley Publishing Company

Course Title	**Electromagnetism and Optics**	Course No.	**PH111**
Focus Group	Physics	L-T-P[C]	3-1-3[5]
Offered for		Type	Core
Pre-requisite		To take effect from	20 July 2014

Objective

To develop an understanding of the foundations of optics and electromagnetism.

Learning Outcome

The students will be able to relate theoretical concepts with problem solving approach in electrodynamics and optics.

Contents

1. *Electromagnetism*
2. *Vector Calculus:* Physical interpretation of Gradient, Divergence and Curl, Line, Surface, and Volume integrals.
3. *Electrostatics:* Coulomb's law, Gauss's theorem, electrostatic potential, Laplace's equation, conductors, capacitors and dielectrics.
4. *Magnetostatics:* Biot Savart's law, Ampere's law, Lorentz force.
5. *Magnetic Induction:* Faraday's law, Lenz's law, Self and Mutual inductance, energy stored in magnetic field.
6. *Maxwell's equations:* Displacement current, electromagnetic waves, plane wave solutions of Maxwell's equation, Poynting vector.
7. *Optics*
8. *Wave Nature of Light:* Interference, Fresnel and Fraunhoffer diffraction, ordinary and extraordinary rays, Plane, circular and elliptically polarized light, Birefringence, half wave plates.

Reference Books

1. Ghatak, A. K., (2007), *Optics,* Tata McGraw Hill
2. Griffiths, D. J., (2005), *Introduction to Electrodynamics,* Prentice Hall of India

Course Title	**Physics of Semiconductor Devices**	Course No.	**EE111**
Focus Group	Electrical Engineering	L-T-P [C]	3-0-0 [3]
Offered for	B.Tech.	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objective

To teach students design and fabrication steps of semiconductor devices

Learning Outcomes

1. Understanding of physical concepts behind the diode and transistors
2. Ability to design advance semiconductor devices

Contents

1. *Physics and Properties of semiconductors:* crystal structure, energy-bands and energy gaps, charge carriers in semiconductors, carrier concentrations, drift of carriers in electric and magnetic fields, diffusion of carriers, generation and recombination of excess carriers.
2. *p-n junctions:* electrostatics, space charge, abrupt and linearly graded, current-voltage and capacitance-voltage characteristics, junction breakdown, transient behaviour.
3. *Metal-Semiconductor contacts:* Schottky effect, metal-semiconductor contacts, current-voltage characteristics, ohmic contacts, hetero-junctions.
4. *Bipolar junction transistors (BJTs):* transistor action, current gain, static characteristics, frequency response, transient behaviour, junction breakdown, modelling-Ebers-Moll/Gummel-Poon, thyristor.
5. *Field effect transistors (FETs):* Junction field effect, metal-insulator-semiconductor (MIS), MOS diode, MOSFET, characteristics, threshold voltage, frequency response, device scaling, modelling, charge couple devices.
6. *Advanced semiconductor devices:* Structure and characteristics of MESFETs, HBTs, high-electron-mobility transistors (HEMTs), modulation-doped field effect transistors (MODFETs).

Reference Books

1. Neamen, D. A., (2007), *Semiconductor Physics and Devices*, Tata McGraw Hill
2. Sze, S. M., (2001), *Physics of Semiconductor Devices,* John Wiley & Sons
3. Streetman, B. G. & Banerjee, S. K., (2007), *Solid State Electronic Devices,* Pearson Education Asia
4. Anderson, B. L. & Anderson, R. L., (2005), *Fundamentals of Semiconductor Devices,* McGraw Hill Higher Education
5. Kasap, S. O., *Optoelectronics and Photonics*, Pearson Education

II Semester

Course Title	**System Exploration - Workshop**	Course No.	**ME121**
Focus Group	Mechanical Engineering	L-T-P[C]	3-0-3[4]
Offered for	B.Tech.	Type	Hands-on Experience for CSE, ME, EE, BISS, SS
Pre-requisite		To take effect from	July 2014

Objectives

1. To develop basic knowledge of handling tools in different areas of manufacturing.
2. To provide a practical exposure to the vocational trades within basic practical activities associated with all branches of engineering.
3. To instill confidence to manufacture, assess quality and to perform maintenance or correction in product design.

Learning Outcomes

1. The importance of quality and design of the product with respect to material use, design dimensions and tolerances.
2. Understanding the activities and practical difficulties of skilled workman who ultimately are involved in producing all goods in any industry.
3. Understanding the various aspects of materials.

Contents

1. *Introduction:* Classification of engineering materials and their important mechanical and manufacturing properties, Phase diagrams, Gibbs phase rule, Lever rule, Iron-Iron carbide Phase diagram, T-T-T Diagram, General classification of manufacturing processes, Selection of manufacturing processes, Manufacturing attributes of manufacturing processes. Introduction to bulk property enhancement and surface property enhancement processes.
2. *Casting:* Principles of metal casting (Alloy solidification, homogenous and heterogeneous nucleation, cooling curve, concept of supercooling, grain growth, avrami equation), Patterns, Types of Patterns, Pattern Materials and pattern allowances, Types of Sands, Characteristics of molding sand, Types of cores, Chaplets and chills, their materials and functions, Casting Defects.
3. *Geometric Tolerance design:* Concept of limits fits and tolerances, hole based system, shaft based system, different types of fits
4. *Metal Forming and Sheet metal operations:* Basic Operations and their description (Forging, Rolling, Drawing, Extrusion, Bending, Spinning, Stretching, Embossing and Coining, Die and Punch operation in press work, Shearing, Piercing and blanking, Notching, Lancing.)
5. *Material Removal Processes:* Principles of metal cutting, Introduction to orthogonal and oblique cutting, Chip formation, Cutting tools, their materials and applications, Geometry and nomenclature of single point cutting tool, Tool life, Cutting fluids and their functions, Basic machine tools (Lathe, milling machine, Drilling Machine, Shaper, Planer) and their applications, Introduction to grinding processes. Introduction to non-traditional machining processes (EDM, USM, CHM, ECM, LBM, AJM, and WJM).
6. *Joining Processes:* Fundamentals of Electric arc welding (MMAW, SAW, GMAW, GTAW, PAW) Gas welding and cutting, Resistance welding and Thermit welding, Soldering,

Brazing and Braze welding, Adhesive bonding, Mechanical fastening (Riveting, Screwing, etc.). Plastic Processing: Plastics, their types and manufacturing properties, Introduction to Compression molding, Injection molding and Blow molding, Additives in Plastics. Modern Trends In Manufacturing: Introduction to numerical control (NC) and computerized numerical control (CNC) machines and Rapid Prototyping Techniques

7. *Laboratory Work:* Woodworking (Pattern making exercise), Preparation of aluminum casting, Machining exercise (turning operations), Welding exercise (Preparation of square butt joints, T-joints using arc welding), Sheet metal fabrication (Preparation of tray, funnel, etc.), Fitting exercise and heat treatment of steels, Demonstration on CNC Lathe, CNC Milling. Demonstration on Rapid Prototyping Technique and Electric Discharge Machine.

Reference Books

1. Degarmo, E. P., Kohser, R. A., and Black, J. T., (2008), *Materials and Processes in Manufacturing*, 8th Edition, Prentice Hall of India
2. Kalpakjian, S. & Schmid, S. R., (2006), *Manufacturing Processes for Engineering Materials*, 4th Edition, Dorling Kindersley
3. Chapman W. A. J., (2001), *Workshop Technology* (3 Vols.), 5th Edition, CBS Publishers & Distributors
4. Groover, M. P., (1996), *Fundamentals of Modern Manufacturing*, Prentice Hall International
5. Campbell, J. S., (1999), *Principles of Manufacturing, Materials and Processes*, Tata McGraw Hill Company

Course Title	**Basic Electronics Engineering**	Course No.	**EE121**
Focus Group	Electrical Engineering	L-T-P [C]	3-1-3 [5]
Offered for	B.Tech.	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objectives

1. To introduce different components used in electronic circuits and explain their terminal characteristics
2. To teach various methods of electronic circuit analysis and design

Learning Outcomes

1. Ability to do time-domain analysis of electronic circuits for various branch currents and node voltages
2. Ability to appreciate the use of discrete components in designing application specific circuits

Contents

1. *Components and Sources:* Passive components, Resistance, Inductance, Capacitance; lumped element model; series, parallel combinations; Kirchhoffs law: voltage, current, linearity, Voltage and current sources; non ideal sources; representation under assumption of linearity; controlled sources: VCVS, CCVS, VCCS, CCCS; concept of gain, transconductance, transimpedance.
2. *Basic Circuit and Transient Analysis:* Node and loop analysis; Choice of nodes and branches for efficient analysis. Superposition theorm; Thevenin's theorm; Norton's theorem, RL and RC Circuits, Sinusoidal Steady State Analysis, RLC circuits, Time domain response of RL and RC circuits, Two-port Networks and Transfer Function, Sinusoidal steady state response; phasor; impedance; transfer function of two port networks. Frequency response: concept; amplitude and phase response; Bode plots.
3. *Discrete components and Circuits:* Discrete electronic devices: Diode, zener diode, BJT (Bipolar junction transistor), LED, Photodiode, Phototransistor, varactor; characteristics and operation using equivalent circuits, Diode circuits; clipper, clamper circuits. DC power supply: rectifier- half wave, full wave (center tapped, bridge), zener regulated power supply, regulation, BJT biasing; CE-biasing circuits, operating point; large/small signal models of CE-BJT amplifier.
4. *Operational Amplifiers:* Basic model; virtual ground concept; inverting amplifier; non-inverting amplifier, Integrator; differentiator; Basic feedback theory; +ve and -ve feedback; concept of stability; oscillator. Waveform generator for Square wave, triangular wave, Wien bridge oscillator, Schmitt trigger; astable multivibrator, Introduction to active filters, 555 timer: description and data sheet.
5. *Logic gates and Applications:* Numbering system, OR, NOT, AND, NOR and NAND; universal gates; XOR and XNOR gate; Truth tables, Combinational circuits. Designing combinational circuits: SOP, POS form; K-map; Optimization, Multiplexer; Gate base implementation. Logic function representation using truth table, Sequential circuits, flip-flops, S-R flip-flop; JK master slave flip flop; D-flip flop,
6. *Laboratory:* Using Laboratory Instruments; Characterization of Passive Circuit Elements (R, L, C); Time Response of RC and RL Circuits; Frequency Response of RC and RLC Circuits; Equivalent Circuits and Audio Signals; Diode Characteristics and DC Power

Supply; Bipolar Junction Transistor (BJT) Circuits: Inverter and Common Emitter Amplifier; Operational Amplifiers; Basic Combinatorial Circuits; Any new circuit.

Reference Books

1. Smith, R. J. & Dorf, R. C., (2009), *Circuits, Devices and Systems,* 5th Edition, John Wiley
2. Hayt, W. H., Kemmerly, J. E., and Durbin, S. M., (2010), *Engineering Circuit Analysis*, 7th Edition, Tata McGraw Hill
3. Boylestad, R. L. & Nashelsky, L., (2009), *Electronic Devices and Circuit Theory*, 10th Edition, Prentice Hall
4. Sedra, A. S. & Smith, K. C., (2011), *Microelectronic Circuits*, 6th Edition, Oxford University Press

Course Title	**Engineering Mechanics**	Course No.	**ME122**
Focus Group	Physics	L-T-P[C]	3-0-3[4]
Offered for	B.Tech.	Type	Basic for CSE, ME, EE, SS, BISS
Pre-requisite		To take effect from	July 2014

Objectives

1. To provide practice to apply knowledge in work, energy and momentum to study rigid body mechanics
2. To educate about the forces and inertia and its effect of motion of rigid bodies.

Learning Outcomes

1. To analyse forces and moments on static rigid body, moments on or between multiple static rigid bodies and internal forces or moment within them
2. To model practical structural problems using concepts of free body diagrams and equilibrium conditions

Contents

1. Basic dimensions in Mechanics, Law of dimensional homogeneity, Vector and Scalar Quantities, Elements of vector algebra. Moment of force about a point/axis, Couple, Moment of Couple about a line. Free Body Diagram, Equations of Equilibrium, Static indeterminacy, Equilibrium in three dimensions Coulomb Fraction, Surface contact friction, Transmission of power through belt. Screw jack, screw thread. Moment of area and centroid, Pappus-Guldinus Theorems, Second moments and product of Area, Transfer theorems, Principal axes. Inertial quantities, Mass-Inertia/Area-Inertia terminology, Translation of coordinate axes.
2. Kinematics of particles, Velocity and acceleration in terms of path variables, simple relative motion, motion of particle relative to a pair of translating axes Newtons laws of rectangular coordinates/rectilinear translation, cylindrical coordinate/Central force motion. Conservation of Mechanical Energy, Work-energy equations, Center of mass based Kinetic energy, Principle of virtual work. Impulse and Momentum relation of particles, Moment of momentum equations-single particle/system of particles Translation/Rotation of rigid bodies, Charles theorem, time derivative of vector for different references. Parallel axis theorems, Rotational Pure rotation of a body of revolution about its axis of revolution/combined with translation. Three dimensional rotation, moment of inertia tensor, relation between angular momentum and torque in three dimensions, Gyroscopic forces. Simple harmonic oscillator, phase and phase difference, phasor diagram, oscillator with constant friction/velocity dependent damping. Forced Oscillations, power adsorption, lightly damped oscillator Motion in non-inertial frames, centrifugal foce, Coriolis force/acceleration, rate of change of vector in inertial and rotating frames.
3. *Experiments:* Vector Analysis with force table; Motion Studies Position Vs time, Velocity Vs Time; Measuring Acceleration due to gravity; Projectile launch; Centripetal motion of Pendulum; Dynamics Atwood Machine; Dynamics experiments with Friction; Sound Waves Frequency analysis

Reference Books

1. Shames, I., (2003), *Engineering Mechanics*, Prentice Hall
2. Gross, D., Hauger, W., and Schrder J., (2012), *Engineering Mechanics*, Springer
3. Meriam, J. L., & Kraige, L. G., (2002), *Engineering Mechanics*, John Wiley and Sons

Course Title	**Complex Analysis and Differential Equations**	Course No.	**MA121**
Focus Group	Mathematics	L-T-P[C]	4-1-0[5]
Offered for		Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objectives

1. Understanding of fundamentals of complex analysis.
2. Understanding of fundamentals of differential equations.

Learning Outcomes

1. Techniques for differentiation and integration of complex valued functions.
2. Finding analytical and series solution for ordinary and partial differential equations.

Contents

1. Complex numbers, algebra of complex numbers, functions, continuous and analytic functions, Cauchy Riemann Equations, elementary functions, Integral of a complex function, Cauchy-Goursat theorem, Cauchys Integral formula, derivatives of analytic functions, Moreras Theorem, Liouvilles theorem, maximum modulus principle, Taylor series, singularity, types of singularities, Laurant series, Cauchys Residue Theorem, Jordans Lemma, Evaluation of Real integrals.
2. First Order Ordinary Differential Equations, Geometrical interpretation of solution, Solution methods for separable equations, Exact equations, Linear equations, Picards Theorem for IVP, Picards iteration method, Eulers Method, Improved Eulers Method. Second Order Linear differential equations: General solution of homogeneous equation, Existence and uniqueness of solution of IVP, Wronskian and general solution of nonhomogeneous equations, Euler-Cauchy Equation, Extensions of the results to higher order linear differential equations; Power Series Method- application to Legendre equation, Legendre Polynomials, Frobenius Method, Bessel equation, Properties of Bessel functions, Sturm-Liouville BVP, Orthogonal functions, System of first order ODE and its stability, Laplace Transform and Fourier series.
3. Partial Differential equations of first order, solution to pde of first order, Cauchys method for first order pde, Charpits method, Classification of second order equations, characteristics, Riemann Method, uniqueness theorem for hyperbolic equations with given initial and boundary conditions, Dirichlet and Neumann problems, Poisson Integral, Green and Neumanns Function, Heat Equation.

Reference Books

1. Ahlfors, L. A., (2013), *Complex Analysis, 3rd* Edition, Tata McGraw Hill
2. Brown, J. W., & Churchill, R. V., *Complex Variables and Applications*, 7th Edition
3. Lang, S., *Complex Analysis*, 4th Edition.
4. Simmons, G. F., *Differential Equations with applications and Historical Notes*, 2nd Edition, Tata McGraw Hill
5. Boyce, W. E. & DiPrima, R. C., *Elementary Differential Equations and Boundary Value Problems,* 10th Edition.
6. Rao, K. S., *Introduction to Partial Differential Equations*

Course Title	**Electromagnetic Theory**	Course No.	**EE122**
Focus Group	Electrical Engineering	L-T-P [C]	3-1-0 [4]
Offered for	B.Tech.	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objective

Obtain an understanding of Maxwells equations and be able to apply them to solving practical electromagnetic fields problems

Learning Outcomes

1. Have an understanding of Maxwells equations and be able to manipulate and apply them to EM problems.
2. Formulate and analyse problems involving lossy media with planar boundaries using uniform plane waves.
3. To solve engineering problems involving transmission lines, metallic/dielectric waveguides, and optical fibers.
4. For simple antennas derive fundamental antenna parameters starting from Maxwells equations and be able to use these in the design of rudimentary wireless communications systems.

Contents

1. *Review of Maxwells equations:* Review of Gausss law, Faradays Law, Ampre-Maxwells Law, time-harmonic fields, scalar and vector potentials, boundary conditions.
2. *Uniform plane waves:* Wave propagation in free space, dielectric and conducting media, energy and Poynting vectors, wave polarization.
3. *Plane waves at boundaries and in dispersive media:* Plane wave reflection and refraction at boundaries: Normal and oblique incidence, half-wave and quarter wave matching, wave propagation in dispersive media.
4. *Transmission Lines:* Transmission line parameters and equations, Input impedance, standing wave ratio and power, Smith chart, Impedance matching, Applications of transmission lines, Transient on transmission lines.
5. *Waveguides:* TE, TM and TEM waves, parallel-plane, rectangular and cylindrical waveguides, waveguide resonators, dielectric guides.
6. *Antennas:* Hertzian dipole, half-wave dipole and quarter-wave monopole antennas, small loop antenna, antenna characteristics and arrays.

Reference Books

1. Hayt, W. H. & Buck, J. A., *Engineering Electromagnetics*, 6th Edition, Tata McGraw-Hill
2. Sadiku, M. N. O., (2009), *Principles of Electromagnetics*, Oxford University Press
3. Pozar, D. M., *Microwave Engineering*, 3rd Edition, Wiley
4. Rao, N. N., *Elements of Engineering Electromagnetics,* 6th Edition, Pearson Education

III Semester

Course Title	**Chemistry**	Course No.	**CY211**
Focus Group	Chemistry	L-T-P[C]	3-0-3 [4]
Offered for		Type	Core
Pre-requisite		To take effect from	July 20, 2014

Objectives

1. This is a course designed to relate the fundamental principles of chemistry with practical problems encountered for engineers. Emphasis will be placed on problem-solving.
2. This course will enable the students to scientific logics of various laboratory safeties and fire in different type of labs. Laboratory will correlate with lecture material.

Learning Outcomes

1. Understanding the behavior of matter and materials using fundamental knowledge of their nature
2. Predict potential complications from combining various chemicals or metals in an engineering setting.
3. Maintaining safe laboratory practice while working in lab and otherwise.
4. Keep notebooks of laboratory experiments and be able to evaluate results based on their own notes.

Contents

1. *Thermodynamics of Chemical Processes:* Concept of entropy, Chemical potential, Equilibrium conditions for closed systems, Phase and reaction equilibria, Maxwell relations, Real gas and real solution.
2. Electrochemical Systems: Electrochemical cells and EMF, Applications of EMF measurements: Steady state approximation, Chain reactions, photochemical kinetics
3. Basic Spectroscopy - Fundamentals of Microwave, IR and UV-VIS Spectroscopy: Basic concepts of spectroscopy, Selection rule, Determination of molecular structure.
4. Coordination Chemistry: Coordination numbers, Chelate effect, Coordination complexes and application.
5. Bio-inorganic chemistry: Metal ions in Biological systems, environmental aspects of Metals, NOx, CO, CO_2
6. Organic Reaction Mechanism: Mechanisms of selected organic, bio-organic, polymerization and catalytic reactions.
7. Stereochemistry of Carbon Compounds: Selected Organic Compounds: Natural products and Biomolecules
8. Organic material: polymers, synthetic and natural polymers and their applications
9. *Lab:* (i) Aldol condensation (preparation of tetra phenyl cyclo pentadienone); (ii) Preparation of complex salt of (Co (en) 6) Cl3; (iii) Preparation of double salt crystal of ammonium copper (II) sulphate hexahydrate; (iv) Saponification (Preparation of soap); (v) Preparation of Nylon-6, 6; (vi) To prepare hexamine coblt (III) Chloride (Co (NH3) 6)Cl3; (vii) Determination of dissolved oxygen in a water by Winklers method; (viii) To use Fourier transform infrared (F. T. I. R) spectroscopy in combination with A. T. R. (Attenuated total reflectance) technique for bio analysis of caffine in tea & coffee and also get IR spectrum of Aldol product and analysis of the spectrum; (ix) To plot the excitation and emission spectrum of curcumin in solvents respectively ethanol and

hexane and find stokes shift by using fluorescence spectroscopy; (x) To determine the heat capacity, glass transition temperature and the change in heat capacity for glass transition temperature for polystyrene by using Differential scanning calorimetry (DSC); (xi) To understand the theory and working principle of cyclic voltammetery and to perform CV on ferricyanide solution and to know its electrical properties for example Ep, Ip and diffuse rate etc; (xii) Determine of the Enantiomeric Purity of Naproxen and Ibuprofen; (xiii) A General chemistry laboratory Experiment relating Electron configuration and Magnetic Behaviour.

Reference Books

1. Silberberg, M., *Chemistry: The Molecular Nature of Matter and Change*, 6th Edition, Mc Graw Hill Education
2. McMurry, J. & Fay, R. C., *Chemistry*, 5th Edition, Pearson
3. Hill, R. H. & Finster, D., (2010), *Laboratory Safety for Chemistry Students Laboratory Safety for Chemistry Students,* Wiley

Course Title	**Thermodynamics**	Course No.	**ME211**
Focus Group	Mechanical Engineering	L-T-P [C]	3-0-0 [4]
Offered for	B.Tech	Type	Basic for CSE, EE, ME, SS, BISS
Pre-requisite		To take effect from	July 2014

Objectives

1. To use the First Law of Thermodynamics to estimate the potential for thermo-mechanical energy conversion.
2. To recall and comprehend work producing and work consuming cycles.
3. To inculcate the importance of water and steam and change of state.

Learning Outcomes

1. To exemplify how different heat engines work and identify the energy exchange processes.
2. To apply steady flow energy equation to thermodynamic devices.
3. To identify path and non-path based processes and assess their thermodynamic efficiencies.

Contents

1. *Basic concepts:* Thermodynamic system, Properties, State, Process, Thermodynamic equilibrium, Pressure measurement, Zeroth law, Temperature measurement;
2. *Concept of energy and energy transfer in the form of work and heat:* Thermodynamic definition and evaluation of work, Work transfer and its value for different processes, Heat transfer; Equation of state for ideal and real gases, Gas mixtures;
3. *Thermodynamic properties of pure substance:* Phase change process of pure substance and their property diagram, Use of steam table and Mollier diagram;
4. *Energy analysis of closed and open systems:* First law analysis for closed systems undergoing cycle and process, Steady flow energy equation, Flow processes, Throttling process, Joule-Thomson effect, Energy analysis of open systems, Analysis of First law for unsteady flow;
5. *Second law of thermodynamics and Thermodynamic property relations:* Kelvin-Planck and Clausius statement, Heat engine, Heat pump, Refrigerator, Concept of entropy, Entropy principle, Change of entropy for various processes, Introduction to Availability, Concept of Irreversibility, Second law efficiency, Maxwell relations, T-ds relation, Clausius-Clapeyron equation;
6. *Introduction to steam, gas and refrigeration cycles:* Carnot cycle and its limitation, Vapor power cycles (Simple Rankine, Reheatand Regeneration cycles), Gas power cycles (Otto, Diesel, Dual and Brayton cycles), Refrigeration cycles (Vapor compression and Vapor absorption cycles);

Reference Books

1. Moran, M. J. & Shapiro, H. N., (2011), *Fundamentals of Engineering Thermodynamics*, 7th Edition, Wiley
2. Cengel, Y. A. & Boles, M. A., (2010), *Thermodynamics: An Engineering Approach,* McGraw Hill Education
3. Sonntag, R. & Wylen, V., (1998), *Fundamentals of Thermodynamics,* Wiley

Course Title	**Signals and Systems**	Course No.	**EE213**
Focus Group	Electrical Engineering	L-T-P [C]	3-1-0 [4]
Offered for	B.Tech.	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objectives

1. Fundamentals of continuous-time and discrete-time linear systems and their dynamical properties.
2. Understanding of frequency domain transform analysis of LTI systems.
3. State space analysis of I/O systems.
4. Design and analysis of various Filters.

Learning Outcomes

1. Understanding the practical relevance of system properties such as linearity, time invariance, stability and causality and use of mathematical transform methods to analyze LTI systems.
2. Analyzing continuous time systems using Fourier transform as well as Laplace transform and discrete time systems using Discrete Time Fourier Transform as well as Z-transform.
3. Fundamentals of filter concepts

Contents

1. *Continuous and discrete time signals:* Classification of signals, Signal Energy, Signal Power, Useful operation on signals and signal models, even and odd functions
2. *Frequency Domain Representation:* Fourier series, Fourier, Laplace and Z transform techniques, DTFT, DFT.
3. *Sampling:* Sampling Theorem, Signal Reconstruction, Application of the sampling theorem, Analog to Digital Conversion.
4. *LTI systems:* Classification of Systems, I/O description, impulse response and system functions, pole/zero plots, state space description, block diagram representation, Time and Frequency domain analysis, FIR and IIR Systems
5. *Analog Filters:* Low-pass, high-pass, band-pass and band-stop (band-reject) filters. Filter characteristics, filter circuit transfer function, and its poles and zeros. First order, second order active and passive filters and building blocks to construct higher order filters.

Reference Books

1. Lathi, B. P., (2009), *Principles of Linear Systems and Signals*, 2nd Edition, Oxford University Press
2. Haykin, S. & Veen, B. V., (2008), *Signals and Systems,* 2nd Edition, Wiley
3. Ziemer, R. E., Tranter, W. H. & Fanin, D. R., (1998), *Signals and Systems: Continuous and Discrete,* 4th Edition, Prentice Hall
4. Kamen, E. W. & Heck, B. S., (2000), *Fundamentals of Signals and Systems Using the Web and MATLAB,* 2nd Edition, Prentice-Hall
5. Oppenheim, A. & Wilsky, A. S., *Signals and Systems*, 2nd Edition, Prentice-Hall

IV Semester

Course Title	**Electrical Machines**	Course No.	**EE221**
Focus Group	Electrical Engineering	L-T-P [C]	3-0-3 [4]
Offered for	B.Tech.	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objective

To understand construction, principle of operation, modeling, testing and performance of various electrical machines used in industry

Learning Outcomes

Provide knowledge of principles of operation of different electrical machines. The student will be able to:

1. Model various electrical machines and determine the performance under different loading conditions.
2. Test various machines and pre-determine their performance by the end of the semester.

Contents

1. *Transformers:* Three phase transformers - Equivalent circuit, performance parallel operation-connections-testing-three winding transformers-Auto transformers -Tap-changing-Cooling
2. *Basic concepts of rotating ac machines:* Armature windings-Production of rotating magnetic field in three phase and two phase ac motors-torque development
3. *Induction machines:* Principle- Equivalent circuit-Slip-torque characteristics- Testing of 3-phase Induction motor Circle diagram-harmonic effects-High torque cage motors-Induction generator
4. *Synchronous machines:* Principle-Harmonics in voltage generated-regulation methods-operation with infinite bus-parallel operation-stability-phase swinging-synchronous motor- starting methods- applications testing
5. *Special Machines:* Principle of operation, characteristics and applications of Reluctance motor-shaded pole motor-single phase synchronous motors-ac series motor

Laboratory

1. 3 Phase to 2 Phase conversion using Scott - connection;
2. Parallel Operation of Transformer;
3. Surnphers Test on 3 Phase Transformer;
4. Predetermination of Performance of 3 Phase induction motor using Circle diagram;
5. Load Test on 3 Phase Induction motor;
6. Regulation of Alternator using EMF method;
7. Regulation of Alternator using ZPF method;
8. Parallel Operation of alternator with infinite bus;
9. Slip Test and determination of Xd and Xq;

Reference Books

1. Say, M. G., (1983), *Alternating Current Machines*, Pitman Publishing
2. Langsdorf, A. S., (1999), *Theory of Alternating Machines*, Tata McGraw-Hill
3. Fitzgerald, A. E., Kingsley, C. and Umans, S. D., *Electrical Machinery,* 6th Edition, Tata McGraw-Hill
4. Puchstein, A. F. & Lloyd, T. C., *Alternating Current Machines*, John Wiley & Sons

Course Title	**Probability, Statistics and Random Processes**	Course No.	**MA221**
Focus Group	Mathematics	L-T-P[C]	4-1-0[5]
Offered for		Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objectives

1. To equip the students with the broad perspective of probability theory.
2. To develop the understanding of various discrete and continuous distributions along with their properties.
3. To understand and differentiate among various statistical and random processes techniques.

Learning Outcomes

1. Ability to analyze and differentiate between deterministic and random environment.
2. Ability to select an appropriate distribution for analyzing data specific to an experiment.
3. Understanding of various statistical and random processes techniques which can be applied to data arising in various applications.

Contents:

1. Introduction to Probability, axioms of probability, Conditional probability, Bayes Theorem, Random Variable, Discrete and Continuous random variables, Distribution Function and Probability Density (Mass) Function, Expectation and Moments of random variables, Moment Generation Function and Characteristic Function, Jointly distributed random variable, Transformation of Random Variables, Special Discrete distributions, Special Continuous distributions, Chebyshevs inequality, Law of large numbers, Central Limit Theorem
2. Regression Analysis, Parameter Estimation, Maximum Likelihood Estimator, Confidence Interval, Hypothesis Testing, Goodness of Fit test
3. Stochastic Processes, Markov Chain, Markov Processes, Queuing models.

Reference Books:

1. Ross, S. M., (2012), *Introduction to probability and statistics for engineers and scientists*, Elsevier
2. Rohatgi, V. K. & Ehsanes Saleh, A. K., (2011), *An Introduction to Probability and Statistics,* Wiley
3. Johnson, R. A., (2010), *Miller & Freund's Probability and Statistics for Engineers,* PHI Learning
4. Papoulis, A. & Pillai, U. S., (2002), *Probability, Random Variables, and Stochastic Processes,* Tata Mc-Graw Hill

Course Title	**Digital Logic and Design**	Course No.	**EE222**
Focus Group	Electrical Engineering	L-T-P [C]	3-0-3 [4]
Offered for	B.Tech.	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objectives

1. To introduce the basic concepts of digital system and the use of Boolean algebra in logic analysis and design
2. Understand the principles and methodology of digital logic design at the gate and switch level, including both combinational and sequential logic elements.
3. To introduce basic tools of logic design and provide hands-on experience designing digital circuits and components through simple logic circuits to hardware description language and interface programming in C.
4. To appreciate the uses and capabilities of a modern FPGA platform

Learning Outcomes

Students will be able to:

1. Apply Boolean algebra and other techniques to express and simplify logic expressions.
2. Analyze and design combinational and sequential digital systems.
3. Use different techniques among them a hardware description language and a programming language, to design digital systems.

Contents

1. *Number system:* binary numbers, 1s and 2s complement, arithmetic operations in integer and floating point systems; ASCII, binary and gray codes;
2. *Boolean algebra:* Boolean Equations, Minimization of Boolean functions; Designing combinational Circuits using gates and/or Multiplexers
3. *Combinational circuit:* Adder, decoder, multiplexers, code converters (binary, gray and BCD);
4. *Sequential circuit:* Bistable, Monostable, latches and flip-flops, counters (binary, ring and Johnson), shift register, timer circuits;
5. *Hardware Description Languages:* Combinational Logic, Structural Modeling, Sequential Logic, More Combinational Logic, Finite State Machines, Parameterized Modules, Test benches
6. *Digital IC families:* DTL, TTL, ECL, MOS, CMOS and their interfacing.
7. *ADC and DAC:* Sample and hold circuits, ADCs, DACs.
8. *Memories:* semiconductor memories, PALs, PLAs and FPGAs; Pipelining and timing issues, PROMs;

Laboratory

Priority encoder, multiplexer and decoder; VHDL code for simulation of a 4- Bit fast look ahead carry adder; VHDL code for simulation of an 8-bit signed integer multiplier.

1. Familiarization with logic gates and logic building.
2. Encoders and decoders
3. Adder circuits: half adder and full adder
4. Flip-flops and counters
5. Latches and memories

6. Seven segment display
7. Arithmetic logic circuits
8. Digital to analog converters
9. Analog to digital converters
10. Serial communication
11. AND, OR and EX_ OR gates using Nand (7400) gates; BCD to 6-3-1-1 Code converter; 6-3-1-1 to Gray Code converter; full adder circuit using AND, OR and XOR gates; a 4 - Bit comparator using logic gates; Pseudo-random bit generator; 4 - bit ripple carry adder; Master - Slave J-K Flip-Flop using Logic gates; Bi - directional counter using J-K Flip-flops; using

Reference Books

1. Tocci, R. J., Widmer, N. and Moss, G., (2009), *Digital Systems: Principles and Applications*, 10th Edition, Pearson
2. Mano, M. M. & Ciletti, M. D., (2012), *Digital Design: With an Introduction to the Verilog HDL*, 5th Edition, Prentice Hall
3. Harris, D. M. & Harris, S. L., *Digital Design and Computer Architecture,* 2nd Edition, Morgan Kaufman

Course Title	**Power Systems**	Course No.	**EE223**
Focus Group	Electrical Engineering	L-T-P [C]	3-0-3 [4]
Offered for	B.Tech.	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objective

1. To provide students an understanding of various components of Power system and their functions
2. To provide knowledge of modeling of components and their analysis
3. To give exposure to fault analysis, protection of various components and reactive power control

Learning Outcomes

1. Ability to model different components of power system.
2. Ability to make fault analysis, solve load flow problem, understand reactive power control methods and protection schemes.

Contents

1. Introduction to generation, transmission and distribution systems, Substation arrangements. Power system grounding.
2. Single line diagram and per unit system, Mathematical modelling of power systems- Model of synchronous generators and Transformers, Transmission lines lumped and distributed parameter models
3. *Transmission lines:* parameter calculations- Short, medium and long line models of transmission lines, voltage and current relations
4. *Cables:* types of cables, parameters calculations, voltage and current relations
5. *Load Flow Studies:* Load Flow Problem, Gauss-Seidel and Newtown- Raphson methods
6. *Fault Calculations:* Symmetrical and Unsymmetrical faults, Symmetrical components and sequence networks, Analysis of symmetrical and unsymmetrical faults
7. *Power System Stability:* Transient stability, Swing Equation, Equal Area criterion, Numerical solution for swing equation.
8. *Reactive power control:* need and advantages, methods of reactive power control
9. *Switchgear and protection:* Protective relays and their characteristics. Over-current, distance and differential protection schemes, Circuit breakers
10. *Laboratory:* Determination of ABCD parameters of Transmission line; Load flow Analysis using Gauss Siedel method; Load Flow Analysis using N R method; Formation of Z bus and short circuit analysis of a given network; Transient Stability study of a given network; Reactive power control using Tap charging Transformer; Reactive power control using FACT devices; Characteristics of IDMT relay; Characteristics of differential current relay.

Reference Books

1. Stevenson, W. D., (1982), *Elements of Power System Analysis,* McGraw-Hill
2.Gross, C. A., (1986), *Power System Analysis*, Wiley
3.Kothari, D. P. & Nagarath, I. J., (2003), *Modern Power System Analysis,* Tata McGraw-Hill

V Semester

Course Title	**Power Electronics**	Course No.	**EE311**
Focus Group	Electrical Engineering	L-T-P [C]	3-0-3 [4]
Offered for	B.Tech.	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objective

Power Electronics is designed to understand the Power Electronic devices and circuits used for various converters in the industry and to design various circuits used for specific converters.

Learning Outcome

This course provides the knowledge by which, the student would be able to analyse any Power converter operation and design the same at the end of the semester.

Contents

1. *Power semiconductor devices:* structure and characteristics of power diodes, SCR, and Transistors and IGBT GTOs, SCR switching circuits, protection, series and parallel operation
2. *Controlled rectifiers:* Fully controlled/half-controlled, single phase and three phase Rectifiers, Operation with R, R-L, R-L-E load, power factor, harmonics and effect of source inductance, dual converters.
3. *AC regulators:* Single phase AC static switches; transient-free switching of inductive loads; voltage regulators; cyclo- converter, induction heating
4. *DC-DC converters:* Step-Up and Step-Down converters with various type of loads, Switching mode regulators, Buck, Boost, and Buck-Boost Regulators, Voltage commutated and current commutated Choppers.
5. *Inverters:* Current source and Voltage source inverters, active and reactive power handling, single phase and three phase voltage source and PWM inverters; PWM techniques

Laboratory

Characteristics of SCR and UJT; R, R-C, and UJT Trigging Schemes; Single Phase controlled rectifier with R, R L and R L E load; 3 phase Rectifier with R, R L loads; Single phase AC voltage controller; Performance of Buck and Buck-Boost regulator; Single phase (PWM) Inverter with R , R L load; 3 phase Inverter (PWM) with R and R L load.

Reference Books

1. Rashid, M. H., (2004), *Power Electronics: Circuits, Devices, and Applications*, Pearson Education India
2. Sen, P. C., (1987), *Power Electronics*, Tata McGraw-Hill Education
3. Dubey, G. K., Doradla, S. R. and Joshi, A., (2005), *Thyristorised Power Controllers*, New Age International Publishers

Course Title	**Microprocessors and Microcontrollers**	Course No.	**EE312**
Focus Group	Electrical Engineering	L-T-P [C]	3-0-3 [4]
Offered for	B.Tech	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objective

To teach architecture and programming of microprocessors and microcontrollers.

Learning Outcomes

1. Students will be able to design an embedded system using processors (PIC) for real applications
2. Ability to use Integrated Development Environment (IDE) to program processors

Contents

1. *Architecture of Microprocessor:* Introduction to building blocks of microprocessors ALU, control unit; Architecture and programming of 8085 processor; instruction set of microprocessor; timing diagrams of different machine cycles interfacing of microprocessor with memory
2. *Architecture and programming of Microcontroller:* Architecture of PIC Microcontrollers (PIC 18FXXX Series); Assembly language programming; introduction to integrated development environment
3. *Peripherals:* UART, I2C, Timers, CCP modules, RTC, Watchdog timer, ADC; I/O Ports, power saving modes.
4. *Specifications and Modeling:* Concept of finite state machine, sequential flow charts to model different logical sequences.

Reference Books

1. Huang, H., *PIC Microcontrollers: An introduction to software and hardware interfacing*, Thomson Learning
2. Gaonkar, R., (2007), *Fundamentals of Microcontrollers and Applications in Embedded Systems with PIC,* Thomson Learning
3. Mazidi, M. A., McKinlay, R. D. and Causey, D., *PIC Microcontroller*
4. Hohl, W., (2009), *ARM Programming*
5. Gaonkar, R., (2002), *Microprocessor Architecture, Programming, and Applications With the 8085,* Prentice Hall

Course Title	**Communication Systems**	Course No.	**EE313**
Focus Group	Electrical Engineering	L-T-P [C]	3-1-0 [4]
Offered for	B.Tech.	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objectives

1. To provide students an understanding of the concepts related to transmission and reception techniques for communications.
2. To provide communication concepts and techniques required for implementation of a digital communication transceiver and application of these concepts in a system context.
3. To provide concepts and techniques required for holistic understanding of a communication system.
4. The concepts taught in class will be discussed in the context of wired telephony, cellular communication systems, satellite communications, and deep space communications.

Learning Outcomes

1. Analyse and design basic communications systems.
2. Apply concepts and techniques from communication theory to design communication systems.
3. Develop the ability to compare and contrast the strengths and weaknesses of various communication techniques. Model physical properties of wired and wireless communication channels.

Contents

1. Communication problem and system models, elements of communication systems, communication channels and their characteristics, mathematical models for communication channels, multiple access techniques, link budget analysis, baseband/IF subsystems and RF subsystems: radio receivers, power amplifiers, antenna.
2. Representation of deterministic and stochastic signals, random noise characterization in communication systems, signal-to-noise ratio, characterization of communication signals and systems: signal space representations, representation of analog and digitally modulated signals, spectral characteristics of modulated signals.
3. *Optimal receivers:* Receivers for signals corrupted by AWGN, Error performance Analysis of receivers for memory-less modulation, optimal receivers for modulation methods with memory, performance analysis of digital subscribers loop systems.
4. *Carrier and Symbol Synchronization:* Carrier recovery and symbol synchronization in signal demodulation, carrier phase estimation, symbol timing estimation.
5. *Spread spectrum signals for digital communications:* Model of spread spectrum communication system, direct sequence spread spectrum signals, frequency hopped spread spectrum signals, synchronization of spread spectrum systems.

Reference Books

1. Proakis, J. G. & Salehi, M., (2008), *Communication System Engineering*, McGraw-Hill Higher Education
2. Haykin, S., (2001), *Communication Systems*, Wiley
3. Lathi, B. P. & Ding, Z., (2010), *Modern Digital and Analog Communication Systems*, Oxford University Press
4. Proakis, J. G. & Salehi, M., (2008), *Digital communications*, McGraw-Hill Higher Education
5. Sklar, B. & Ray, P. K., (2009), *Digital Communications: Fundamentals and Applications,* Pearson Education
6. Madhow, U., (2008), *Fundamentals of Digital Communication*, Cambridge University Press
7. Dixon, R. C., (2010), *Spread Spectrum Systems with Space Applications,* Wiley

Course Title	**Analog Electronics**	Course No.	**EE314**
Focus Group	Electrical Engineering	L-T-P [C]	3-1-0 [4]
Offered for	B.Tech.	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objectives

1. To develop an understanding of how electronic circuits work
2. To teach design and analysis of Amplifier and frequency response
3. Exposure to a selection of analog integrated circuit topics

Learning Outcomes

1. Learning the principles associated with the BJT and MOS devices
2. Learning the biasing and various amplifier design techniques.
3. Understanding the differential amplifiers and frequency response

Contents

1. *Transistors & Biasing:* Bipolar Junction Transistors (BJTs) and MOS Field-Effect Transistors (MOSFETs), Biasing and bias stability
2. *Bipolar amplifiers:* Operating point analysis, bipolar amplifier topologies, Small signal equivalent circuits, impedances, gain, Effect of various Biasing techniques on properties of amplifiers, Cascode stages and Current mirrors with BJT
3. *MOSFET amplifiers:* MOSFET amplifier topologies, Small signal equivalent circuits, impedances, gain, differences in BJT and MOSFET amplifiers, suitable applications, Cascode stages and Current mirrors with MOSFET.
4. *Differential Amplifiers:* BJT and MOS differential pair, large and small signal analysis, Common mode rejection, Active loads, Applications
5. *Frequency response of amplifiers:* Fundamental concepts, High frequency model of transistors, Gain versus frequency, finding cutoff frequency of various amplifiers, Internal Capacitances, Millers theorem and its use,
6. *Feedback:* Negative feedback, Gain Desensitization, Bandwidth extension, Modification of I/O impedances, Sense and Return techniques, stability in feedback systems
7. *Operational Amplifiers:* Differential and Common mode operation, practical circuits, DC offset parameters, frequency parameters, Op-Amp specifications, Constant gain multiplier, Voltage summing, Voltage buffer, Controller sources, Instrumentation circuits, Active filters, Frequency response of Op-Amps: open loop gain as a function of frequency, High frequency Op-Amp equivalent circuits, Close loop frequency response, circuit stability and slew rate, Oscillators, Comparator: basic comparator, zero crossing detector, limitation of Op-Amp as comparator, High speed precision type comparator, Voltage to frequency and frequency to voltage conversion, ADC and DAC circuits
8. *Output Stages and Power Amplifiers:* Basic stages, Large signal considerations, Efficiency and PA classes
9. *Analog Filters:* General considerations, Filter characteristics, Classification of filters, Transfer function of filters, second order filters, active filters, Approximation of filter response.

Reference Books

1. Razavi, B., (2013), *Fundamentals of Microelectronics,* 2nd Edition, Wiley India
2. Gayakwad, R. A., (2002), Op-Amps and Linear Integrated Circuits, 4th Edition, Prentice-Hall
3. Sedra, A. S., Smith, K. C., and Chandorkar, A. N., (2013), *Microelectronic Circuits: International Version,* 6th Edition, Oxford University Press

Course Title	**B. Tech. Project**	Course No.	EE398
Focus Group	Electrical Engineering	L-T-P [C]	0-0-9 [3]
Offered for	5^{th} to 8^{th} Semester	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objectives

1. To gain hands on experience on innovative technology project
2. To prepare the students to solve/work on the real world/practical/theoretical problems involving issues in computer science and engineering

Learning Outcomes

1. Ability to design and model a system
2. Ability to plan and execute well defined objective
3. Ability to work in team at component level and system level
4. Ability to troubleshoot
5. Ability to reuse- or integrate with- existing components
6. Ability to derive performance metrics and assess quantitatively the performance of system
7. Ability to report and present the findings in standard formats

VI Semester

Course Title	**Information Theory and Coding**	Course No.	**EE321**
Focus Group	Electrical Engineering	L-T-P [C]	3-1-0 [4]
Offered for	B.Tech	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objectives

1. To introduce the notion of entropy and information;
2. To discuss the fundamental limits of data compression (source coding).
3. To discuss the fundamental limits of transmission systems (channel coding).
4. To provide practical techniques that can achieve or approach the fundamental limits.

Learning Outcomes

By the end of this course, students will be able to:

1. Compute and analyse fundamentals limits of data compression and reliable communication over noisy channel.
2. Design practical systems that achieve close to the aforementioned fundamental limits.

Contents

1. *Mathematical models for information sources:* measure of information, entropy, relative entropy, differential entropy, Jensens inequality, data processing inequality, Fanos inequality.
2. *Data Compression:* asymptotic equipartition property (AEP), consequences of AEP, Typical sets, lossless source coding theorem.
3. *Rate-distortion theory:* scalar and vector quantization; calculation of the rate distortion function.
4. *Source coding for analog and discrete sources:* lossless coding-optimal codes, instantaneous codes, prefix codes, Huffman coding, universal source coding, Lempel-Ziv-Welch coding; lossy coding-waveform coding, analysis-synthesis techniques, prefix coding, universal source coding.
5. *Channel capacity:* Jointly typical sequences, channel coding theorem, results for Gaussian channel.
6. *Channel Codes:* Linear block codes, convolution codes: rate adaptation and Viterbi decoding algorithm, turbo codes, low density parity check codes.

Reference Books

1. Cover, T. A. & Thomas, J. A., (2006), *Elements of Information Theory*, John Wiley & Sons
2. Abramson, N., (1963), *Information Theory and Coding*, McGraw-Hill Book Company Inc.
3. Lathi, B. P., & Ding, Z., (2010), *Modern Digital and Analog Communication Systems,* Oxford University Press
4. Gallager, R. G., (2009), *Principles of Digital Communication,* Cambridge University Press
5. Proakis, J. G., & Salehi, M., (2008), *Digital Communications,* McGraw-Hill Higher Education

Course Title	**Digital Signal Processing**	Course No.	**EE322**
Focus Group	Electrical Engineering	L-T-P [C]	3-1-0 [4]
Offered for	B.Tech.	Type	Compulsory
Pre-requisite	Signals, Systems and Networks	To take effect from	July 2014

Objectives

To develop skills for:

1. Analysis of signals and systems
2. Development of efficient algorithms to process discrete time signals

Learning Outcome

Students will be able to design filters of given specifications and will be able to implement the same with minimal hardware requirement.

Contents

1. *Sampling of Continuoustime signals:* Discrete time processing of continuous time signals, Practical Sampling and reconstruction, sampling of band-pass signals,
2. *Computation of the Discrete Fourier transform:* The discrete Fourier transform (DFT), Sampling of the discrete time Fourier transform, properties of the DFT, linear convolution using the DFT, Fourier analysis of the signals using the DFT, Direct computation of the DFT, Decimation-in-time FFT algorithms, Decimation-in-frequency FFT algorithm.
3. *Design of FIR filters:* FIR filters with linear phase, design of FIR filters by windowing and frequency sampling. Design of some special FIR filters, Real Time Implementation of FIR filters.
4. *Design of IIR filters:* Introduction to IIR filter design, Design of continuous time low pass filters, transformation of continuous time filters to discrete time filters, design examples for low pass IIR filters, Frequency transformations of low pass filters.
5. *Multirate signal processing:* sampling rate conversion, implementation of Multirate systems, filter design for Multirate systems, two channel filter banks and multi channel filter banks.
6. *Finite wordlength effects:* Number representation, statistical analysis of quantization error, quantization of Fixed-point and Floating point numbers, A/D and D/A conversion
7. A/D conversion noise analysis, quantization of filter coefficients, Effects of finite wordlength on digital filters.
8. *Radom signal processing:* Spectral analysis of stationary processes, Optimum linear filters, Linear prediction, Forward and Backward linear prediction, Solution of the Normal Equations, Properties of the Linear Prediction-Error Filters, Wiener Filters for Filtering and Prediction and all-pole signal modeling.

Reference Books

1. Mitra, S. K., (2008), *Digital Signal Processing*, 3rd Edition, McGraw-Hill
2. Manolakis, D. & Ingle, V., (2011), *Applied Digital Signal Processing,* Cambridge University Press
3. Proakis, J. G. & Manolakis, D. G., (1996), *Digital Signal Processing (Principles, Algorithms, and Applications)*, 3rd Edition, Prentice Hall International Inc.

Course Title	**Microwave Engineering**	Course No.	**EE323**
Focus Group	Electrical Engineering	L-T-P [C]	3-0-0 [4]
Offered for	B.Tech.	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objectives

1. To enable the student to become familiar with active & passive microwave devices & components used in Microwave communication systems.
2. Familiarize with microwave sources.

Learning Outcomes

1. Understand important and unique engineering issues at microwave and millimeter wave frequencies.
2. Study the effects of impedance mismatches on power transmission and the use of tuners for impedance matching.
3. Ability to use scattering parameters to characterize components.

Contents

1. *Review of EM Theory:* Maxwell's equations, plane waves in dielectric and conducting media, transmission lines.
2. *Planar transmission lines:* stripline, micro-stripline; Wave propagation in planar lines: design, effective dielectric constant, attenuation, dispersion, power-handling capability; Design of distributed circuits using planar lines.
3. *Network analysis:* scattering-matrix: representation, properties, shift in reference planes, generalized S-matrix;
4. *Lumped passive components and their design:* Operation and S-matrices of resonators/cavities, directional couplers, power splitters/combiners, filters, non-reciprocal components: isolators and circulators;
5. *Microwave active components:* RF diodes and transistors; microwave sources: klystron, travelling wave tube, magnetron, Amplifiers: low-noise amplifier, power amplifier, Oscillators: oscillator design, crystal oscillators, transistor oscillator, Gunn oscillator; frequency multipliers, mixers.

Reference Books

1. Pozar, D. M., *Microwave Engineering,* 3rd Edition, Wiley
2. Collin, R. E., *Foundations for Microwave Engineering,* 2nd Edition, Wiley-IEEE Press

Course Title	**Control Systems**	Course No.	**EE324**
Focus Group	Electrical Engineering	L-T-P [C]	3-0-3 [4]
Offered for	B.Tech.	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objectives

1. To introduce Linear Time Invariant System.
2. To teach design of linear feedback controller using time and frequency domain methods.

Learning Outcomes

1. Enable students to analyze linear control system and to understand effect of feedback.
2. Students can design linear controllers.

Contents

1. *Mathematical modeling of physical systems:* Differential equation, Difference equation, and State variable representations; Examples of modeling different types (e. g. Electrical, mechanical, chemical, biological, social etc.) of systems, Equivalence between the elements of different types of systems
2. *Linear systems and their s-domain representations:* Linearity and linearization, Convolution integral, Laplace domain representation of signals and systems, Transfer function and its interpretation in terms of impulse and frequency responses, Block-diagram and signal flow graph manipulations.
3. *Characterization of systems:* Stability concept and definition, poles, Routh array, internal stability of coupled systems, Time domain response damping coefficient, natural frequency, overshoot, settling time, rise time; Frequency domain response peak and peaking frequency, bandwidth and cut-off rate; Link between time and frequency domain response features.
4. *Advantages of closed loop operation:* Sensitivity and complementary sensitivity, Disturbance and noise reduction, Structured and unstructured plant uncertainties.
5. *Analysis of closed loop systems:* Stability and relative stability using root-locus approach, Nyquist stability criterion, Steady state errors and system types
6. *Compensation techniques:* Performance goals -- Steady-state, transient and robustness specifications, PID, lag-lead and algebraic approaches for controller design.
7. *State space modelling and state feedback control:* State space modelling, controllability and observability, state feedback and observer design.

Laboratory

1. Introduction to MATLAB, SIMULINK based Modeling of Control Systems of Different Orders and Types.
2. Modelling of Servomotor by deriving its Transfer Function and its control by using SIMULINK and QUARC blocks to introduce the concept of Hardware in loop.
3. Design and Verification of Speed Control System for Servomotor by using Transient Response Characteristics.
4. Design and Verification of Control System for Nonlinear Plant (Ball and Beam Balancer) by using Transient Response Characteristics and Multiple Loop Feedback.
5. Design and Verification of Position Control System for Unstable Plant (Magnetic

Levitation System) by using Dynamic Response Characteristics.

6. Design and Verification of Optimal Control System for Unstable Plant (Inverted Pendulum) using Euler Lagrange Approach.
7. Control of active suspension system understanding effect of disturbances.
8. Control of industrial servo system using industrial emulator.

Reference Books

1. Nise, N., (2007), *Control Systems Engineering,* 4th Edition, Wiley India
2. Ogata, K., (2002), *Modern Control Engineering,* Prentice Hall India
3. Franklin, G. F., Powell, J. D. and Emami-Naeini, A. E., (2002), *Feedback Control of Dynamic Systems,* Prentice Hall
4. Gopal, M., (2008), *Control Systems,* 3rd Edition, Tata McGraw Hill
5. Kuo, B. C., (2002), *Automatic Control Systems,* 8th Edition, Wiley

Course Title	**B. Tech. Project**	Course No.	EE399
Focus Group	Electrical Engineering	L-T-P[C]	0-0-9[3]
Offered for	5^{th} to 8^{th} Semester	Type	Compulsory
Pre-requisite		To take effect from	July, 2014

Objectives

1. To gain hands on experience on innovative technology project
2. To prepare the students to solve/work on the real world/practical/theoretical problems involving issues in computer science and engineering

Learning Outcomes

1. Ability to design and model a system
2. Ability to plan and execute well defined objective
3. Ability to work in team at component level and system level
4. Ability to troubleshoot
5. Ability to reuse- or integrate with- existing components
6. Ability to derive performance metrics and assess quantitatively the performance of system
7. Ability to report and present the findings in standard formats

VII Semester

Course Title	**B. Tech. Project**	Course No.	EE498
Focus Group	Electrical Engineering	L-T-P [C]	0-0-18 [6]
Offered for	5^{th} to 8^{th} Semester	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objectives

1. To gain hands on experience on innovative technology project
2. To prepare the students to solve/work on the real world/practical/theoretical problems involving issues in computer science and engineering

Learning Outcomes

1. Ability to design and model a system
2. Ability to plan and execute well defined objective
3. Ability to work in team at component level and system level
4. Ability to troubleshoot
5. Ability to reuse- or integrate with- existing components
6. Ability to derive performance metrics and assess quantitatively the performance of system
7. Ability to report and present the findings in standard formats

VIII Semester

Course Title	**B. Tech. Project**	Course No.	EE499
Focus Group	Electrical Engineering	L-T-P[C]	0-0-18[6]
Offered for	5^{th} to 8^{th} Semester	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objectives

1. To gain hands on experience on innovative technology project
2. To prepare the students to solve/work on the real world/practical/theoretical problems involving issues in computer science and engineering

Learning Outcomes

1. Ability to design and model a system
2. Ability to plan and execute well defined objective
3. Ability to work in team at component level and system level
4. Ability to troubleshoot
5. Ability to reuse- or integrate with- existing components
6. Ability to derive performance metrics and assess quantitatively the performance of system
7. Ability to report and present the findings in standard formats

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Course Booklet for B.Tech.

(Electrical Engineering)

2015