Proceedings of the meeting of

Seventh Board of Studies

of

Department of

"Electronics and Communication Engineering"

ISLAMIC UNIVERSITY OF SCIENCE AND TECHNOLOGY

AWANTIPORA, J&K, INDIA-192122

25th July, 2022

ANNEXURE I

VETTED COURSE STRUCTURE AND VETTED SYLLABUS (For B. Tech – Batches 2021 and onwards)

**** A minimum of 166 credits to be earned for the completion of B.Tech programme in ECE***

**** Practical training (2 credit course) to be taken up at the end of 5th semester. Evaluation will be done at the start of the 6th semester***

**** It is necessary to complete of at least 8 credits of open electives, 9 credits of Discipline Centric Electives and 6 credits of Generic Electives during the B.Tech Programme (ECE)***

**** A student will be eligible to get Under Graduate Degree with Honors or Additional Minor Engineering, if he/she completes an additional 20 credits, which should be acquired through MOOCs and scores a CGPA of ≥ 8.0***

Semester-I

S. No	Course Code	Course Title	Hours Per Week			Total Contact Hours	Credits
			L	T	P		
1.	PHY101C	Physics	4	0	0	4	4
2.	CHM101C	Chemistry	4	0	0	4	4
3.	MTH103C	Mathematics-I	3	0	0	3	3
4.	MEC150C	Workshop Practices	1	0	0	5	3
5.	ELE150C	Basic ElectricalEngineering	3	0	0	3	3
6.	CIV150C	Engineering Mechanics	3	0	0	3	3
7.		Induction program	-	-	-	-	-
Total Credits							**20**

Semester-II

S. No	Course Code	Course Title	Hours Per Week			Total Contact Hours	Credits
			L	T	P		
1.	MTH153C	Mathematics –II	4	0	0	4	4
2.	CSE150F	Programming forProblem Solving	3	0	0	3	3
3.	BIO101F	Environmental Science	3	0	0	3	3
4.	MEC101C	Engineering Graphicsand Design	1	0	4	5	3
5.	ENG101F	Communication Skills	3	0	0	3	3
6.	CSE151F	Programming Lab	0	0	2	2	1
7.	PHY150C	Physics Lab	0	0	2	2	1
8.	CHM150C	Chemistry Lab	0	0	2	2	1
Total Credits							**19**

Semester-III

S. No	Course Code	Course Title	Hours Per Week			Total Contact Hours	Credits
			L	T	P		
1.	ECE201C	Electronic Devices	3	0	0	3	3
2.	ECE202C	Digital Electronics and Logic Design	3	0	0	3	3
3.	ECE203C	Signals and Systems	3	0	0	3	3
4.	ECE204C	Network Theory	3	0	0	3	3
5.	ECE205C	Electronic Instruments and Measurements	3	0	0	3	3
6.	MTH203C	Applied Mathematics for Engineers	3	0	0	3	3
7.	ECE210C	Electronic Devices Lab	0	0	2	2	1
8.	ECE211C	Digital Electronics and Logic Design Lab	0	0	2	2	1
9.	ECE212C	Basic Electrical and Electronics Lab	0	0	2	2	1
10.	-	Open Elective	-	-	-	-	x
Total Credits							**21+x**

Semester-IV

S. No	Course Code	Course Title	Hours Per Week			Total Contact Hours	Credits
			L	T	P		
1.	ECE250C	Analog Circuits I	3	0	0	3	3
2.	ECE251C	Analog Communication	3	0	0	3	3
3.	ECE252C	Electromagnetic Waves	3	0	0	3	3
4.	ELE250C	Control Systems	3	0	0	3	3
5.	STA253C	Probability and Statistics	3	0	0	3	3
6.	ECE253C	Microprocessors and Microcontrollers	3	0	0	3	3
7.	ECE260C	Analog Circuits I Lab	0	0	2	2	1
8.	ECE261C	Analog Communication Lab	0	0	2	2	1
9.	ECE262C	Microprocessors and Microcontrollers Lab	0	0	2	2	1
10.	-	Open Elective	-	-	-	x	x
Total Credits							**21+x**

Semester-V

S. No	Course Code	Course Title	Hours Per Week			Total Contact Hours	Credits
			L	T	P		
1.	ECE301C	Analog Circuits II	**3**	**0**	**0**	**3**	**3**
2.	ECE302C	Digital Communication	**3**	**0**	**0**	**3**	**3**
3.	ECE303C	Transmission Lines, Antenna and Wave Propagation	**3**	**0**	**0**	**3**	**3**
4.	ELE301C	Electrical Machines	**3**	**0**	**0**	**3**	**3**
5.	MTH309C	Numerical Methods in Engineering	**3**	**0**	**0**	**3**	**3**
6.	ECEXXXE	Elective-I (Discipline Centric)	**3**	**0**	**0**	**3**	**3**
7.	ECE310C	Analog Circuits II Lab	**0**	**0**	**2**	**2**	**1**
8.	ECE311C	Digital Communication Lab	**0**	**0**	**2**	**2**	**1**
9.	ECE312C	Transmission Lines, Antenna and Wave Propagation Lab	**0**	**0**	**2**	**2**	**1**
10.	-	Open Elective	**-**	**-**	**-**	**-**	**x**
Total Credits							**21+x**

Semester-VI

S. No	Course Code	Course Title	Hours Per Week			Total Contact Hours	Credits
			L	T	P		
1.	ECE350C	Power Electronics	**3**	**0**	**0**	**3**	**3**
2.	ECE351C	Digital Signal Processing	**3**	**0**	**0**	**3**	**3**
3.	ECE352C	VLSI Design	**3**	**0**	**0**	**3**	**3**
4.	-	Elective-II (Generic)	**x**	**0**	**0**	**x**	**x**
5.	ECEXXXE	Elective-III (Discipline Centric)	**3**	**0**	**0**	**3**	**3**
6.	ECE360C	Power Electronics Lab	**0**	**0**	**2**	**2**	**1**
7.	ECE361C	VLSI Design Lab	**0**	**0**	**2**	**2**	**1**
8.	ECE362C	Seminar	**0**	**0**	**2**	**2**	**1**
9.	ECE 413C	Industrial Training	**-**	**-**	**-**		**2**
10.	ECE363C	Mini Project/Electronic Design Workshop	**0**	**0**	**4**	**4**	**2**
11.	-	Open Elective	**-**	**-**	**-**	-	**x**
Total Credits							**19+x**

Semester-VII

S. No	Course Code	Course Title	Hours Per Week			Total Contact Hours	Credits
			L	T	P		
1.	ECE401C	Wireless Communication	**3**	**0**	**0**	**3**	**3**
2.	ECE402C	Microwave Engineering	**3**	**0**	**0**	**3**	**3**
3.	ELE406C	Power Systems	**3**	**0**	**0**	**3**	**3**
4.	-	Elective-IV (Generic)	**x**	**0**	**0**	**X**	**x**
5.	ECE411C	Microwave Engineering Lab	**0**	**0**	**2**	**2**	**1**
6.	ECE412C	Major Project (Stage I)	**-**	**-**	**-**	**-**	**5**
7.	-	Open Elective	**-**	**-**	**-**	-	**x**
Total Credits							**16+x**

Semester-VIII

S. No	Course Code	Course Title	Hours Per Week			Total Contact Hours	Credits
			L	T	P		
1.	ECE450C	Optical Fiber Communication	**3**	**0**	**0**	**3**	**3**
2.	ECEXXXE	Elective-V (Discipline Centric)	**3**	**0**	**0**	**3**	**3**
3.	-	Elective-VI (Generic)	**x**	**0**	**0**	**X**	**x**
4.	ECE460C	Optical Fiber Communication Lab	**0**	**0**	**2**	**2**	**1**
5.	ECE461C	Major Project (Stage II)	**-**	**-**	**-**	**-**	**9**
6.	-	Open Elective	**-**	**-**	**-**	-	**x**
Total Credits							**16+x**

Electives (Discipline Centric)

S. No.	Course Code	Course Title	Hours Per Week			Credits
			L	T	P	
1.						
2.	ECE302E	VLSI Technology	3	0	0	3
3.	ECE303E	Computer Organization and Architecture	3	0	0	3
4.	ECE350E	Op Amps and Linear Integrated Circuits	3	0	0	3
5.	ECE351E	Optical Fiber Communication	3	0	0	3
6.	ECE353E	Advanced Microcontroller Programming	3	0	0	3
7.	ECE354E	MATLAB	3	0	2	4
8.	ECE355E	Computer Networks	3	0	0	3
9.	ECE450E	Information Theory and Coding	3	0	0	3
10.	ECE451E	System Design	3	0	0	3
11.	ECE452E	Radar Systems	3	0	2	4
12.	ECE404E	Photovoltaic System Design	3	0	0	3
13.	ECE405E	Mobile Adhoc Networks	3	0	0	3
14.	ECE406E	Wireless Sensor Networks	3	0	0	3

Note:

1. *Discipline Centric electives are offered to the students of the Department of Electronics and Communication Engineering only.*
2. ***9 credits** of Discipline Centric electives to be completed during the B. Tech programme*
3. *The students of the Department of Electronic sand Communication Engineering have to choose Discipline Centric Electives from the above list.*

Electives (Generic)

S. No.	Course Code	Course Title	Hours Per Week			Credits
			L	T	P	
1.	ECE351G	Optimization Techniques	**3**	**0**	**0**	**3**
2.	ECE352G	Process Control Instrumentation	**3**	**0**	**0**	**3**
3.	ECE355G	Embedded System Design				
4.	ECE356G	Pattern Recognition & Image Analysis	**3**	**0**	**0**	**3**
5.	ECE401G	Advanced Computer Architecture	**3**	**0**	**0**	**3**
6.	ECE402G	IoT and Multimedia Technology	**2**	**0**	**2**	**3**
7.	ECE403G	Digital Image Processing	**3**	**0**	**2**	**4**
8.	ECE404G	Photovoltaic System Design	**3**	**0**	**0**	**3**
9	ECE405G	Machine Learning	**3**	**0**	**0**	**3**
10.	ECE450G	Artificial Neural Networks And Fuzzy Logic	**3**	**0**	**2**	**4**
11.	ECE451G	Mobile Adhoc Networks	**3**	**0**	**0**	**3**
12.	ECE452G	Wireless Sensor Networks	**3**	**0**	**0**	**3**
13.	ECE453G	Cyber Forensics	**3**	**0**	**0**	**3**
14.	ECE454G	Network Security	**3**	**0**	**0**	**3**

Note:

1. *Generic electives are offered to the students of the School of Engineering and Technology including the students of the Department of Electronics and Communication Engineering.*
2. *The students of the Department of Electronics and Communication Engineering have to choose Generic Electives from the list of courses offered by all the Departments of School of Engineering and Technology.*
3. ***6 credits** of Generic electives to be completed during the B. Tech programme.*
4. *The subjects listed above are offered as Generic Electives by Department of Electronics and Communication Engineering for School of Engineering and Technology (SoET)*

Open Electives

S. No.	Course Code	Course Title	Hours Per Week			Total Contact Hours	Credits
			L	T	P		
1.	ECE001OE	Emerging Technologies in ICT	**3**	**0**	**0**	**3**	**3**
2.	ECE002OE	e-Waste Management	**3**	**0**	**0**	**3**	**3**
3.	ECE003OE	Introduction to Computer Networking	**3**	**0**	**0**	**3**	**3**
4.	ECE004OE	Introduction to Electronic Devices and Circuits	**2**	**0**	**2**	**4**	**3**
5.	ECE005OE	Introduction to Digital Logic Design	**2**	**0**	**2**	**4**	**3**
6.	ECE006OE	Basics of Communication Engineering	**2**	**0**	**0**	**3**	**2**
7.	ECE007OE	Cyber Laws	**2**	**0**	**0**	**2**	**2**
8.	ECE008OE	Wireless Home Solutions	**2**	**0**	**0**	**2**	**2**
9.	ECE 10OE	Consumer Electronics	**2**	**0**	**0**	**2**	**2**

Note:

1. *Open electives are offered to the students of all Departments of the university other than the Department of Electronics and Communication Engineering.*
2. *The students of the Department of Electronics and Communication Engineering have to choose Open Electives offered by the departments other than the Department of Electronics and Communication Engineering.*
   ***8 credits** of Open electives to be completed during the B. Tech programme (ECE)*
3. *The subjects listed above are offered as Generic Electives by Department of Electronics and Communication Engineering for departments outside School of Engineering and Technology (SoET)*

PHY101C **Physics** **4-0-0**

Vectors: Vector Analysis, Rotation of coordinate axis and Transformation of vectors, Gradient of scalar field, divergence and curl of vector field in Cartesians, Spherical polar and Cylindrical Coordinate systems, line , surface & volume integrals, Gauss's divergence theorem, Stokes's theorem.

Mechanics: Newton's laws of motion**,** rigid body, centre of mass, conservation of linear momentum, moment of inertia, conservation of angular momentum, Central forces, Keplers laws for planetary motion.
SHM, Damped, undamped and forced Oscillations (no derivation): Equation of motion, solution, amplitude resonance, velocity resonance, quality factor.

Special theory of Relativity: Frame of reference, Michelson-Morley experiment, Galilian transformations, basic postulates of special relativity, Lorentz transformations, length contraction and time dilation, mass energy relation.

Optics: Electromagnetic theory of light, Interference**:** Conditions for Interference of light, Young's double slit experiment, Newton's rings, diffraction**:** Single Slit diffraction pattern, Diffraction grating, Grating spectra, Polarization: Malus Law, Phenomena of double refraction.

Lasers: Properties of laser light**,** Main components of laser, absorption, spontaneous and stimulated emission, CW and pulsed lasers, Examples and applications: He-Ne laser, Ruby laser.

Quantum Theory: Need of Quantum theory, Photoelectric effect, Compton Effect, Heisenberg's uncertainty principle, de Broglie's hypothesis. Basic postulates of quantum mechanics, Wave function and its properties, Schrodinger's equation and its application to particle in 1-D box.

Nuclear physics: Structure of nucleus. Basic properties of nucleus (size, charge, and density), Binding energy, nuclear fission & fusion, Radioactivity, Gas detectors: GM counters.

Elementary Solid State Physics: Crystal lattice, Crystal structure, Unit cells, Miller Indices, Bravais lattice, Bragg's Law, Photographic crystal X-ray diffraction techniques, Laue's method. Free electron theory of metals, Classification of solids, formation of energy bands in metals, semiconductors and insulators, intrinsic and extrinsic semiconductors.

Text Books/Reference Books:

1. Griffiths D. J., Introduction to electrodynamics, *Pearson Education (India).*
2. Murray R. Speigel, Schaum's Outline on Vector Analysis, *McGraw Hill Education India.*
3. Upadhaya J. C., Classical Mechanics, *Himalaya Publishing House.*
4. Ghatak A., Optics, *McGraw Hill Education India.*
5. Besier A., Mahajan S., Choudhary S. R., Concepts of Modern Physics, *McGraw Hill EducationIndia.*
6. Omar M. A., Elementary Solid State Physics, *Prentice Hall of India.*

CHM101C Chemistry 4-0-0

Chemical Thermodynamics: Introduction and Importance, First Law of Thermodynamics, Work done in Isothermal and Adiabatic Conditions, Heat capacities, Relation between C_p and C_v relations, Second Law of Thermodynamics, Concept of Entropy, Carnot engine, Gibbs free energy. Free Energy Changes as Criteria of Reversible and Irreversible process, Gibbs-Helmholtz's equation, Clausius–Clapeyron equation.

Electro-Chemistry and Corrosion: Introduction, Conductivity of Electrolytes, Kohlrausch's Law of Independent Migration of Ions and its Application, Debye Huckel Theory of Strong Electrolytes. Electrochemical cells, Electrode-Potential, Standard Electrode Potential, Fuel Cells, Batteries, Introduction, Effects of Corrosion, Dry Corrosion and Wet Corrosion, mechanisms, Types of Corrosion (Pitting Corrosion, Crevice Corrosion, Galvanic Corrosion and Stress corrosion), Factors Effecting Corrosion (Nature of the Metal and Nature of the Environment), Corrosion Protection and Inhibition (Cathodic Protection, Anodic Protection, Protective Coatings)

Nano-Technology and Polymers: Nanoscale and Its Significance, Properties at Nanoscale: Optical, Electrical, and Magnetic. General Methods of Preparation of Nanomaterials viz Top Down (Ball Milling, Lithography) and Bottom up Methods (Sol-Gel, Solution Based Method), Advantages of Polymers over other Engineering Materials, Functionality, Degree of Polymerization, Concept of Molecular Weight, Polymerization (Addition, Condensation and Copolymerization), Polymerization Techniques (Bulk, Solution, Suspension and Emulsion polymerizations), Preparation, Properties and Engineering application of some Important Polymers, Polythene (LDPE and HDPE), Polyvinyl Chloride, Polystyrene, Teflon, Phenol Formaldehyde, urea-formaldehyde resin

Lubricants: Introduction, Function of Lubricants, Mechanism of Lubrication, Classification of Lubricants (Liquid, Semisolid, Solid), Properties of Lubricants (Flash Point and Fire Point, Viscosity, Aniline Point Acid value)

Instrumental Techniques: Introduction, Advantages and Disadvantages of Instrumental and Non-Instrumental Methods, Electromagnetic Radiation, Electromagnetic Spectrum, Light Absorption (Beers-Lambert Law) UV-Vis spectroscopy (Types of Transition, Chromophors, Auxo-chromes and Applications), Infrared Spectroscopy (Modes of vibration, IR bands corresponding to different functional groups and Applications), Nuclear Magnetic Resonance: Principle, shielding mechanism, chemical shift, number of Signals, Application of Nuclear Magnetic Resonance to Simple Organic Molecules.

Text Books/Reference Books:

1. Chemistry in Engineering and Technology Volumes I & II, J. Kuriacose, R. Rajaram, 2001, TMH publishing company Limited, New Delhi.
2. Engineering Chemistry, P.C. Jain, 16th Edition, Dhanpat Rai & Sons, Nai Sarak; New Delhi.
3. Chemistry of Engineering Materials, C.V. Agarwal, 9th Edition.
4. Chemistry in Engineering, L. A. Munro, 1964, Prentice Hall, New York.

5. Applied Chemistry for Engineers, R. M. E. Diamant, 3rd Revised Edition, Pitman Publishing.
6. Principles of Physical Chemistry – Puri, Sharma and Pathania, 2017, 4th Edition, Vishal Publishing Co.
7. Physical Chemistry by Peter Atkins, Julio de Paula, 8th Edition, 2006, WH Freeman.
8. Concise Inorganic Chemistry by J.D. Lee, 5th Edition, 2008, Oxford University Press.
9. Electrochemistry and Corrosion Science by N. Perez, 2nd Edition, 2016, Springer.
10. Polymer Science, V.R. Goowriker, N.V Viswanathan and Jayadev Sreedhar, 2nd Edition, 2015, New Age International Publishers.
11. Nanotechnology Fundamentals and Applications, Manasi Karkare, Rajni Bahuguna, 2013, I K international.
12. Nanotechnology Importance And Application, Fulekar, 2010, K International Publishing House.

MTH103C **Mathematics-I** **3-0-0**

Brief Review of Differential Calculus: Limit, continuity and differentiability of functions of several variables, Chain rule, Jacobi theorem. Taylor's theorem of one and two variables, extrema of functions, two or more variables using method of Lagrange's multipliers.

Ordinary Differential Equations: Exact ordinary differential equations and Ordinary differential equations reducible to exact differential equations. Linear differential equations and equations reducible to linear form. Linear Differential equations of second and higher order with constant and variable coefficients. Applications of ordinary differential equations. Series solution of differential equations.

Vector Spaces: Linear dependence of vectors, Basis and Dimensions; Linear Transformations(maps), Range and Kernel of a linear map, Rank and Nullity, Inverse of a linear transformation, Rank-Nullity Theorem, Composition of Linear maps, Matrix associated with a linear map.

Algebraic Equations, Elements of the theory of polynomial equations. Fundamental theorem of Algebra, Relation between the roots and the coefficients of an equation, Solution of cubic & bi-quadratic equations.

Text Books:

1. Shanti Narayan, Differential calculus, *S. Chand & Sons.*
2. J. W. Brown, R. V. Churchill, Complex variables and Applications, *McGraw Hill Education India.*
3. Raisinghania M. D., Ordinary and Partial Differential equation, *S. Chand & Sons*.
4. Kreyszig I., Advanced Engineering Mathematics, *John Wiley & Sons.*

Reference Books:

1. James Stewart, Calculus, *Early Transcedentals.*
2. Bali N. P., A text Book on Engineering Mathematics, *Luxmi Publications.*
3. Jain R.K., Iyengar S. R. K., Advanced Engineering Mathematics, *Narosa Publications.*
4. Hoffmann &Kunze,Linear Algebra, *Prentice Hall of India.*
5. Piaggio H. T., Differential equations and its applications, *Prentice Hall of India*.
6. Sastry, Engineering mathematics Vol I-II, *Prentice Hall of India.*

MEC150C Workshop Practices 1-0-4

(i) Lectures and Videos

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods.
2. CNC machining, Additive manufacturing.
3. Fitting operations & power tools.
4. Electrical & Electronics.
5. Carpentry.
6. Plastic moulding, glass cutting.
7. Metal casting.
8. Welding (arc welding & gas welding), brazing.

(ii) Workshop Practice

1. Machine shop
2. Fitting shop
3. Carpentry
4. Electrical & Electronics
5. Welding shop (Arc welding, gas welding)
6. Casting
7. Smithy Shop

Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., Elements of Workshop Technology, Vol. I 2008 and Vol. II 2010, *Media promoters and publishers private limited, Mumbai.*
2. Kalpakjian S. And Steven S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.

Reference Books:

1. Gowri P. Hariharan and A. Suresh Babu,Manufacturing Technology – I,*Pearson Education,2008.*
2. Roy A. Lindberg, Processes and Materials of Manufacture, 4th edition, *Prentice Hall India, 1998.*
3. Rao P.N., Manufacturing Technology, Vol. I and Vol. II, *Tata McGraw Hill House, 2017.*

ELE150C Basic Electrical Engineering 3-0-0

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems.

AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits, resonance in series and parallel RLC circuits. Three phase balanced circuits, voltage and current relations in star and delta connections.

Transformers: Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Three-phase transformer connections.

Electrical Machines: Generation of rotating magnetic fields. Construction and working of a three-phase induction motor. Significance of torque-slip characteristic. Starting of induction motor. Construction, working, torque-speed characteristic of separately excited dc motor. Construction and working of synchronous generators.

Electrical Installations: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries.

Text Books:

1. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering, *Tata McGraw Hill, 2010.*
2. D. C. Kulshreshtha, Basic Electrical Engineering, *McGraw Hill, 2009.*
3. V. D. Toro, Electrical Engineering Fundamentals, *Prentice Hall India, 1989.*

Reference Books:

1. E. Hughes, Electrical and Electronics Technology, *Pearson, 2010.*
2. Charles K. Alexender, Mathew N. O. Sadiku,Fundamentals of Electric circuits,*McGraw Hill,*
3. Jack E. Kemmerly William H. Hayt,Engineering Circuit Analysis, *McGraw Hill, 2012.*
4. L. S. Bobrow, Fundamentals of Electrical Engineering, *Oxford University Press, 2011.*

CIV150C Engineering Mechanics 3-0-0

Force Systems: Basic concepts, equilibrium of rigid bodies, system of forces, coplanar concurrent forces, components in space, resultants, moment of forces and its application, couples and resultant of force system, equilibrium of system of forces, free body diagrams, equations of equilibrium of coplanar systems and spatial systems, static indeterminacy.

Centroid and Second Moment of Area: Centroid of simple figures from first principle, centroid of composite sections; Area moment of Inertia, Moment of Inertia of plane sections from first principles, theorems of moment of inertia, moment of inertia of standard sections and composite sections.
Basic Structural Analysis: Equilibrium of deformable bodies, external and internal forces, stresses and strains in bars, basic introduction to beams, shear force and bending moment in simple beams, basic introduction to torsion, and analysis of trusses using method of joints.

Friction: Types of friction, limiting friction, dry friction, laws of friction, static and dynamic friction; motion of bodies, wedge friction, screw jack, friction clutches and brakes.

Centre of Gravity and Moment of Inertia: Centre of gravity and its implications; Mass moment of inertia, Moment of inertia of Cylinder, Cone, Sphere, etc.

Fundamentals of Dynamics: Kinematics and Kinetics of particles in rectilinear and curvilinear motion; Kinematics and Kinetics of Rigid bodies, types of motion, instantaneous centre of rotation in plane motion, D'Alembert's principle and its applications in plane motion and connected bodies, Work Energy principle, Impulse-Momentum principle, Impact.

Text Books:

1. Irving H. Shames, Engineering Mechanics, *Prentice Hall India, New Delhi.*
2. R. C. Hibbler, Engineering Mechanics: Principles of Statics and Dynamics, *Pearson Education.*

Reference Books:

1. F. P. Beer, E. R. Johnston, Vector Mechanics for Engineers, Vol I & Vol II, *McGraw Hill Education (India).*
2. Andy Ruina and Rudra Pratap, Introduction to Statics and Dynamics, *Oxford University Press.*
3. Shanes and Rao, Engineering Mechanics, *Pearson Education.*
4. Hibler and Gupta, Engineering Mechanics (Statics, Dynamics), *Pearson Education.*
5. Bansal R. K., A Text Book of Engineering Mechanics, *Laxmi Publications.*

MTH153C **Mathematics-II** **4-0-0**

Integral Calculus: Definite Integrals and their properties, Differential under the sign of integration. Double and triple integrals, Change of variables, Beta and Gamma functions, Fourier series.

Non-linear differential equation of first order, Simultaneous differential equation, Simultaneous differential equation of the form dx/P = dy/Q = dz/R . Partial differential equations of first order, langrage linear equation, Standard form, Charpit`s Method to solve non- linear partial differential equation, Partial differential equations of second and higher order, Homogeneous Partial Differential equations with constant coefficients, Solutions by the method of separation of variables, heat flow equation, Wave equation.

Matrices: Eigen values and Eigen vectors of a matrix, Cayley-Hamilton Theorem, Symmetric, Skew-symmetric, Hermitian, skew- Hermitian, Orthogonal and unitary matrices and their properties, Diagonalization; Inner product spaces, Gram-Schmidt Orthogonalization.

Complex Variables: Differentiation, Cauchy-Riemann Equations, Analytic functions, Harmonic functions, elementary analytic functions(exponential, logarithmic and trigonometric) and their properties, Taylor's series and Laurent's series.

Text Books:

1. Kreyszig I., Advanced Engineering Mathematics, *John Wiley & Sons.*
2. Piaggio H. T., Differential equations and its applications, H *Prentice Hall of India.*
3. Raisinghania M. D., Ordinary and Partial Differential equation, *S. Chand & Sons.*

Reference Books:

1. James Stewart, Calculus, *Early Transcedentals.*
2. Hoffmann & Kunze, Linear Algebra, *Prentice Hall of India.*
3. Shanti Narayan, Integral Calculus by Shanty Narayan, *S. Chand & Sons.*
4. Greenberg, Advanced Engineering Mathematics, *Pearson education.*
5. Sastry, Engineering mathematics Vol I-II, *Prentice Hall of India*.

CSE150F Programming for Problem Solving 3-0-0

Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc. Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

Branching, Loops, and Arrays: Arithmetic expressions and precedence, Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops. Arrays, Arrays (1-D, 2-D), Character arrays and Strings.

Algorithms, Order complexity and Functions: Basic Algorithms, Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required), Function, Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference.

Recursion: Recursion as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort, Structure, Structures, Defining structures and Array of Structures.

Pointers: Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation), File handling.

Text Books:

1. E. Balaguruswamy, Programming in ANSI C, *McGraw Hill Education India.*
2. Yashavant Kanetkar, Let Us C, *BPB Publications*

Reference Books:

1. Gottfried, Schaum's Outline of Programming with C, *McGraw Hill Education India.*
2. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, *Prentice Hall ofIndia.*

BIO101F Environmental Science 3-0-0

Introduction to Environmental Science: Scope and importance, Public Environmental awareness and methods of its propagation, Consumerism and Green Consumerism. Environmental issues, Environmental Ethics-Anthropocentricism and Ecocentricism.

I**ntroduction to Ecosystem and Ecology**: Types of Ecosystems, Structure of an Eco system-biotic and abiotic components, Food chain and Food Web, Ecological Pyramids; Ecological Succession, Energy flow in an ecosystem, Major World Ecosystems and their characteristics.

Natural resources: Classification and their conservation; Biodiversity-Definition, values and threats to biodiversity; Classification of species as per IUCN; Hot Spots of Biodiversity. Conservation approaches – *In-Situ* and *Ex-Situ* conservation; Alternatives to conventional developmental approaches – Sustainable Development.

Introduction to global climate change: Greenhouse effect, global warming, acid rain, ozone layer depletion. Definition, Cause, effects and control measures of Air pollution, water pollution, soil pollution, noise pollution, thermal pollution and Solid waste pollution.

Field work (Field work equal to 5 lecture hours), Visit to a local area to document environmental assets river/forest/grassland/hill/mountain. Visit to a local polluted site-Urban/Rural/Industrial/Agricultural. Studyof common plants, insects, birds. Study of simple ecosystems-pond, river, hill slopes, etc.

Text Books/Reference Books:

1. Ecology and Environment, P. D. Sharma, *Rastogi Publications.*
2. Environmental Science Towards a Sustainable Future, Nebel and Wright,*Prentice Hall of India.*
3. Environmental Studies, Erach Barucha, *Oxford Publications.*
4. Environmental Studies From Crises to Cure authored, R. Rajagopalan, *Oxford University Press.*
5. Environmental Management by Oberoi, *Excel Books.*
6. Principles of Environmental Science: Inquiry & Applications, William Cunningham & Mary Cunningham, *Tata McGraw Hill.*
7. Perspectives of environmental studies, A. P. Kaushik and C.P. Kaushik,*New Age International Publications.*

MEC101C Engineering Graphics and Design 1-0-4

Introduction: Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance, Drawing instruments, lettering, Conic sections; Cycloid, Epicycloid, Hypocycloid and Involute; Scales.

Orthographic Projections: Principles of Orthographic Projections, Conventions, Projections of Points and lines inclined to bothplanes; Projections of planes inclined Planes, Auxiliary Planes;

Projections of Solids: Auxiliary Views; Draw simple annotation, dimensioning and scaling. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

Sections of Solids: Prism, Cylinder, Pyramid, Cone, Auxiliary Views; Development of surfaces; sectional orthographic views, objects from industry and dwellings.

Isometric Projections: Principles of Isometric projection, Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa

Overview of Computer Graphics: Computer technologies, CAD software, the Menu System, Toolbars, Standard, Object Properties, Draw, Modify and Dimension, Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus, Different commands used in CAD, Isometric Views of lines, Planes, Simple and compound Solids.

Customization & CAD Drawing: Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints.

Text Books:

1. Gill P. S., Engineering Drawing, *S. K. Kataria and sons.*
2. Bhatt N. D., Engineering Drawing, *Charotar Book Stall.*
3. James D. Bethune, Engineering Graphics with Auto CADD, *Pearson Education.*

Reference Books:

1. Shah M. B., Rana B. C., Engineering Drawing and Computer Graphics, *Pearson Education.*
2. Agrawal B., Agrawal C. M., Engineering Graphics, *TMH Publication.*

ENG101F Communication Skills 2-0-2

Vocabulary Building: The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Synonyms, antonyms, and standard abbreviations.

Basic Writing Skills, Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely.

Identifying Common Errors in Writing: Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés.

Nature and Style of sensible Writing: Describing, Defining, Classifying, Providing examples or evidence, Writing introduction and conclusion

Writing Practices: Comprehension, Précis Writing, Essay Writing.

Oral Communication: (This unit involves interactive practice sessions in Language Lab): Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations

Text Books/Reference Books:

1. Michael Swan, Practical English Usage,*OUP, 1995*.
2. Wood F. T., Remedial English Grammar,*Macmillan, 2007*.
3. William Zinsser, On Writing Well,*Harper Resource Book, 2001*.
4. Liz Hamp-Lyons and Ben Heasly, Study Writing,*Cambridge University Press, 2006*.
5. Sanjay Kumar and Pushp Lata, Communication Skills, *Oxford University Press, 2011*.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad,*Oxford University Press.*

CSE151F **Programming Lab** **0-0-2**

List of Experiments

1. Familiarization with the programming environment
2. Simple computational problems using arithmetic expressions
3. Problems involving if-then-else structures
4. Iterative problems e.g., sum of series
5. 1D Array manipulation
6. Matrix problems, String operations
7. Simple functions
8. Programming for solving Numerical methods problems
9. Recursive functions
10. Pointers and structures
11. File operations

PHY150C **Physics Lab** **0-0-2**

List of Experiments

1. To determine the value of e/m of an Electron by Thompson Method
2. To determine the value of Acceleration due to gravity(g) by using Bar Pendulum
3. To determine the value of Acceleration due to gravity(g) by using Kater's Reversible Pendulum
4. To determine the Young's Modulus of rigidity of rectangular Steel Bar by Bending of Beam Method.
5. To determine the Wavelength of Sodium Light by Newton's Rings.
6. To determine the Wavelength of Laser Source by Fresnel Bi-prism
7. To determine the frequency of AC by Melde's Method
8. To determine The Resolving Power of Telescope.
9. To study the moment of Inertia of a Fly Wheel
10. To determine the refractive index of Crown Glass Prism.
11. To determine the wavelength of Sodium Light by Plane diffraction Grating.
12. To study the characteristics of Zener Diode.
13. To determine the Wavelength of Prominent lines of Mercury Light by Plane DiffractionGrating.
14. To study the characteristics of PN Junction Diode (Forward Bias)
15. To verify Biot-Savart's Law by showing that magnetic field produced is directly proportionalto the current passed in a coil.
16. To study the characteristics of G.M. Tube.
17. To determine Planck's constant by LED Method.
18. To verify Stefan's Law by Electrical method.
19. Determination of Modulus of rigidity by Maxwell's Needle
20. Determination of velocity of Sound by Standing Wave Method.
21. To study the Hall Effect:
    (i) Determination of Hall Voltage and RH.
    (ii) Determination of mobility of charge carriers and carrier concentration

CHM150C **Chemistry Lab** **0-0-2**

List of Experiments

1. Basic Introduction on Solution Preparation, Concentration terms, Handling of Glass ware, Chemicals, Instruments: Precautions.
2. Determination of strength of NaOH solution by standardization of sodium hydroxide using Oxalic acid
3. To determine the acid value of a given mineral oil or vegetable oil.
4. To determine the moisture content of a given sample of coal.
5. To determine the Degree of dissociation of a weak acid by Conductometry.
6. Determination of the strength and pKa value of the weak acid by titration with an alkali.
7. To determine the Aniline point of the given sample of a Lubricating oil.
8. Synthesis of the phenol formaldehyde resin.
9. To determine the temporary and permanent hardness of a sample of water by complexometrictitration.
10. To determine the Alkalinity of the given sample of water.
11. Determination of the ion exchange capacity of cation exchange resin.

Demonstration Experiments

1. Determination of pH of different concentration of acid and bases by pH meter.
2. Spectrophotometer (concentration determination, wavelength maximum)

Text Books/Reference Books:

1. Laboratory Manual On Engineering Chemistry by S. K. Bhasin, S. Rani, 2009, *D R Publications.*
2. J. B. Yadav, Advanced Practical Physical Chemistry.

ECE 201C Electronic Devices 3-0-0

Course Outcomes:

CO1	Understand the principles of semiconductor Physics
CO2	Understand and utilize the mathematical models of semiconductor junctions and MOS transistors for circuits and systems.
CO3	Design and analysis of amplifier circuits using BJT and FET
CO4	Differentiate the structures and working principle of Electronic switches like UJT, BJT, MOSFET etc..

SemiconductorPhysics: Reviewofquantummechanicsandreviewofcrystalstructureofsemiconductors,Intrinsic and Extrinsic semiconductors, carrier statistics and thermal equilibrium carrier concentration, energy bands in intrinsic and extrinsic semiconductors, carrier transport by drift and diffusion, carrier generation and recombination, Poisson and Continuity equation.

***Pn* Junction:** Basic structure, pn junction under zero, forward and reverse bias, built-in potential barrier, electric field and space charge width, junction capacitance, charge flow in a pn junction, current-voltage relationship, minority carrier distribution, dynamic behavior under small and large signals, breakdownmechanisms(qualitative),metal-semiconductorjunctions,ohmiccontacts.

Bipolar Transistor: Basic structure and principle of operation, modes of operation, static IV characteristics in active and saturation modes, amplification, minority carrier distribution, emitter efficiency, transport factor, current gain, non-ideal effects, small signal model and frequency limitations.

MOS Field Effect Transistor: Zener diode, its VI characteristics, PIN diode Introduction to MOS its types, Construction, Working, Modes of operation. Construction and working of UJT, Tunnel diode VI characteristics.

Special Semiconductor Devices: Photodiodes, pn Junction Solar Cell, Light Emitting Diodes, Laser Diodes, Power Semiconductor Devices

Text/ Reference Books:

1. NeamenD.A.andBiswasD.,SemiconductorPhysicsandDevices,McGrawHillEducation
2. StreetmanB.G.andBanerjeeS.K.,SolidStateElectronicDevices,PearsonEducation

ECE 202C Digital Electronics and Logic Design 3-0-0

Course Outcomes:

CO1	Various number systems and conversion from one number system to another.
CO2	Boolean algebra, realization of Boolean functions using basic and universal gates.
CO3	Analyze different combinational and sequential circuits.
CO4	Introduction to PLAs and field programmable gate arrays.
CO5	Understanding of Logic families and their interfacing.

Number System and Boolean Algebra: Number Systems and Codes: Binary, octal, and hexa decimal number systems, binary arithmetic, binary codes, excess-3 code, gray code, error detection and correction codes. Boolean algebra: Postulates and theorems, logic functions, minimization of Boolean functions using algebraic, Karnaugh map and Quine–Mc Clausky methods, realization using logic gates.

Combinational Circuits: Introduction to combinational circuits, realization of basic combinational functions like Adder, Subtractor, Encoder/Decoder, Multiplexer, Comparators, delays and hazards in combinational circuits, Code converters – Implementation using MUX and ROM.

Sequential Circuits: Flip-Flops: SR, JK, T, D, Master/Slave FF, triggering of FF, Analysis of clocked sequential circuits-their design, state minimization, state assignment, circuit implementation, Registers: shift registers, inter-conversion of shift registers, Counters.

Programmable Logic Devices and Memory: PLAs, PALs and their applications; Sequential PLDs and their applications; State-machine design with sequential PLDs; Introduction to field programmable gate arrays (FPGAs). Read-only memory, read/write memory – SRAM and DRAM.

Logic Families: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, RTL, DCTL, HTLECL, CMOS families and their interfacing

Text/Reference Books:

1. Mano M., Digital logic and Computer Design, Prentice Hall India
2. Floyd T.L., Digital Fundamentals, Charles E. Merrill Publishing Company
3. Jain R.P., Modern Digital Electronics, Tata McGraw Hill

ECE 203C **Signals and Systems** **3-0-0**

Course Outcomes:

CO1	Acquiring knowledge about signals, systems and their classification
CO2	Study of the application of Fourier analysis on signals
CO3	Laplace transform analysis and its application to signals and systems
CO4	Z-transform analysis and its application vis-à-vis other analyzing tools

Introduction: Definition of Signals, Classification of Signals, Elementary Signals, Operations on Signals, Definition of Systems, Classification of Systems, Interconnection of Systems, Introduction to LTI Systems, Convolution Sum and Integral, Properties of LTI Systems.

Laplace Transform: Introduction and Definition, Region of Convergence for Laplace Transforms, Inverse Laplace Transform, Properties of Laplace Transform, Analysis and Characterization of LTI Systems Using the Laplace Transform, System Function Algebra and Block Diagram Representations, The Unilateral Laplace Transform, Solution of differential equations using Laplace transform.

Z-Transform: Introduction and Definition, Region of Convergence for Z-Transforms, Inverse Z-Transform, Properties of Z-Transform, Analysis and Characterization of LTI Systems Using Z-Transform, System Function Algebra and Block Diagram Representations, Unilateral Z-Transform, Solution of difference equations using Z-transform.

Fourier Series:FourierSeriesRepresentationofContinuous-TimePeriodicSignals, Convergence of the Fourier Series, Properties of Continuous-Time Fourier Series, Fourier Series Representation of Discrete-Time Periodic Signal, Properties of Discrete-Time Fourier Series, Fourier Series and LTI Systems, Continuous and Discrete-Time Filters Described by Differential Equations.

Fourier Transform: Continuous-Time Fourier Transform, Properties of the Continuous-Time Fourier Transform, Convolution Property, Systems Characterized by Linear Constant-Coefficient Differential Equations, Discrete-Time Fourier Transform, Properties of the Discrete-Time Fourier Transform, Duality in Fourier Series and Fourier Transform.

Text/Reference Books:

1. Oppenheim A.V., Wilsky A.S. and Nawab S.H., Signals and Systems, Pearson Education
2. Haykin S. and Veen B.V., Signals and Systems, John Wiley and Sons
3. Roberts M.J., Signals and Systems: Analysis Using Trans form Method and MATLAB, Tata McGraw Hill.

ECE 204C Network Theory 3-0-0

COURSE OUTCOMES (COs)

CO1	Solve network problems using mesh current and node voltage equations
CO2	Design filter circuits for given bandwidth/cutoff requirement
CO3	Compute responses of first order and second order networks using time domain/frequency analysis
CO4	Obtain circuit response using Laplace Transform
CO5	Analyze networks using Thevenin, Norton, Maximum power transfer, Superposition, Miller and Tellegen's theorems

Basic Concepts: Basic circuit solving Techniques-KVL, KCL, Voltage Division Rule, Current Division Rule, Practical sources, Source transformations, Network reduction using Star – Delta transformation, graph theory of circuit's, Loop and node analysis, Concepts of super node and super mesh, basics of magnetic circuits.

Review of Network Theorems: Superposition Theorem, Thevenin's and Norton's theorems, Reciprocity, Millman's theorem, Maximum Power transfer theorem, Tellegan's theorem.

Transient and Steady State Behaviour: Behaviour of RL, RC, RLC-circuits under switching conditions and evaluation of initial and final conditions in RL, RC and RLC circuits for AC and DC excitations. Conditions for transient free networks. Steady state response using Laplace transform, state space approach.

Resonant Circuits: Concept of Impedance, Admittance, Power/Impedance Triangle, Active/Reactive Power, Series and Parallel Resonance, frequency- response of series and Parallel circuits, Q–Factor, Bandwidth. Low pass and High pass RC and RL circuits.

Two port Networks: Definition of Z, Y, h and T-parameters, modelling with these parameters, relationship between parameters.

Text/ Reference Books:

1. Network Analysis by M. E. Van Valkenber
2. Networks and Systems by D. Roy Choudhury
3. Circuit theory by F. F. Kuo
4. Fundamentals of Electric Circuits by A. K. Alexander and M. N. O. Saidko
5. Engineering Circuit Analysis by W. H. Hayt, S. M. Durbin and J. Kemmerly

ECE205C Electronic Instruments and Measurements 3-0-0

COURSE OUTCOMES (COs)

CO1	To recognize the evolution and history of units and standards in Measurements.
CO2	To identify the various parameters that are measurable in electronic instrumentation.
CO3	To describe the bridge configurations and their applications
CO4	To practice the construction of testing and measuring set up for electronic systems.
CO5	To have a deep understanding about instrumentation concepts which can be applied to control systems and relate the usage of various instrumentation standards.

Errors, Standards and Bridge Measurements: Units, dimensions and standards, errors in measurement, systematic errors, propagation of errors, significant figures, rules for rounding off. Wheatstone Bridge, Kelvin Bridge, AC Bridge and their applications, Maxwell Bridge, Hay's Bridge, Unbalance Conditions, Wein Bridge, Anderson's Bridge, De Sauty's Bridge, Schering Bridge

Analog Indicating Instruments: Permanent Magnet Moving Coil (PMMC) instruments, Moving Iron (MI) instruments, electrostatic type meters, electro dynamic type wattmeter, induction type energy meter

Digital Methods of Measurement and the CRO: Counter Timer, Analog to Digital Converters: Flash, Successive Approximation Type, Dual Slope ADC, Digital Multimeter. Introduction to CRO, Oscilloscope block diagram, Cathode Ray Tube, Delay Line, Multiple Trace, Digital Storage Oscilloscope

Transducers: Electrical transducers selection and considerations, resistive, strain gauges, temperature transducers, platinum resistance type, thermistor, thermocouples, LVDT, piezoelectric, photoelectric transducers

Data Acquisition Systems and Display Devices: Introduction to Data Acquisition Systems, various DAS configurations, data acquisition in PLC, SCADA, Sensors - its various types. Displays – LED, LCD, 7-segment displays

Text/Reference Books:

1. Cooper W.D. and Helfrick A.D., Electronic Instrumentation and Measurement Techniques, Prentice Hall
2. Sawhney A. K., A Course in Electronic Measurements and Instrumentation, Dhanpat Rai andCo.

MTH 203C Applied Mathematics for Engineers 3-0-0

COURSE OUTCOMES (COs)

CO1	Understand the notion of mathematical thinking, mathematical proofs, and algorithmic thinking, and be able to apply them in problem solving.
CO2	Understand the basics of transformations and be able to apply the methods from these subjects in problem solving.
CO3	To have ability of understanding the trigonometric series and hence expansion of the functions in Fourier series.
CO4	Modelling real world problems using Laplace / Fourier transforms.

Laplace Transform: Shifting theorem, Laplace transforms of derivatives and integrals, Heaviside's unit function. Dirac Delta function and its Laplace transforms. Laplace transforms of periodic functions, Heaviside's expansion theorem. Initial and final value theorems. Convolution theorem and its applications, use of Laplace transforms in the solution of linear differential equations.

Fourier Transform: Fourier sine and cosine transform. Fourier integral formula and its applications to solution of boundary value problems.

Series Solution of ODE: Bessel's function, Recurrence relations, Legendre polynomial, Rodrigues formula, Recurrence relations

Complex Analysis: Complex variables, analytic functions, Cauchy Riemann equations. Complex integration, Cauchy's fundamental theorem, Cauchy's integral formula, Cauchy's inequality and Liouville's theorem on integral function.

Expansions and Seriesin Calculus: Taylor's & Laurent's expansions, Zeros & poles of analytic functions, Residues. Fourier series, Harmonic analysis.

Text Books/Reference Books:

1. SaffE.B., SniderA.D., Fundamentals of Complex Analysis for Mathematics, Science, and Engineering, Prentice Hall India, NewDelhi.
2. Spiegel Laplace Transforms, Schaum Series.
3. Churchill R.V., Complex variables and applications, McGraw Hill Education(India).
4. Snedden N., Theuse of Integral Transforms, McGraw Hill Education (India).

ECE 210C Electronic Devices Lab 0-0-2

List of Experiments:

1. Steady State Characteristics of pn junction under different bias conditions
2. Small signal and large signal behavior of diodes
3. Static IV characteristics of bi-polar transistors
4. Small signal behavior of bi-polar transistors
5. Static IV characteristics of MOSFETs
6. Characteristics of LED with different wavelengths
7. Simulation experiments using PSPICE or Multisim

ECE 211C Digital Electronics and Logic Design Lab 0-0-2

List of Experiments:

1. To realize the truth table of different logic gate
2. To realize half-adder and verify its truth table
3. To realize full-adder and verify its truth table
4. To realize half subtractor and verify its truth table
5. To realize full subtractor and verify its truth table
6. To design multiplexer using 2input NAND gates
7. To design demultiplexer using 2input NAND gates
8. To realize flipflops
9. To realize ripple counters
10. Circuit implementation using MUX and ROM

ECE212C Basic Electrical and Electronics Lab 0-0-2

List of Experiments*:*

1. Familiarity with lab equipments like multimeter, ammeter, voltmeter, breadboard, CRO, power supplies, etc.
2. Familiarity with electrical/electronic components like resistors, inductors, capacitors, diodes, LEDs, etc.
3. Colour coding of resistors
4. Series and parallel combination of resistors.
5. Verification of OhmsLaw, Kirchoff's Laws.
6. Voltage divider and current dividers.
7. Verification of Superposition Theorem.
8. Verification of Thevenin and Norton Theorems.
9. Verification of Maximum Power Transfer Theorem.
10. Hands on soldering and desoldering techniques

ECE250C **Analog Circuits I** **3-0-0**

COURSE OUTCOMES (COs)

CO1	Comprehensive understanding of electronic devices and circuits.
CO2	Understand the operation and applications of BJTs, FETs and MOSFETs.
CO3	Design and analysis of CE, CB, CC amplifiers using small signal h-model and pi- model
CO4	Performance analysis of basic class-A, class-B, class AB and class-D power amplifiers.

Basic Diode Circuits: Circuit models, graphical and iterative analysis, load line analysis, rectifier circuits, voltage regulation, limiting circuits, level shifters.

BasicBJT and MOSFET circuits: Briefre view of structure and operation, IV characteristics, Equivalent circuit models, Analysis of BJT circuits at DC, Analysis of MOSFET circuits at DC.

Single Stage Transistor Amplifiers: Basic principles of amplifier design, Voltage Transfer Characteristics(VTC), Linear Amplification, Transistor Biasing, Small Signal Operation and equivalent models, analysis ofbasic amplifier configurations (CE, CB, CC for BJT and CS, CG, CD for MOSFET), CE amplifier withemitterresistance,CSamplifierwithsourcedegeneration,emitterfollower.

Frequency Response of Transistor Amplifiers: Brief overview of poles and zeros in transfer functions andBode's rules, low frequency response of CE and CS amplifiers, internal capacitive effects and high frequencymodels for transistors (BJT and MOSFET), high frequency response of CS and CE amplifiers, Miller'sTheorem,opencircuittimeconstantsfordeterminingcutofffrequencies.

Output Stages: Classification of output stages, Class A, Class B, Class AB and Class D output stages; circuit operation, transfer characteristics, power conversion efficiency and power dissipation of each output stage.

Text/ReferenceBooks:

1. Sedra A.S.and SmithK.C., Microelectronic Circuits, Oxford University Press.
2. Razavi B., Fundamentals of Microelectronics, John Wiley&Sons.
3. Boylestad R.and Nashelsky L., Electronic DevicesandCircuits, Prentice Hall
4. Neamen D.A., Microelectronics: Circuit Analysis and Design, McGraw Hill Publications

ECE251C Analog Communication 4-0-0

COURSE OUTCOMES (COs)

CO1	To understand basic principles of communication system and Fourier analysis of different signals.
CO2	To understand the need for modulation. To understand the generation, detection of Amplitude Modulation Techniques and also perform the mathematical analysis associated with these techniques.
CO3	To understand the generation, detection of Angle Modulation Techniques and also perform the mathematical analysis associated with these techniques.
CO4	To understand various reception techniques and to understand the pulse modulation techniques.
CO5	To acquire knowledge to understand different sources of noise, classification of noise and noise performance of analog modulation techniques.

Introduction: Introduction to the Communication system, Introduction to signals, classification of signals, some useful signal operations, unit impulse function , Dirac Delta Function. Trigonometric Fourier series and exponential Fourier series, transforms of some useful functions, some properties of the Fourier transform, signal transmission through a linear system.

Amplitude (Linear) Modulation: Modulation and need for modulation, Amplitude modulation, Spectrum of amplitude modulation, power analysis of AM signal, Standard AM generation, detection using envelop detector. DSB/SC-AM, generation and detection of SSB-SC modulation, Vestigial Side Band AM signal.

Angle (Exponential) Modulation: Types of Angle Modulation, Concept of Instantaneous frequency, Wide band and Narrow band FM, Generation and detection of FM,Generation and detectionof PM,FDM, Phase-Locked Loop: Nonlinear Model of PLL, Linear Model of PLL, nonlinear effects in FM systems.

Pulse modulation techniques and different receivers: Frequency division multiplexing (FDM), Tuned radio frequency, heterodyne receiver, image frequency, Pulse modulation techniques-pulse amplitude modulation (PAM), Pulse Position Modulation (PPM), Pulse Width Modulation (PWM), Methods of Generation and detection of PAM, PPM, and PWM.

Noise: Definition of noise, sources of noise, noise power, white noise, band limited white noise, signal to noise ratio, SNR of base band communication system, SSB, DSB-SC, Standard AM, SNR of FM, Noise figure, relative performance.

Text/Reference Books:

1. Haykin S., Communication Systems, John Wiley and Sons
2. LathiB.P.,ModernDigitalandAnalogCommunicationSystems,OxfordUniversityPress
3. TaubH.,SchillingD.,SahaG.,Taub'sPrinciplesofCommunicationSystems,TMG.

ECE252C Electromagnetic Waves 3-0-0

COURSE OUTCOMES (COs)

CO1	Understand basic vector algebra and calculus as mathematical tool for analysis of electric and magnetic fields.
CO2	Recognize and classify the basic Electrostatic theorems, laws, classify the basic magneto static theorems and laws and infer the magnetic properties of matter.
CO3	Summarize the concepts of electrodynamics & to derive and discuss the Maxwell's equations.
CO4	Students are expected to be familiar with Electromagnetic wave propagation in different mediums
CO5	To understand the concept of power flow modelled by poynting vector

Unit I- Fundamentals of Electromagnetic Analysis: Circuit theory and Field theory, Why study EM waves?, Vector Analysis, differential length element and line integral, differential surface element and surface integral, differential volume element and volume integral, Gradient of scalar, Divergence of vector, Curl of vector, physical interpretation of gradient, divergence and curl, Divergence Theorem, Stoke's Theorem.

Unit II- Review of Electric and Magnetic Fields: Fundamental relations of electrostatic fields, Coloumbs Law, Gauss's Law, Potential Function, Equipotential surfaces, Electric fields in materials and dielectric constant, poisons and laplace equation, Fundamental Relations of magnetostatic fields, Biot Savarts Law, Ampere Circuital Law, Magnetic Scalar and vector potentials, Magnetic fields in materials and permeability, Magnetic Induction and Faradays Law.

Unit III- Maxwell's Equations: Equations for electrostatic fields, Equations for magnetostatic fields, Inconsistency of Ampere Circuital Law, Maxwell's equation for time varying fields, equation of continuity for time varying fields, Boundary conditions for electric and magnetic fields.

Unit IV- Electromagnetic Plane Waves: Solution for free space condition, Uniform plane wave propagation, Uniform plane waves, wave propagation in lossy dielectrics, plane waves in lossless dielectrics, plane waves in free space, plane waves in good conductors.

Unit V- Poynting Vector and the flow of power: Poynting's theorem, Note on interpretation of E × H, Instantaneous, Average and Complex Poynting vector, Power loss in plane conductor, Reflection of plane wave by perfect conductor: normal incidence, reflection of plane wave by perfect dielectric: Normal incidence.

Text Books: 1) Sadiku M.N, Elements of Electromagnetics, Oxford university press.

Reference Books:1) Electromagnetic waves and Radiating Systems by Jordan, Balman, PHI.

2) Electromagnetic Waves by R.K Shevgoankar, Mc Graw Hill.

ELE250C **Control Systems** **3-0-0**

COURSE OUTCOMES (COs)

CO1	State open and closed loop control systems and their mathematical models.
CO2	Transfer functions of linear systems and block diagram reduction technique.
CO3	Time response of the control systems, and stability analysis in terms of root-locus technique and bode plots.
CO4	Design of very basic control systems using controllers.

Unit I- Introduction to Linear Control Systems: Control systems – examples and classification, open loop and closed loop control systems and their differences, transfer functions, block diagram representation of systems, signal flow graphs – reduction using Mason's gain formula, models of some industrial control devices and systems

Unit II- Continuous Time System Response and Stability: Standard test signals, time domain performance of first and second order control systems, time domain specifications of these systems, steady state and transient response, steady state errors and error constants, concept of stability, BIBO stability, relation between characteristic equation roots and BIBO stability, Routh Hurwitz stability criterion, relative stability analysis

Unit III - Root Locus and Frequency Response Analysis: Root locus technique and its construction principles, frequency response and frequency domain specifications, Bode diagrams–determination of stability, phase margin and gain margin from the Bode diagrams, Nyquist methods – determination of stability, phase margin and gain margin from Nyquist diagrams

Unit IV- Classical Control System Design Methods: Control system design using root locus methods, relationship between root locus and time domain –Cascade (lag, lead, lag-lead, PI, PID) and feedback (PD) compensation using root locus plots, compensator design using Bode plots – Cascade (lag, lead, lag-lead, PI, PID) and feedback(PD)compensation

Unit V- Control System Analysis using State Variable Analysis: Introduction to state variable representation, conversion of state variable models to transfer functions and vice versa, eigen values and eigen vectors, solution of state equations, properties of state transition matrix.

Text/ReferenceBooks:

1. Nise N.S., Control Systems Enginering, JohnWiley and Sons
2. Gopal M., Control Systems–Principles and Design, Tata McGraw Hill
3. Stefani R., Savant C., Shahian B and Hostetter G., Design of Feedback Control Systems, Saunders College Publishing
4. Ogata K., Modern Control Engineering, Prentice Hall India

STA253C **Probability and Statistics** **3-0-0**

COURSE OUTCOMES (COs)

CO1	Understand the notion of mathematical thinking, mathematical proofs, and algorithmic thinking, and be able to apply them in problem solving.
CO2	Understand the basics of discrete probability and number theory, and be able to apply the methods from these subjects in problem solving.
CO3	To have ability of Counting and Solving Recurrence Relations.
CO4	Modelling real world problems using discrete mathematics.

Unit I- Statistics: Measures of central tendency and Measures of variations (Dispersions), Moments, Measures of Skewness and Kurtosis. Moment generating functions, problems.

Unit II- Standard Distributions: Binomial, Poisson and Normal Distributions, Beta and Gamma Distribution, t-Distribution, F-Distribution,Chi-square Distribution and their applications.

Unit III- Method of Least Squares & Correlation: Methods of least squares, fitting of straight line and parabola of degree 'p'. Regression and Correlation. Multiple and Partial Correlation.

Unit IV- Probability: Random experiment, sample space, events, classical, statistical and axiomatic definitions ofprobability.Statementsandproofoftheoremsonadditionandmultiplicationofprobabilities, problems.

Unit V- Conditional Probability: Bayes theorem on conditional probability. Random variables, Derivation of formulae for mean, variance and moments of random variables for discrete and continuous cases. Laws of expectation problems.

Text/ReferenceBooks:

1. Gupta S.C., Kapoor V. K., Fundamentals o fMathematical Statistics, S. Chand & Sons.
2. Brownlee, Statistical Theory and Methodology in Science & Engineering, John Wiley & Sons.
3. Walpole R.E., Introduction to Mathematical Statistics, Mac millan Publications.

ECE-253C Microprocessors and Microcontrollers 3-0-0

COURSE OUTCOMES (COs)

CO1	Identify the difference between the different microprocessors and microcontrollers and can describe the advantages and disadvantages of both.
CO2	Demonstrate the internal architecture, addressing modes and instruction set of different microprocessor, 8085 and 8086
CO3	Illustrate the chips (8255, 8155) and their interfacing with 8085.
CO4	Introduction to programming (Embedded C and Assembly language)
CO5	Exposure to state-of-art microcontrollers, like Arduino and Raspberry Pi.

Unit I- 8085 pinot diagram, function of different pins, data bus, address bus, multiplexing and de multiplexing of address/data lines, control bus, control and status signals, internal architecture (ALU, Register Array, timing and Control Unit), flags, Different addressing modes, instruction set, arithmetic and logic operations, 8085 assembly language programming, (addition, subtraction, multiplication, Division), timing diagrams, Instruction cycle.

Unit II- Addressing techniques, memory mapped I/O and I/O mapped I/O scheme, Partial and absolute address decoding, Basic interfacing concepts, interfacing input devices, interfacing output devices, 8085 Interrupts, stack and subroutines, counters and time delays.

Unit III- 8086 architecture, addressing modes, Instruction set, Basic programming concepts, interrupts.

Unit IV- Interfacing peripheral devices, Multi-purpose programmable device (8155, Programmable peripheral interface (8255), 8259A programmable interrupt controller, Interfacing 8085 and 8086 using 8155 & 8255, with different devices - stepper motor, A/D and D/A converters, Interfacing with LCD.

Unit V- Overview of 8051 Microcontroller family, Architecture, Basic assembly language programming concepts, The program Counter and ROM Spaces in the 8051, Data types, 8051 Flag Bits ad PSW Register, 8051 Register Banks and Stack. Introduction to 8 bit AVR microcontrollers, ATmega328 Architecture

Text Books:

1) Ramesh S Gaonkar, Microprocessor Architecture, Programming and Applications with 8085. PRI Publishing (India) Pvt. Ltd.
2) B Ram
3) 8086 Microprocessor, by D. Hall

Reference Books:

1) Gilmore, Microprocessors, TMH India.
2) K.L. Short, Microprocessors and Programming Logic
3) Mazidi M.A. and Naimi S., AVR Microcontroller and Embedded Systems: Using Assembly and C, Pearson Publications

ECE260C Analog Circuits I Lab 0-0-2

List of Experiments:

1. Diode rectifier circuits (half-wave and full-wave)
2. Limiter circuits and level shifters using diodes
3. Voltage regulation using zener diodes
4. Design of a DC power supply
5. DC characterization of transistors
6. Design of simple transistor amplifiers
7. Introduction to SPICE design environment

ECE261C Analog Communication Lab 0-0-2

List of Experiments:

1. To realize Amplitude Modulation (AMDSB-FC) and demodulation.
2. To realize Amplitude Modulation (AMDSB-SC) and demodulation.
3. To realize Amplitude Modulation (AMSSB-FC) and demodulation.
4. To realize Frequency Modulation (FM) and demodulation.
5. To realize Pulse Amplitude Modulation (PAM) and demodulation.
6. To realize Pulse Width Modulation (PWM) and demodulation.
7. To realize Pulse Position Modulation (PPM) and demodulation.
8. To realize Pulse Code Modulation (PCM) and demodulation.
9. To study heterodyne receiver.
10. To study Frequency division multiplexing.

ECE 262C Microprocessors and Microcontrollers Lab 0-0-2

List of Experiments:

1. Write an ALP for 8085 Microprocessor to add two 8 bit numbers.
2. Write an ALP for 8085 Microprocessor to subtract two 8 bit numbers.
3. Write an ALP for 8085 Microprocessor to multiply two 8 bit numbers.
4. Write an ALP for 8085 Microprocessor to divide two 8 bit numbers.
5. Interfacing of ADC with 8085 using 8155
6. Interfacing of Stepper Motor with 8085 using 8255
7. Interfacing of ADC with 8085 using 8255
8. Interfacing of Stepper Motor with 8085 using 8155

ECE301C Analog Circuits II 4-0-0

COURSE OUTCOMES (COs)

CO1	Characterization and stability of feedback amplifiers.
CO2	Analyze input/output relation for various simple applications of Op-Amp in analog circuits
CO3	Concept of positive feedback and design of an oscillator circuit.
CO4	Understanding of converters and operating principle of 555 based monostable and astable multivibrator.

Unit I- Feedback Amplifiers: Review of amplifiers, Feedback in amplifiers, General feedback structure, impact of negative feedback on properties of amplifiers (gain, linearity, bandwidth and I/O impedances), feedback topologies (series-shunt, series-series, shunt-series, shunt-shunt), stability in feedback amplifiers(stability criterion, phase and gain margins, frequency compensation),

Unit II- Differential Amplifiers: Definition, AC and DC analysis, methods for increasing input impedance, large signal analysis and small signal analysis of differential pairs, common mode rejection, Operational amplifier (Op-Amp) and its performance parameters (slew rate, GBW product, operating frequency), Inverting and Non inverting amplifier, voltage follower, integrator and differentiator.

Unit III- Converters: Instrumentation amplifier, Analog to digital converters (counter, successive approximation, ramp and flash type), Digital to analog converters (binary weighted and R-2R ladder type). 555 timer- architecture and applications (astable and monostable multivibrator).

Unit IV- Oscillators: Basic principle of sinusoidal oscillators, oscillation criterion, analysis of oscillator circuits, phase shift, Wein Bridge oscillators, LC oscillators, brief discussion on crystal oscillators. Wave-shaping circuits, astable, bistable, monostable multivibrators.

Unit V Operational Transconductance Amplifiers: Definition, applications, Current sources, current mirrors, Wilson current mirror, Wildar current source, Darlington pair, Current conveyors.

Text/Reference Books:

1. Sedra A.S and Smith K.C., Microelectronic Circuits, Oxford University Press.
2. Razavi B., Fundamentals of Microelectronics, John Wiley & Sons.
3. Boylestad R. and Nashelsky L., Electronic Devices and Circuits, Prentice Hall
4. Neamen D.A., Microelectronics: Circuit Analysis and Design, Mc Graw Hill Publications

ECE302C **Digital Communication** **3-0-0**

COURSE OUTCOMES (COs)

CO1	Analyze various digital modulation systems.
CO2	Various keying techniques, generation and applications.
CO3	Spread spectrum modulation and related modulation techniques.
CO4	Analyze various source coding and line coding systems.
CO5	Compute band width requirement and probability of error in various digital modulation systems.

Unit I- Introduction to Digital Communication: Sampling theorem, quantization error, Pulse Code Modulation (PCM), PCM transmitter and receiver, Bandwidth, Differential PCM systems (DPCM), Delta modulation and its drawbacks, Adaptive Delta Modulation, Comparison of PCM and DMsystems.

Unit II- Digital Modulation Techniques: Digital Modulation Techniques, Generation and detection of ASK,FSK,PSK, DPSK, QPSK, QAM, Pulse modulation techniques- Pulse Amplitude Modulation (PAM), Pulse Position Modulation(PPM),Pulse Width Modulation (PWM).

Unit III- Spread Spectrum Modulation Techniques: Frequency hopping, SS modulation, DSS, FHSS, Hybrid, M-sequences and its properties, Gold sequences, CDMA, OFDM, introduction to convolution analysis

Unit IV- Error Detection and Control: Error detection and correction techniques: Parity coding, linear block coding, VRC &;HRC, Cyclic Redundancy(CRC),Convolution Codes- Introduction, encoding of convolution codes, time domain approach, transform domain approach, graphical approach-State, Tree and Trellis diagram.

Unit V- Transmission of Data: Bit and Baud rate, Channel capacity and Shannon's law, Synchronous and asynchronous transmission, UART, USART, Line encoding, Unipolar encoding, Polar encoding, Bipolar encoding, Manchester encoding.

Text/Reference Books:

1. Proakis J. G. and Salehi M., Digital Communication, McGraw Hill
2. Haykin S., Digital Communications, John Wiley and Sons
3. Farouzan. B., Data Communication and Networks.

ECE303C Transmission Lines, Antenna and Wave Propagation 3-0-0

COURSE OUTCOMES (COs)

CO1	Introduce different types of transmission lines and perform the lumped circuit model analysis of a transmission line and their characteristics.
CO2	Use the smith chart as a graphical tool for solving various transmission line problems.
CO3	Analyze the electric and magnetic field radiations from various basic antennas and mathematical formulation of the analysis.
CO4	To acquire knowledge on the basic parameters considered in the antenna design process
CO5	To understand different types of wave propagation.

Unit I- Transmission Line Theory: Transmission line general solution, basic definitions, distortion less line, telephone cables, inductance loading, line not terminated in Z_O, reflection, open and short circuited lines, reflection coefficient, parameters of open wire and coaxial lines at radio frequency, standing wave ratio, input impedanceoflossless,openwireandshortcircuitedlines,quarterwavelinesasimpedancetransformer,half waveandeightwavelines,impedancematching,SmithChartbanditsapplications.

Unit II- Fundamentals of Antennas: Potential functions and electromagnetic field, radiation mechanism, current elements, power radiated by current element, radiation resistance, antenna definition, isotropic radiator; Antennaparameters:Radiationresistance,bandwidth,radiationpattern,radiationintensity,directivityand gain, antenna aperture, efficiency, effective aperture, effective length, polarization

Unit III- Special Purpose Antennas: Half wave antenna, vertical antenna above ground, grounded quarter wave antenna, dipole and folded dipole antenna, horn antenna, parabolic antenna, helical antenna, Yagi antenna and microstrip antenna.

Unit IV- Propagation of Waves: Waves in free space, attenuation, absorption and polarization, effects of environment, ground wave propagation, sky wave propagation, space wave propagation, Tropo-spherical propagation and Extra-terrestrial propagation

Text/ReferenceBooks:

1. Ryder J.D., Networks, Lines and Fields, Prentice Hall India
2. Balanis C.A., Antenna Theory: Analysis and Design, John Wiley and Sons
3. Jordan and Balman , Electromagnetic Waves and Radiating Systems, PHI

ELE301C **Electrical Machines** **3-0-0**

Course Outcomes:

CO1	To obtain the performance characteristics of single phase transformer.
CO2	To obtain the open circuit and load characteristics of self and separately excited dc generator.
CO3	To obtain the performance characteristics of DC compound and DC Shunt motors.
CO4	Principle of operation of induction and synchronous machines.

Unit I- Transformers: Operating principle, classification, construction, EMF equation, phasor diagrams, equivalent circuit model, losses and efficiency, voltage regulation, polarity test, open circuit test, short circuit test, autotransformers

Unit II- DC Generators: General introduction, principles of operation, construction, types, EMF equation, types of windings, commutation and armature reaction, characteristics, applications of DC generators

Unit III- DC Motors: Principles of operation, construction, types, back EMF and torque equation torque and speed, characteristics of various types of DC motors, starting and speed control of DC motors

Unit IV- Induction Machines: Rotating magnetic field, principle of operation of an induction motor, construction ,types, slip, equivalent circuit torque developed in an induction motor, torque/speed characteristics, losses and efficiency, single phase induction motor, double field revolving theory, types of single phase induction motors, universal motor

Unit V- Synchronous Machines: Construction, types and operating principle of synchronous generator, AC armature windings, pitch factor and distribution factor, equivalent circuit, phasor diagrams. Synchronous Motor: Principle of operation, effect of load on synchronous motor, effect of varying excitation, hunting, damper windings

Text/Reference Books:

1. Nagrath and Kothari, Electric Machines, Tata McGraw Hill
2. Wildi T., Electrical Machines Drives and Power Systems, Pearson Education
3. Chapman, Electric Machinery Fundamentals

MTH309C Numerical Methods in Engineering 3-0-0

COURSE OUTCOMES (COs)

CO1	Understand the networking problem and its solution and understand the essence of layering mechanism of OSI and TCP/IP network models.
CO2	Explore the data link layer and understand the need of various protocols for efficient communication.
CO3	Understand the addressing mechanism of internet and protocols which help smooth functioning of the today's congested internetworked world.
CO4	Understand the security implications in the modern internet and how they are resolved.
CO5	Modelling real world problems and getting the solution using Numerical Methods.

Unit I- Finite Differences and Interpolation: Difference Table and its usage. The difference operators Δ, ∇ and the operator E. Interpolation with equal intervals, Newton's advancing difference formula. Newton'sbackward difference formula. Interpolation with unequal intervals. Newton's divided difference formula. Lagrange's interpolation formula.

Unit II- Central Differences and Inverse interpolation: The central difference operator δ and the averagingoperator μ. Relations between the operators. Gauss forward and backward interpolation formula, Sterling's, Bessel's, Laplace and Everett's formulae, Newton's divided difference formula, Lagrange's inverse interpolation formula

Unit III- Numerical solution of algebraic and Transcendental Equations and Numerical differentiation &Numerical Integration: GraphicMethod, Regula-Fast method, Balzano's Process of bisection of intervals, Newton-Raphson Method and its geometrical significance. Numerical differentiation of a function. Differential coefficient of a function in terms of its differences. Numerical Integration, General Quadrature Formula, Trapezoidal rule, Simpson's one-third and three-eight rules, Weddles' rule, Euler- Maclaurin expansion formula.

Unit IV- DifferenceEquationsandNumericalSolutionofordinarydifferentialequations: Linear homogeneous and non-homogeneous difference equations of ordern with constant coefficient, and their solution, methods of undetermined coefficient. Numerical solution of ordinary differential equations, Picard's method. Taylors series method, Euler's method, Runge-Kutta Method.

Unit V- Numerical solution of simultaneous equations and Eigen value problem: Gauss elimination method, Gauss Jordon method, Gauss-Jacobi and Gauss-Seidel iteration methods, power methods for solving Eigen value problems.

Text/Reference Books:

1. Jain M.K., Iyengar S.R., Jain R.K.,Numerical Methods for Scientists and Engineering,WileyEasternLtd.
2. Scarborough S.C., Mathematical Numerical Analysis, Oxford and I BH publishing Company.
3. Sastry S.S., Introductory methodsin Numerical Analysis, Prentice Hall of India.
4. Jain M.K., Numerical Solution of Differential equations, New Age International Publishers.
5. Stanton R.G., Numerical Methods for Science & Engineering, Prentice Hall of India.

ECE310C Analog Circuits II Lab 0-0-2

List of Experiments:

1. Multivibrator circuits for wave form generation
2. Op Amp as inverting, non-inverting amplifier and voltage follower
3. Integrator & Differentiator
4. Design of RC oscillators (Phase shift & Wein bridge oscillator)
5. 555 timer as astable and monostable multivibrator
6. Realization of Op-Amp as differential amplifier
7. Realization of Op-Amp Instrumentation amplifier
8. Frequency response of transistor amplifiers
9. Design of LC oscillators (Colpitt/Hartley)
10. Simple feedback circuits to demonstrate impact of negative feedback on transistor amplifiers

ECE311C Digital Communication Lab 0-0-2

List of Experiments:

1. To realize Pulse Code Modulation (PCM) and Demodulation.
2. To realize Amplitude Shift Keying (ASK) and its demodulation.
3. To realize Frequency Shift Keying (FSK) and its demodulation.
4. To realize Phase Shift Keying (PSK) and its demodulation.
5. Study Quadrature Phase Shift Keying (QPSK).
6. To study sampling technique and aliasing.

ECE312C Transmission Lines Antenna and Wave Propagation Lab 0-0-2

List of Experiments

1. Determine the primary (R, L, G, C) of a transmission Line
2. To measure the Characteristic Impedance of a Transmission Line
3. Study of stationary waves
4. To study frequency characteristics of a Transmission Line
5. To study the method of evaluation of an unknown load impedance by measuring VSWR and the position of voltage minimum
6. To study gain-radiation characteristics of a simple dipole antenna
7. To study gain radiation characteristics of a horn antenna, folded dipole antenna, different element Yagi Uda antenna
8. To Design a microstrip patch antenna

ECE350C **Power Electronics** **3-0-0**

Course Outcomes:

CO1	Acquire knowledge about fundamental concepts and techniques used in power electronics.
CO2	Ability to analyze various single phase and three phase power converter circuits and understand their applications.
CO3	Construct and demonstrate the operation of DC-DC switching regulators, and differentiate the switching techniques and basics topologies of DC-DC switching regulators.
CO4	Foster ability to identify basic requirements for power electronics based design application.

Unit I- Introduction: Introduction to power electronics and power semiconductor devices, characteristics andspecificationsofswitches,idealcharacteristics,characteristicsofpracticaldevices,switchspecifications,figures of merit, power semiconductor devices, basic theory of operation (power diodes, BJTs, power MOSFETs, IGBTs, GTOs); SCR: Characteristics, two transistor model, protection, firing, recent advances in power semiconductor devices

Unit II- AC-DC Converters: AC-DC uncontrolled converters: single phase halfwave rectifiers, concept of free wheeling, single phase full wave rectifiers, three phase bridge rectifiers, effect of source impedance. AC-DC controlled converters: single phase controlled converters (semi converters, full converters), analysis for different types of load

Unit III- DC-DC Converters: Introduction, control of DC-DC converters, Buck, Boost and Buck-Boost Chopper configurations, continuous and discontinuous conduction mode, output voltage ripple

Unit IV- Inverters: Introduction, principle of operation and classification (VSI and CSI), performance parameters, single phase inverters, three phase inverters, PWM control, performance of square wave inverters, singlepulsewidthmodulation,multiplepulsewidthmodulation,sinusoidalpulsewidthmodulation,currentsource inverters

Unit V- AC Voltage Controllers: Introduction, principle of AC voltage control (ON OFF control, phase control), single phase controllers (Analysis for different types of load), evaluation of performance parameters cyclo converter(1–phase)

Text/Reference Books:

1. Rashid M.H., Power Electronics: Circuits, Devices and Applications, Pearson Education
2. Lander C.W. ,Power Electronics, McGraw Hill Education
3. Bhimbra P.S., Power Electronics, Khanna Publishers

ECE351C **Digital Signal Processing** **3-0-0**

Course Outcomes:

CO1	Concept and evolution of digital signal processing and its day-to-day use.
CO2	Discrete Fourier Transform and its use in linear filtering.
CO3	Various filter structures and their implementation.
CO4	Designing of analog and digital filters, comparison and methods.

Unit I- Introduction: Basic Elements of Digital Signal Processing, Concept of Frequency in Continuous-Timeand Discrete-Time Signals, A/D and D/A Conversion, Discrete-Time Signals and Systems, Analysis of Discrete-Time LTI systems, Discrete-Time Systems Described by Difference Equations, Implementation of Discrete-Time Systems.

Unit II- Discrete Fourier Transform: Introduction and Definition,Frequency-Domain Sampling and Reconstruction of Discrete-Time Signals, Discrete Fourier Transform, DFT as a Linear Transformation, Relationship of the DFT to Other Transforms, Properties of the DFT, Linear Filtering Methods Based on the DFT, Frequency Analysis of Signals Using the DFT.

Unit III- Fast Fourier Transform: Introduction and Definition,Direct Computation of the DFT, Divide-and-Conquer Approach to Computation of the DFT, Radix-2 and Radix-4 FFT Algorithm, Split-Radix FFT Algorithms, Implementation of FFT Algorithms, Applications of FFT Algorithms, Linear Filtering Approach to Computation of the DFT, Quantization Effects in the Computation of the DFT.

Unit IV- Structures for Discrete Time Systems: Structures for the Realization of Discrete-Time Systems, Structures for IIR Systems, State-Space System Analysis and Structures, Quantization of Filter Coefficients, Round-Off Effects in Digital Filters

Unit V- Filter Design Techniques: Design of FIR filters, Design of Linear-Phase FIR Filters Using Windows, Design of Linear-Phase FIR Filters by the Frequency-Sampling Method, Design of IIR filters from continuous time filters: Approximation of Derivatives, Impulse Invariance, Bilinear Transformation.

Text/Reference Books:

1. MitraS.K.,DigitalSignalProcessing:AComputerBasedApproach,TataMcGrawHill
2. ProakisJ.G.andManolakisD.G.,DigitalSignalProcessing:Principles,AlgorithmsandApplications,PrenticeHall
3. OppenheimA.V.,SchaferR.W.andBuckJ.R.,DiscreteTimeSignalProcessing,PearsonEducation

ECE352C **VLSI Design** **3-0-0**

Course Outcomes:

CO1	Identify the various IC fabrication methods.
CO2	Express the Layout of simple MOS circuit using Lambda based design rulesfor subsystem design.
CO3	Differentiate various FPGA architectures and design an application using Verilog HDL
CO4	Concepts of modeling a digital system using Hardware Description Language.

Unit I- MOS Transistor Theory: Review of MOS structure and operation, nMOS, pMOS enhancement transistor, IV characteristics, short channel effects, MOS capacitor, CV characteristics, scaling of MOS transistor, Introduction to CMOS circuits, quality metrics of digital design

Unit I- CMOS Inverter: Operation of MOS transistor as a switch, CMOS logic, CMOS inverter (pull up and pull down), CMOS inverter static characteristics, noise margin, beta ratio, transistor sizing, switching characteristics of inverter (rise time, fall time, delay time), power consumption, static dissipation, dynamic dissipation

Unit III- CMOS Logic Design: CMOS logic gate design (NAND and NOR logic), combinational logic, compound gate, ratioed logic, pseudo nMOS inverter, saturated load inverters, pass transistor logic, complementary pass transistor logic, transmission gate, dynamic logic, issues in dynamic design, glitching, cascading dynamic gates, domino logic, charge sharing, Bi-CMOS logic, layout

Unit IV- Sequential MOS Logic Circuits: Multiplexer, MUX implementation in CMOS and transmission gates, CMOS subsystem design, design and implementation of adder, design methodology, carry ripple adder, carrylookaheadadder,carryskipadder,carryselectadder,dynamicadderdesign,Manchester chain carry adder, transmission gate adder, SR flip-flop, memory elements–SRAM and DRAM cell, latches

Unit V - CMOS Process Flow: Simplified CMOS process flow, CMOS technology, basic n-well and p-well process

Text/Reference Books:

1. Weste N.H.E. and Eshranghian K., Principles of CMOS VLSI Design,Wesley Publications
2. Rabaey J.M., handrakasan A. and Nikolic B., Digital Integrated Circuits: Analysis and Design, McGraw Hill Education

ECE360C Power Electronics Lab 0-0-2

List of Experiments:

1. To obtain IV characteristics of SCR, TRIAC and DIAC
2. To obtain UJT characteristics
3. To study half-wave gate controlled rectifier using one SCR
4. To study single phase half controlled full wave rectifier
5. To study three phase half controlled full wave rectifier
6. To study buck converter
7. To study boost converter
8. To study buck-boost converter
9. Study the performance of relay control combination of P,I and D control schemes in a temperature control system

ECE361C **VLSI Design Lab** **0-0-2**

List of Experiments*:*

1. Study of simulation tools
2. Design entry and simulation of combinational logic circuits
3. Design entry and simulation of sequential logic circuits
4. Schematic entry and SPICE simulation for CMOS inverter
5. Automatic layout tgeneration

ECE363C Mini Project/Electronic Design Workshop 0-0-2

Guidelines:

1. The mini-project is a team activity having 3-4students in a team. This is electronic product design work with a focus on electronic circuit design.
2. The mini project may be a complete hard ware or a combination of hard ware and software. The software part in mini project should be less than 50% of the total work.
3. Mini Project should cater to a small system required in laboratory or real life.
4. It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.
5. After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of mini project.
6. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
7. The student is expected to exert on design, development and testing of the proposed work as per the schedule.
8. Art work and Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.
9. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.
10. The tutorial sessions should be used for discussion on standard practices used for electronic circuits/product design, converting the circuit design in to a complete electronic product, PCB design using suitable simulation software, estimation of power budget analysis of the product, front panel design and mechanical aspects of the product, and guidelines for documentation/report writing.

ECE401C **Wireless Communication** **3-0-0**

Course Outcomes:

CO1	Different wireless communication systems and their components.
CO2	Characteristics of wireless channel and propagation path loss models.
CO3	Different multiple access techniques in cellular Communication.
CO4	Different standards of cellular network, WLAN family and wireless broadband networks.
CO5	Functionalities of mobile network layer, transport layer and fundamental concepts of mobile internet Protocol

Unit I- Introduction: Wireless Communication Systems, Advantages and challenges of Wireless communication, Classification of Wireless Systems, Evolution of mobile radio communication, Performance parameters in wireless communication, Spectrum limitations and standards.

Unit II- Introduction to the cellular concepts: System design fundamentals, Frequency Reuse, channel assignment strategies, Hand-off strategies, Interference & system capacity, Improving Coverage & capacity in cellular systems (Cell Splitting and Sectoring), Introduction to radio-wave propagation, Large-scale path loss, small-scale fading & its types, Multipath Fading.

Unit III- Review of basic modulation techniques: Nyquist Criterion for ISI cancellation, Radio propagation mechanisms, Propagation effects with mobile radio, Structure of wireless communication link.

Unit IV- Spread Spectrum Systems: PN Sequence and its generation, Direct Sequence SS, Frequency Hopping Spread spectrum (FHSS), Time Hopping Spread Spectrum (THSS), Hybrid Spread Spectrum, FDMA, TDMA, CDMA Systems, Orthogonal Frequency Division Multiplexing.

Unit V- Recent Trends in Wireless Communication: UWB, MIMO, 4G and 5G, Internet of Things. Introduction to Cognitive Radio

Text/ Reference Books:

1. Wireless communication, Principles & Practices (2ndedition) T.S Rapport, Prentice Hall, 2002.
2. Andreas. F. Molisch , ―Wireless Communications, John Wiley –India, 2006.
3. Simon Haykin& Michael Moher, ―Modern Wireless Communications, Pearson Education, 2007.
4. Wireless Communications and Networking, J. W. Mark & W. Zhuang, Prentice Hall India, 2006

ECE402C **Microwave Engineering** **3-0-0**

Course Outcomes:

CO1	Analyze the wave propagation in TE, TM or TEM modes, in rectangular and circular waveguides.
CO2	To understand scattering parameters and microwave passive components and devices.
CO3	To understand the limitations of conventional tubes and to understand the generation and amplification of microwave signals.
CO4	To understand the Principle and Working of Semiconductor devices.

Unit I- Introduction to Microwaves: Frequency Allocations, Need, Advantages and Applications of microwave signals, Overview of a typical Microwave system, Modes of propagation in guided media.

Unit II- Waveguides and Cavity Resonators: Transverse Electric and Transverse Magnetic Waves, Wave propagation through rectangular and circular waveguides and their analysis, Power transmission and attenuation in waveguides, Electromagnetic Resonators, Rectangular & Circular Cavity Resonators, Q factor of cavity Resonators.

Unit III- Microwave Passive Components and Devices: Scattering Matrix of Waveguide Junctions, Properties of S-Matrix, E-Plane Tee, H-plane Tee, Magic Tee, Attenuators, Directional Couplers, Ferrite Devices, Faraday Rotation, Gyrator, Isolator, Circulators and Cavity Resonators.

Unit IV- Microwave Solid-State Devices: Gunn Diode and its Modes of Operation, Avalanche IMPATT Diode, TRAPATT Diode, Operations and V-I Characteristics of Tunnel Diode, Schottky Diode, Varactor Diodes, PIN Diode and its Applications.

Unit V- Microwave Linear Beam and Cross Field Tubes: Klystrons, bunching and velocity modulation process, multi cavity klystron amplifier, reflex klystron, helix travelling wave tube (TWT), microwave crossed field tubes, magnetron oscillator, linear magnetron, FWCFA

Text/Reference Books:

1. Liao S. Y., Microwave Devices and Circuits, Prentice Hall
2. Pozar D. M., Microwave Engineering, John Wiley and Sons

ELE409C **Power Systems** **3-0-0**

Course Outcomes:

CO1	Develop the models for power system components under steady state operating condition and represent the power system network by impedance diagram.
CO2	Apply numerical methods to solve the power flow problem
CO3	Determine the performance of power system under balanced and unbalanced faulted condition.
CO4	Analyze the transient behavior of the power system when it is subjected to a fault.
CO5	Apply numerical methods to analyze the stability of the power system

Unit I- Fundamentals of Power Systems: Introduction to power systems, single line diagram, impedance and reactance diagram, single phase and three phase transmission, overhead and underground transmission system, elements of AC distribution, single fed, double fed and ring main distributor, PU method of representing quantities, PU impedance diagram of a power system

Unit II- Overhead Line Insulators and Insulated Cables: Types of insulators and their applications, potential distribution over a string of insulators, string efficiency and methods of equalizing potential drop, classification of cables, conductors, insulating materials, insulation resistance, electrostatic stress, grading ofcables,capacitancecalculation,lossesandcurrentcarryingcapacity

Unit III- Over Transmission Lines: Transmission line parameters, types of overhead conductors with calculations of inductance and capacitance, effect of earth on capacitance of a transmission line, bundled conductors, skin and proximity effect, corona, interference of power lines with communication lines

Unit IV- Performance of Lines: Representation of lines, modeling and performance analysis of short, medium and long transmission lines, ABCD constants, transposition of transmission conductors, surge impedance loading and Ferrani effect

Unit V- Fault Analysis: Faults, types of faults, symmetrical components of a three phase system, evaluation of components, three phase power in terms of symmetrical components, sequence impedances, sequencenetworkequations,calculationoffaultcurrentsforunsymmetricalfaults,singlelinetoground,linetoline ,doublelinetogroundfaultsandforsymmetricalthreephasefaults,currentlimitingreactors

Text/Reference Books:

1. Wadhwa C.L., Electric Power Systems, New Age International
2. Grainger J.J. and Stevenson W.D., Power System Analysis, McGraw Hill
3. Nagrath and Kothari, Power System Engineering,TataMcGrawHill

ECE411C Microwave Engineering Lab 0-0-2

List of Experiments:

1. To Study Microwave test bench
2. Study of Gunn oscillator as a source of microwave power and to study its operation
3. To Study V-I characteristics of Gun diode
4. Study Klystron oscillator as a source of microwave power and to study its operation
5. Study of Directional Coupler and to verify its power at different ports
6. Study as lotted wave guide section and its applications in the measurement of VSWR
7. Study a PIN diode modulator in conjunction with Gunn oscillator and to study modulation depth
8. To study the properties of E and H-plane wave guide tee junctions and to determine isolations, coupling coefficients and input VSWR

ECE450C Optical Fiber Communication 3-0-0

Course Outcomes:

CO1	Understand optical fiber, its structure, advantages and basic principle of optical fiber communication.
CO2	Transmission characteristics of fibers under different physical and operating parameters.
CO3	Understand the basic structure and operation of optical sources and detectors.
CO4	Knowledge of various fiber fabrication techniques and optical fiber connectors.

Unit I- Introduction: Block diagram of optical fiber communication system, Advantages of optical fiber communication, Optical fiber waveguides: structure, light propagation using ray theory, wave theory; modes in planar and cylindrical guide, single mode fibers, cut-off wavelength, mode field diameter, effective refractive index, group and mode delay factor for single mode fiber.

Unit II- Transmission: Transmission characteristics of optical fiber, attenuation in optical fibers, intrinsic and extrinsic absorption, linear and nonlinear scattering losses, fiber bend losses, dispersion and pulse broadening, intramodal and intermodal dispersion for step and graded index fibers, modal noise, dispersion shifted fibers, modal birefringence and polarization maintaining fibers.

Unit III- Optical Sources: Einstein relations and population inversion, feedback and threshold conditions, direct and indirect bandgap semiconductors, spontaneous and stimulated emission in p-n junction, heterojunctions, injection laser structure and its characteristics, LED: Introduction, power and efficiency, structures and characteristics.

Unit IV- Optical Detectors: Introduction, device types, detection principles; absorption, quantum efficiency, photodiodes and phototransistors, noise in p-n, p-i-n and APD receivers, concept of direct and coherent detection in optical receivers.

Unit V- Fabrication: Preparation of optical fibers, Liquid-phase techniques, Vapour-phase deposition techniques, Fiber strength and durability, Fiber splices, Fiber connectors, Fiber couplers.

Text/ Reference Books:

1) Optical Fiber Communication Systems by J. M Senior

2) Optical Communication Systems by John Gowar.

3) Optical Fiber Communication by G. E. Keiser

4) Optoelectronics by Wilson and Hawkes

ECE460C Optical Fiber Communication Lab 0-0-2

List of Experiments:

1. To set up an optical communication link on the SM fiber using the trainer kit and measuring visualizers.
2. To set up an optical voice communication link on the SM fiber using the trainer kit and measuring visualizers.
3. To generate a Pulse amplitude modulation signal and transmit it over an optical communication link using SM fiber and verify the results on visualizer
4. To measure propagation loss for optical SM fiber on an optical communication link tool kit.
5. To measure bending losses for optical SM fiber on an optical communication link tool kit.
6. To measure the Numerical aperture of an optical signal using single mode fiber.
7. To mend a single mode fiber using fusion type splicing technique & study the characteristics of the spliced fiber.

DC ELECTIVES

ECE301E **EDA Tools** **3-0-0**

Course Outcomes:

CO1	To know the flow of electronics in various devices
CO2	Designing of PCB, and various circuits
CO3	Knowledge of Advanced Design Systems (ADS)
CO4	Knowledge of VHDL

Unit I: Definition & importance of EDA Tools, Types of EDA Tools Used in electronic Industry, (Device level, circuit level, System level) General Design Flow in Electronics in ASIC/FPGA

Unit II: Introduction to ECAD tools e.g KICAD, THD and SMDs, Multilayer PCBs, Design of various circuit CAD Drawings, Circuit examples, Rectifiers – HW/FW, Clippers, Clampers, Voltage Regulator Circuits, Amplifiers, Power Supply & Varioys IC Based Circuits

Unit II: An Overview of OS commands. System settings & Configuration. Introduction to UNIX commands. Writing Shell scripts. VLSI design automation tools. An overview of features of practical CAD tools. CADENCE Virtuso, Agilends Advanced Design Systems (ADS), Xylinx ISE/ Vibvado, Model SIM, Leonardo spectrum, Cortus II, VLSI back end tools

Unit IV: Circuit simulation using Spice/ Cadence/ADS; circuit description. AC, DC and transient analysis. Advances Spice commands & analysis. Models for diodes, transistors & OP Amps. Digital building blocks. A/D, D/A and sample & hold circuits. Design & Analysis of mixed signals circuit. Evaluation & analysis of various circuit parameters using EDA Tools, Mixed signal circuit modeling and analysis.

Unit V: VHDL/System Verilog- Introduction, design hierarchy, data types, operators and language constructs. Functional coverage, assertions, interfaces and test bench structures.

Text Books:

1. M.J.S. Smith, “Application Specific Integrated Circuits”, Pearson, 2008
2. M.H.Rashid, “ I ntroduction to PSpice using OrCAD for circuits & electronics”, Pearson, 2004
3. S.Sutherland, S. Davidmann, P.Flake, “ System Verilog for Design”, (2/e) Springer, 2006

ECE302E **VLSI Technology** **3-0-0**

Course Outcomes:

CO1	To understand the fabrication process of IC Technology
CO2	To Lear the MOS process technology
CO3	Analysis of the physical Design Process of VLSI
CO4	To be aware about the trends in Semiconductor technology & its impact on Scaling & Performance

Unit I- Crystal growth & wafer preparation, Processing considerations: Chemical cleaning, getting the thermal Stress factors etc. Epitaxy - Vapors phase Epitaxy, Basic Transport processes & reaction kinetics, doping & auto doping, equipments, & safety considerations, buried layers, epitaxial defects, molecular beam epitaxy, equipment used, film characteristics, SOI structure.

Unit II- Oxidation-Growth mechanism & kinetics, Silicon oxidation model, interface considerations, orientation dependence of oxidation rates thin oxides. Oxidation technique & systems dry & wet oxidation, Masking properties of SiO2. Diffusion -Diffusion from a chemical source in vapor form at high temperature, diffusion from doped oxide source, diffusion from an ion implanted layer.

Unit III- Lithography -Optical Lithography: optical resists, contact & proximity printing, projection printing,
electron lithography: resists, mask generation. Electron optics: roster scans & vector scans, variable beam shape. X-ray lithography: resists & printing, X- ray sources & masks. Ion lithography.

Unit IV- Etching - Reactive plasma etching, AC & DC plasma excitation, plasma properties, chemistry & surface interactions, feature size control & apostrophic etching, ion enhanced & induced etching, properties of etch processing. Reactive Ion Beam etching, Specific etches processes: poly/ polycide, Trench etching.

UNIT V- Metallization - I, Problems in Aluminium Metal contacts, IC BJT - From junction isolation to LOCOS, Problems in LOCOS + Trench isolation, More about BJT Fabrication and Realization, , MOSFET - Metal gate vs. Self-aligned Poly-gate, CMOS Technology

Text Books/ Reference Books:

1. S. M. Sze, "Modern Semiconductor Device Physics", John Wiley & Sons, 2000.
2. B.G. Streetman, "Solid State Electronics Devices", Prentice Hall, 2002.|
3. Chen, "VLSI Technology" Wiley, March 2003.

ECE303E Computer Organization & Architecture 3-0-0

COURSE OUTCOMES (COs)

CO1	To have Knowledge of various basic concepts of Computer Network
CO2	To know the processes taking place at various network Layers
CO3	Having Knowledge about Routing Algorithms and Transport Protocols
CO4	Be familiar with different security issues and challenges in a computer netwok

Unit I- Register Transfer and Micro-operations: Introduction and comparison of Computer Architecture & Organisation, Computer Registers, Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro-operations, Logic Micro-operations, Shift Micro-operations, Arithmetic Logic Shift Unit.

Unit II- Basic Computer Organization and Design: Control Organization – Hard wired and micro programmed control. Instruction Codes, Computer Instructions, Instruction Cycle, Memory-Reference Instructions, Input-Output and Interrupt, Control Memory, Address Sequencing,.

Unit III- Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Program Control, Decimal Arithmetic Unit.

Unit IV- Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, Direct Memory Access.

Text Books:

1) M Mano, “Computer System and Architecture”, PHI
2) W. Stallings, “Computer Organization & Architecture”, PHI

Reference Books:

1) J. P. Hayes, “Computer Architecture and Organization”, McGraw Hill
2) J. L Hennessy and D. A. Patterson, “Computer Architecture: A quantitative approach”, Morgon Kauffman, 1992
3) Computer Systems Organization and Architecture, John D. Carpinelli, Pearson Education Inc

ECE350E Operational Amplifiers & LIC 3-0-0

COURSE OUTCOMES (COs)

CO1	To have Knowledge of various Amplifiers
CO2	To know the basic Applications of Op Amps
CO3	To have knowledge about Comprators & their applications
CO4	Be familiar with PLL
CO5	Be familiar with filters

Unit I - Differential Amplifier (DA), Configurations, Circuit and analysis of DA, Methods of Enhancing input impedance, Common mode and different mode signals, Common mode Rejection Ratio (CMMR), output offset voltage, input offset current, input bias current, Operational amplifier- Band width, frequency response, Slew rate.

Unit II- Basic applications of Op amp- IC 741 (integrator, differentiator, voltage follower, Inverting and Non-inverting amplifier), Input and output impedance of Inverting amplifier, Instrumentation amplifier, Electronic Analog Computation, Logarithmic and antilogarithmic amplifiers, Digital to analog converters (DAC)-Binary weighted and R/2R ladder, Analog to digital converters (ADC)-Flash type, Successive approximation, counter type and single slope, dual slope.

Unit III- Comparators, Applications of comparators, Regenerative comparators (Schmitt-trigger) , Square wave and triangular wave generators, pulse generators, voltage time-base generators, Step(Stair-case) generators, analog multipliers, Precision ac/dc converters, Sample and hold systems, Clippers , Clampers and Peak detectors.

Unit IV- Phase locked loop, Basic building block, Operation of loop components, VCO, SE/NE 656, 555 timer, 555 timer as oscillator configuration, Wein-bridge oscillator, Phase shift oscillator, Crystal oscillator. Astable multivibrator, Frequency Synthesizer with types Sinusoidal oscillators- general form of

Unit V- Active filters, low pass, high pass, band pass & band reject filters and their analysis, Operational Transconductance Amplifier (OTA) and applications, current mirrors.

Text Books :
1) OP- Amp and Linear Integrated Circuits by R. A. Gayakward PHI Ltd.

Reference Books:
1) Electronic Principles by Albert Paul Malvino, Fourth Edition, McGraw-Hill International Editions
2) Integrated Electronics By Milliman and Halkias, McGraw hill Book company
3) Operational Amplifiers and Linear Integrated Circuits by Robert F. Coughlin and Frederick F. Drisiol, Gayakward, PHI Private Ltd.

ECE353E Advanced Microcontroller Programming 3-0-0

COURSE OUTCOMES (COs)

CO1	To have knowledge about applications and architecture of ARM microcontroller
CO2	To understand the Instructions of ARM.
CO3	To know about OS basics and various tasks & processes taking place in OS
CO4	To have knowledge about Integration & testing of Embedded systems

Unit I- Introduction to ARM 32 bit microcontroller:Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, Debugging support, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence

Unit II- ARM Cortex M3 Instruction Sets and Programming: Assembly basics, Instruction list and description, Useful instructions, Memory mapping, Bit-band operations and CMSIS, Assembly and C language Programming.

Unit III- RTOS and IDE for Embedded System Design: Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Preemptive Task scheduling techniques, Task Communication, Task synchronization issues – Racing and Deadlock, Concept of Binary and counting semaphores (Mutex example without any program), How to choose an RTOS, Integration and testing of Embedded hardware and firmware, Embedded system Development Environment

Text Books:

1. Embedded Systems: Introduction to Arm(r) Cortex(tm)-M Microcontrollers: 1: by Jonathan Valvano (Author)

Reference Books:

1. TI Tiva ARM Programming For Embedded Systems: Programming ARM Cortex-M4 TM4C123G with C (Mazidi & Naimi ARM Book 2)
2. Microcontroller Programming (8051, PIC, ARM7 ARM Cortex): by T. Bansod (Author), Pratik Tawde (Author)

ECE354E **MATLAB** **3-0-2**

COURSE OUTCOMES (COs)

CO1	Model different signals or systems in MATLAB.
CO2	Find the response of different systems both in continuous and discrete time domains.
CO3	Generate plots and export the results for use in reports and presentations.
CO4	Program scripts and functions.

Unit I

Introduction: Basics of MATLAB, Overview of different windows, Applications of MATLAB, Basic operations in MATLAB.

Unit II

Arrays: Creating 1 D & 2D Arrays, Multi-dimensional Arrays in MATLAB, Indexing of Arrays in MATLAB, Operations performed on Arrays. Plotting Arrays in MATLAB.

Unit III

Simulink: Overview of different tool boxes in Simulink, representation of an operation using Simulink Blocks.

Unit IV

Continuous Time Signals and System in MATLAB: Representation of different continuous time signals & Systems in MATLAB and their simulations. Transfer function in MATLAB and its solutions for different inputs. Solution of a differential equation in MATLAB/ Simulink. RC/RL Circuit simulations in MATLAB using Transfer function or differential Equation Model

Unit V

Discrete Time Signals and System in MATLAB: Representation of different discrete time signals & Systems in MATLAB and their simulations. Transfer function of discrete time systemin MATLAB/Simulink and its solutions for different inputs. Solution of a difference equation in MATLAB/Simulink.

TEXT BOOKS:

1) Introduction to MATLAB and Simulink – A project approach, O Beucher & M. Weeks
2) MATLAB – A quick introduction for Scientists & engineers, Rudra Pratap

ECE355E **Computer Networks** **3-0-0**

COURSE OUTCOMES (COs)

CO1	To have Knowledge of various basic concepts of Computer Network
CO2	To know the processes taking place at various network Layers
CO3	Having Knowledge about Routing Algorithms and Transport Protocols
CO4	Be familiar with different security issues and challenges in a computer netwok

Unit I: Introduction to Computer Networks: LAN, WAN, MAN. Network Topologies. Network Hardware: Routers, Switches, Bridges, Hubs. High Speed Networks, Public switched Networks. Open System Interconnection (OSI) model of a network, TCP/IP model.

Unit - II THE DATA LINK LAYER: Design issues, error detection and correction, elementary data link protocols, sliding window protocols, example data link protocols - HDLC, the data link layer in the internet. THE MEDIUM ACCESS SUBLAYER: Channel allocations problem, multiple access protocols, Ethernet, Data Link Layer switching, Wireless LAN, Broadband Wireless, Bluetooth

Unit - III THE NETWORK LAYER: Network layer design issues, routing algorithms, Congestion control algorithms, Internetworking, the network layer in the internet (IPv4 and IPv6), Quality of Service.

Unit – IV THE TRANSPORT LAYER: Transport service, elements of transport protocol, Simple Transport Protocol, Internet transport layer protocols: UDP and TCP.

Unit - V THE APPLICATION LAYER: Domain name system, electronic mail, World Wide Web: architectural overview, dynamic web document and http. APPLICATION LAYER PROTOCOLS: Simple Network Management Protocol, File Transfer Protocol, Simple Mail Transfer Protocol, Telnet.

TEXT BOOKS: 1. A. S. Tanenbaum (2003), Computer Networks, 4th edition, Pearson Education/ PHI, New Delhi, India.

REFERENCE BOOKS: 1. Behrouz A. Forouzan (2006), Data communication and Networking, 4th Edition, Mc Graw-Hill, India.
2. Kurose, Ross (2010), Computer Networking: A top down approach, Pearson Education, India

ECE450E **Information Theory & Coding** **3-0-0**

COURSE OUTCOMES (COs)

CO1	Familiarity with the basics concepts of Information and Information Models
CO2	Having knowledge of Source Coding and various Algorithms
CO3	Familiarizing eith Communication Channels
CO4	To have knowledge about Error Control and to know the methods to control error

Unit I: Information Theory: Introduction, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Average Information content of symbols in Long dependent sequences, Markov Statistical Model for Information Sources, Entropy and Information rate of Mark off Sources

Unit – II: Source Coding**:** Encoding of the Source Output, Shannon's Encoding Algorithm, Shannon Fano Encoding Algorithm, Source coding theorem, Prefix Codes, Kraft McMillan Inequality property KMI, Huffinan codes

Unit – III: Information Channels: Communication Channels, Discrete Communication channels Channel Matrix, Joint probabilty Matrix, Binary Symmetric Channel, System Entropies. Mutual Information, Channel Capacity, Channel Capacity of Binary Symmetric Channel. Binary Erasure Channel, Muroga's Theorem.

Unit – IV: Error Control Coding: Methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error detection & Correction capabilities of Linear Block Codes, Single error correction Hamming code, Table lookup Decoding using Standard Array.

Unit – V: Binary Cyclic Codes: Algebraic Structure of Cyclic Codes, Encoding using an (n-k) Bit Shift register, Syndrome Calculation, Error Detection and Correction. Convolution Codes: Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, The Viterbi Algorithm.

Text Book:

1. Digital and Analog Communication Systems, K. Sam Shanmugam, John Wtley India Pvt Ltd, 1996.
2. Digital Communication, Simon Haykin, John Wtley India Pvt Ltd, 2008.

Reference Books:

1. Information Theory and Coding, Hari Bhat, Ganesh Rao, Cengage, 2017.
2. lTC and Cryptography, Ranjan Bose, TMH, II edition, 2007
3. Principles ofDigital Communication, J. Das, S.K.Mullick, P. K. Chatterjee, Wiley, 1986- Technology &Engineering
4. Error Correction Coding, Todd K Moon,Wiley Std. Edition, 2006

ECE451E **Digital System Design** **3-0-0**

COURSE OUTCOMES (COs)

CO1	To have Knowledge of Digital Systems for designing
CO2	To understand Sequential Logic Circuit designing
CO3	To understand subsystem Designs
CO4	To understand and implement VHDL language for system design

Unit I- Interconnect: The Wire, Interconnect Parameter, Electrical And Spice Wire Model, RLC Parasitic, Signal Integrity And High Speed Behavior Of Interconnects: Ringing, Cross Talk And Ground Bounce. Layout Strategies At IC And Board Level For Local And Global Signals, Power Supply Decoupling.

Unit II- Designing of sequential logic circuit: Static And Dynamic Latches And Registers, Design And Optimization Of Pipelined Stages, Timing Issues In Digital Circuits, Synchronous And Asynchronous Design Styles, Interface Between Synchronous And Asynchronous Blocks, Concept Of Meta-Stability.

Unit III- System hardware decomposition: Data Path And Control Path, Register Transfer Level Description, Control Path Decomposition (Interfacing With FSM), Pitfalls of Decomposition, Control Flow And Data Flow Pipelines, Communication Between Subsystems, Control Dead Locks.

Unit IV- Subsystem design: Logic Design Consideration For Arithmetic Building Blocks: Adders, Multipliers, Shifters Logic Design Consideration For Memory Architecture: Address Decoder, Sense Amplifier, Voltage Reference, Drivers/Buffers, Timing And Control Shared Memory Data Hazards And Consistency

Unit V- Design for test: Introduction, Test Procedure, Issues in Design for Testability, Ad-Hoc Testing, Scan-Based Test, Boundary Scan Design, Built-In-Self Test (BIST), Test Pattern Generation, Fault Models, Automatic Test Pattern Generation (ATPG).

Text Books : 1) Digital System Design with VHDL By Mark Zwolinski

Reference Books:

1. Digital Systems by Ronald Tocci
2. Digital principles and Applications By Malvino Leach and Saha
3. Digital Fundamentals By Floyd

ECE452E Radar Systems 3-0-2

COURSE OUTCOMES (COs)

CO1	Understand basic operation of radar.
CO2	Understand Doppler effect and its relevance to radars.
CO3	Based on Doppler shift, different types of radars and their utility.
CO4	Radar tracking operation and its evolution.

Unit-I
Simple Pulse Radar: Radar equation, range performances and minimum detectable signal, receiver noise SNR; integration of radar pulses; integration efficiency and loss; radar cross section of targets with examples of simple targets; PRF & range ambiguity, Radar system losses; radar frequencies;

Unit-II
Continuous Wave Radar: Doppler's shift; CW Radar with IF amplification; FM radar; Conventional pulse Radar with Super-Heterodyne receiver, multiple frequency CW radar (block diagram and description), Operation and performance etc.

Unit-III
Moving Target Indication (MTI) & Pulse Doppler Radar (PDR): Doppler's shift applied to pulse radar; butterfly effects, delay line cancellers; MTI with power amp, Pulsed Doppler Radar with operational Block functions, Frequency Modulated CW Radar

Unit-IV
Radar Tracking: Introduction and types of tracking Radar, Block diagram and functions of Tracking Radar, Radar Tracking systems

Unit-V
Radar Beacons: Introduction to Synthetic aperture radar (SAR), applications of SAR, Radar displays, Radar RF Sources, Radar RF Modulators, Radar Transmitters

LIST OF EXPERIMENTS TO BE DONE:

1) To find the radial velocity of a moving target using Doppler effect
2) To find the distance of moving target/stationary target from the radar
3) To find out the time period if simple pendulum using Doppler radar
4) To find out rpm of a fan at some distance D from the radar
5) To find out the frequency of a buzzer in presence of various clutter noises.

Reference Books:
1) Skolnik MI, Radar Systems, Pearson Publications,3rd Ed.
2) Raju GSN, Radar engineering.
3) Kulkarni M, Radar Engineering, Umesh Publications, New Delhi
4) Sharma, KK., Radar, Sonar and Navigation engineering, Katsons Publications, New Delhi

ECE404E **Photovoltaic System Design** **3-0-0**

COURSE OUTCOMES (COs)

CO1	To have Knowledge of photovoltaic systems
CO2	To know MTP& Buck Boost & Flyback converters
CO3	To have knowledge of Photovolatic modules – series & parallel
CO4	Be familiar stand alone and grid PV systems

Unit I- Introduction to photovoltaic systems, advantages, review of semiconductor physics-Energy bands, charge carriers, charge carrier transport, photovoltaic cell characteristics and equivalent circuit, effect of temperature and irradiance, open circuit and short circuit and peak power parameter.

Unit II- Cell efficiency, STC, fill factor of photovoltaic modules, Maximum power point tracking (MPPT) Techniques- open circuit voltage, short circuit current, perturb and observe, incremental conductance. Input impedance of Buck, Boost and Buck-Boost converters.Flyback converters.

Unit III- Photovoltaic modules, series and parallel connection, Mismatch in series and parallel connection, Hot spots and use of bypass diodes in modules, design and structure, wattage of modules, I-V equation and output power.

Unit IV- Stand-alone and grid-tied PV systems, Batteries-Capacity, C-rate, Energy and power density, classification, losses, parameters, PV inverters, charge controllers, PV wire sizing.

Unit V- Atmospheric effects, Air mass, energy with atmospheric effects, Solar radiation, sun-earth movement, angle of sunrays on solar collector, sun tracking-single axis and dual axis.

References:

1. Solar Photovoltaic's - Fundamentals- 3rd Edition, Chetan Singh Solanki, PHI.
2. Photovoltaic Power System-First Edition, Weidong Xiao, John Wiley

ECE405E **Mobile Adhoc Networks** **3-0-0**

COURSE OUTCOMES (COs)

CO1	Having knowledge about Adhoc networks
CO2	Having knowledge about MAC
CO3	Having knowledge about Network Protocols
CO4	Having knowledge about crosslayer design and integration

Unit I Introduction: Introduction to Ad Hoc networks – definition, characteristics features, applications. Characteristics of Wireless channel, Adhoc Mobility Models: - entity and group models.

Unit II Medium access protocols: MAC Protocols: design issues, goals and classification. Contention based protocols, reservation based protocols, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

Unit III Network protocols: Addressing issues in ad hoc network, Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Power/ Energy aware routing algorithm, Hierarchical Routing, QoS aware routing.

Unit IV End -to - end delivery and security:Transport layer: Issues in designing- Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.

Unit V Cross layer design and integration: Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, Cross layer cautionary perspective, Cooperative networks:- Architecture, methods of co-operation, co-operative antennas, Integration of ad hoc network with other wired and wireless networks.

Text Books:

1) C.Siva Ram Murthy and B.S.Manoj, ―Ad hoc Wireless Networks Architectures and protocols, 2 nd edition, Pearson Education. 2007

2) Charles E. Perkins, ―Ad hoc Networking‖, Addison – Wesley, 2000

Reference Books:

1)Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, ―Mobile adhoc networking, Wiley-IEEE press, 2004.

2) Mohammad Ilyas, ―The handbook of adhoc wireless networks, CRC press, 2002.

3) T. Camp, J. Boleng, and V. Davies ―A Survey of Mobility Models for Ad Hoc Network Research, Wireless Communication and Mobile Comp., Special Issue on Mobile Ad Hoc Networking Research, Trends and Applications, vol. 2, no. 5, 2002, pp. 483–502.

ECE406E **Wireless Sensor Networks** **3-0-0**

COURSE OUTCOMES (COs)

CO1	Familiarity with the basics of Ad hoc networks and Wireless Sensor Networks
CO2	Analyze the sensor node architecture and their operation
CO3	Design and apply suitable routing algorithm based on the network and user requirement
CO4	Be familiar with different security issues and challenges in of Ad hoc networks and Wireless Sensor Networks

Unit I-Introduction and Architecture: Introduction to Adhoc and Wireless sensor networks –definition, characteristics, applications, challenges. Characteristics of wireless channel, Enabling Technologies for Wireless Sensor Networks. Difference between WSN and IOT. Single node architecture – Hardware Components, Energy Consumption of sensor nodes.

Unit II- Physical Layer & Medium Access Protocols: WSN-Protocol Stack. Physical Layer and Transceiver Design Considerations, Technologies MAC protocols for WSN: challenges, goals and classification. Contention, Reservation and hybrid protocols. Network Architecture Optimization goals, Gateway, Sink concepts in sensor networks. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPER LAN.

Unit III- Network and Transport Layer Protocols: Routing Protocols: Design issues, goals and classification- Proactive Vs Reactive routing, Data Centric, Flat Based, Hierarchical, Geographical and QoS Based Routing Algorithms, Transport Layer: Issues in designing, Adhoc transport layer protocols.

Unit IV- Infrastructure Establishment and Security: Time synchronization, Localization, Power Management, Topology Management Techniques, Clustering, Security issues in Adhoc networks, sensor networks, network security attacks and challenges, secure routing protocols.

Unit V- Sensor Network Platforms and Tools: Sensor Node hardware – Classification, Berkeley motes, Operating Systems and Execution Environments, Programming challenges, Node level software platforms, Dynamic Reprogramming, Simulators,

Text Books:

1. Ian F. Akyildiz and Mehmeet Can Vuran, “Wireless Sensor Networks” Willey.
2. W.Dargie & C Poellabauer,”Fundamentals of Wireless Sensor Networks”
3. Holger Karl & Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Willey.
4. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks – An Information Processing Approach”, Elsevier

GENERIC ELECTIVES

ECE351G Optimization Techniques 3-0-0

COURSE OUTCOMES (COs)

CO1	Analyze any real-life system with limited constraints and depict it in a model form.
CO2	Convert problem into mathematical model.
CO3	Solve mathematical model manually as well as using software resources.
CO4	Understand variety of problems such as assignment, transportation, travelling salesman etc.
CO5	Solve sequencing problems by processing 'n' number of jobs on 'm' number of machines andfind out optimal solution using dynamic programming.

Unit I- Linear Programming: Introduction to optimization, Linear Programming problem (LPP). Formulation of LPP, Graphical Solution of LPP, Simplex Method, Artificial Variables, Big-M Method, Revised Simplex Method (RSM).

Unit II- Transportation Problems: Formulation, Solution of Balanced Transportation Problem. Finding initial basic Feasible Solutions in North-west corner rule, least cost method and Vogoles approximation method.Degeneracy in Transportation Problems, Max – Type Transportation Problems, UV-Method / Modi Method.

Unit III- Assignment Problems: Introduction and Mathematical Formulation, Hungarian Method, Assignment Model Formulation, Hungarian method for optimal solution; solving unbalanced problems; Max – Type assignment Problems, Routing Problems, travelling salesman problem and assignment.

Unit IV- Sequencing Models: Solution of sequencing problem, processing n jobs through two machines, processing n jobs through three machines, Processing two jobs through m machines.

Unit V- Dynamic Programming: Introduction to Dynamic programming problems, Characteristics and applications of Dynamic Programming, Mathematical formulation and optimal Solution of Dynamic Programming problems.

Text Books/Reference Books:

1. P. SankaraIyer, Operations Research, Tata McGraw Hill 2008
2. A.M. Natarajan, P.Balasubramani, A. Tamilarasi, Operations, Pearson Education, 2005.
3. Brownlee, Statistical Theory and Methodology in Science & Engineering, John Wiley &Sons.
4. Walpole R.E., Introductionto Mathematical Statistics, Macmillan publications.
5. Meyer, Data Analysis for Scientists & Engineers, John Wiley & Sons.

ECE352G **Process Control & Instrumentation** **3-0-2**

COURSE OUTCOMES (COs)

CO1	To understand basic principles and need of Modern control Systems
CO2	To understand the need for modulation. To understand the generation, detection of Amplitude Modulation Techniques and also perform the mathematical analysis associated with these techniques.
CO3	To understand special control Techniques in Advanced Process control and understand Control Analysis
CO4	To understand various computational techniques in control Processes

Unit I: Modern Control System
System Models Examples, Building blocks of state space models, Canonical forms, State equation and its solution, Properties of the state transition matrix, Special cases, Modelling Discrete-time systems with delay operators. Stability modelling energy of the system in terms of quadratic functions, Lyapunov's criterion for continuous- and discrete-time systems. Design in State Space State feedback control for controllable canonical form, State feedback control in general, State feedback for discrete-time systems, Computational algorithms and their complexity, Output feedback control. Full-order and reduced-order observers, Physical aspects of control system design in state space.

Unit II: Advanced Process Control
Review of Systems: Review of first and higher order systems, closed and open loop response. Response to step, impulse and sinusoidal disturbances.Transient response. Block diagrams.Special Control Techniques: Advanced control techniques, cascade, ratio, feed forward, adaptive control, Smith predictor, internal model control.Multivariable Control Analysis: Introduction to state-space methods, , Control degrees of freedom analysis and analysis, Interaction, Bristol arrays, Niederlinski index - design of controllers, Tuning of multivariable controllers.

Unit III: Computational techniques in Control Engineering
Control Systems Analysis – Linear State-space models and solutions of the state equations, Controllability, Observability, Stability, Inertia, and Robust Stability, Numerical solutions and conditioning of Lyapunov and Sylvester equations. Control Systems Design – Feedback stabilization, Eigenvalue assignment, Optimal Control, Quadratic optimization problems, Algebraic Riccati equations, Numerical methods and conditioning, State estimation and Kalman filter.

Unit IV: Advanced Applied Process Control
Control relevant process modelling and identification: Model applications, types of models, empirical dynamic models, model structure considerations, model identification. Identification examples: SISO furnace parametric model identification, MISO parametric model identification, MISO non-parametric identification of a non-integrating process, MIMO identification of an integrating and non-integrating process, design of plant experiments, conversion of model structures.

Unit V: Virtual Instrumentation Virtual Instrumentation
Virtual Instrumentation: Historical perspective, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, HMI / SCADA software, Active X programming. VI programming techniques: VIS and sub-VIS, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and

global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

Text Books:

1. Coughnowr, D., " Process Systems Analysis and Control ", 3rd Edn., McGraw Hill, New York, 2008.
2. H.H. Willard, Merrit and Dean, "Instrumental Methods of Analysis", 5th Edn., 1974.
REFERENCES
1. Marlin, T. E., " Process Control ", 2nd Edn, McGraw Hill, New York, 2000.
2. Smith, C. A. and Corripio, A. B., "Principles and Practice of Automatic Process Control", 2nd Edn., John Wiley, New York, 1997.
3. Jason L. Speyer, Walter H.Chung,"Stochastic Processes, Estimation, and Control",PHI Ltd (2013).

ECE355G Embedded System Design 3-0-0

COURSE OUTCOMES (COs)

CO1	Classify Embedded systems for major application areas
CO2	Design Embedded systems for advanced controllers to real-life situations.
CO3	Design interfacing of the systems with other data handling / processing systems.
CO4	Appreciate engineering constraints like energy dissipation, data exchange speeds etc.

Unit I: Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems vs. General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

Unit II: Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: On-board and External Communication Interfaces.

Unit III: Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

Unit IV: RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems,

Unit V: Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

Text books:

1. A. S. Berger, Embedded Systems Design: An Introduction to Processes, Tools and Techniques, CMP Books.

2. Q. Li and C. Yao, Real-Time Concepts for Embedded Systems, CMP Books.

3. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing, and System Design, PE.

4. Mazidi, The 8051 Microcontroller and Embedded Systems, PE.

ECE356G Image Analysis and Pattern Recognition 3-0-0

COURSE OUTCOMES (COs)

CO1	Apply the definitions of the image classification and analysis problem to common problems in computer vision.
CO2	Explain the basics of object recognition and image search, object detection techniques, motion estimation, object tracking in video using convolutional filters.
CO3	Implement learning algorithms for supervised and unsupervised tasks.
CO4	Describe and model data to solve problems in regression and classification

Unit I: Introduction to image classification and analysis problems, Image features, Convolutional image processing, Image registration and motion analysis, Mathematical morphology, discrete geometry and combinatorial optimization, Shape analysis and feature extraction.

Unit II: Bayes Decision Theory: Minimum-error-rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions, discrete features. Parameter Estimation Methods: Maximum-Likelihood estimation: Gaussian case; Maximum a Posteriori estimation; Bayesian estimation: Gaussian case

Unit III: Unsupervised learning and clustering: Criterion functions for clustering; Algorithms for clustering: K- Means, Hierarchical and other methods; Cluster validation; Gaussian mixture models; Expectation- Maximization method for parameter estimation; Maximum entropy estimation

Unit IV: Sequential Pattern Recognition: Hidden Markov Models (HMMs); Discrete HMMs; Continuous HMMs. Non-parametric techniques for density estimation: Parzen-window method; K-Nearest Neighbour method

Unit V: Dimensionality reduction: Fisher discriminant analysis; Principal component analysis; Factor Analysis. Linear discriminant functions: Gradient descent procedures; Perceptron; Support vector machines. Non-metric methods for pattern classification: Non-numeric data or nominal data; Decision trees: CART

Text Books:

1. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001

2. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009

3. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006

ECE 401G Advanced Computer Architecture 3-0-0

COURSE OUTCOMES (COs)

CO1	Parallel processing and pipelining and implementation of pipelining
CO2	To understand data and data network mechanisms
CO3	To understand loosely and tightly coupled microprocessors
CO4	To understand multithreaded processors

Unit I: Overview of Parallel Processing and Pipelining Processing, study and comparison of uni-processors and parallel processors, Conventional and Explicitly Parallel Instruction Computing (EPIC) architecture, Constraints of conventional architecture.

Unit II: Principles and implementation of Pipelining, Classification of pipelining processors, Pipeline Architecture, Study and comparison of processors with and without pipelining, General pipelining reservation table, Pipelining hazards and resolving techniques.

Unit III: Data buffering techniques, Job sequencing and Collision, Advanced pipelining techniques, loop unrolling techniques, out of order execution, software scheduling, trace scheduling, Predicated execution, Speculative loading, Register Stack Engine, Software pipelining. SIMD Computer Organization Masking and Data network mechanism, Inter PE Communication, Interconnection networks of SIMD, Static Vs Dynamic network, cube hyper cube and Mesh Interconnection network.

Unit IV: Microprocessor Architectures, study and comparison of Loosely and Tightly coupled multiprocessors. Processor characteristics of multiprocessors, Inter Processor communication network, Time shared bus, Crossbar switch, Multiport Memory Model, Memory contention and arbitration techniques, Cache coherency and bus snooping.

Unit V: Study of Architecture of Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues and solutions, Parallel Programming Techniques: Message passing program development, Synchronous and asynchronous message passing, Message passing parallel programming, Shared Memory Programming, Data Parallel Programming.

Text Books:

1) Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing" Mc GrawHill international Edition.
2) Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill References: 1. V.Rajaraman, L Sivaram Murthy, "Parallel Computers", PHI.

Reference Books:

1) William Stallings, "Computer Organization and Architecture, Designing for performance" Prentice Hall, Sixth edition.
2) Kai Hwang, Scalable Parallel Computing.
3) Harrold Stone, High performance computer Architecture.
4) Richard Y. Kain, Advanced Computer Architecture

ECE402G IoT & Multimedia Technology 2-0-2

COURSE OUTCOMES (COs)

CO1	Understand general concepts of Internet of Things
CO2	Recognize various devices, sensors and applications
CO3	Analyze various M2M and IoT architectures
CO4	Evaluate design issues in IoT applications
CO5	

Unit I- Introduction to IoT: Sensing, Actuation, Networking basics, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT, Communication models & APIs.

Unit II- M2M to IoT-The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics. Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT,

Unit III- M2M vs IoT An Architectural Overview–Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. Reference Architecture and Reference Model of IoT.

Unit IV- IoT Reference Architecture- Getting Familiar with IoT Architecture, Various architectural views of IoT such as Functional, Information, Operational and Deployment. Constraints affecting design in IoT world- Introduction, Technical design Constraints.

Unit V- Domain specific applications of IoT: Home automation, Industry applications, Surveillance applications, Other IoT application.

References:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.

2. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-onApproach)”, 1st Edition, VPT, 2014

3. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013

4. Cuno Pfister, Getting Started with the Internet of Things, O‟Reilly Media, 2011, ISBN: 978-1-4493- 9357-1

ECE403G Digital Image Processing 3-0-2

COURSE OUTCOMES (COs)

CO1	To introduce the concepts of Digital Image Processing and basic analytical methods to be used in image processing.
CO2	To familiarize students with image enhancement, Compression and restoration Techniques.
CO3	To introduce segmentation and morphological processing techniques.
CO4	Give the students a taste of the applications of the theories taught in the subject.

Unit-I: Digital Image Fundamentals and Transforms: Elements of visual perception – Image sampling and quantization Basic relationship between pixels – Basic geometric transformations-Introduction to Fourier Transform and DFT – Properties of 2D Fourier Transform – FFT – Separable Image Transforms -Walsh – Hadamard – Discrete Cosine Transform, Haar.

Unit –II: Image Enhancement Techniques: Spatial Domain methods: Basic grey level transformation – Histogram equalization – Image subtraction – Image averaging –Spatial filtering: Smoothing, sharpening filters – Laplacian filters – Frequency domain filters: Smoothing – Sharpening filters – Homomorphic filtering.

Unit- III: Image Restoration: Image restoration model – Noise models – Inverse filtering –Least mean square filtering – Constrained least mean square filtering – Blind image restoration – Pseudo inverse– Singular value decomposition.

Unit –IV: Image Compression: Lossless compression: LZW coding – Bit plane coding- predictive coding- DPCM. Lossy Compression: Transform coding – Wavelet coding – Basics of Image compression standards: JPEG, MPEG, Basics of Vector quantization, Self Organizing Feature Maps.

Unit- V: Image Segmentation: Point, Line and Edge Detection. Use of Robert, Canny, Sobel, Perwitt and Laplacian of Gaussian operators for edge detection. – Thresholding – Region Based segmentation – Region Growing, Region Splitting and Merging.

Reference Books:

1) William K Pratt, Digital Image Processing John Willey (2001)

2) Image Processing Analysis and Machine Vision – Millman Sonka, Vaclav hlavac, Roger Boyle, Broos/colic, Thompson Learniy (1999).

3) A.K. Jain, PHI, New Delhi (1995)-Fundamentals of Digital Image Processing.

4) Chanda Dutta Magundar – Digital Image Processing and Applications, Prentice Hall ofIndia, 2000.

ECE 405G Machine Learning 3-0-0

COURSE OUTCOMES (COs)

CO1	Develop an intuition about the problem and problem solving using machine learning
CO2	Get familiar with different machine learning approaches
CO3	Understand approach for machine learning model creation and evaluation
CO4	Understand approaches for model creation and evaluation using neural networks.

Unit I (Introduction): Machine learning Paradigms: Supervised learning (Classification and Regression Trees, Support vector machines), Unsupervised learning (Clustering), Instance-based learning (K-nearest Neighbour, Locally weighted regression, Radial Basis Function), Reinforcement learning (Learning Task, Q-learning, Value function approximation, Temporal difference learning).

Unit II (Decision Tree Learning): Decision tree representation, appropriate problems for decision tree learning, Univariate Trees (Classification and Regression), Multivariate Trees, Basic Decision Tree Learning algorithms, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning. Bayesian Learning: Bayes theorem and concept learning, Bayes optimal classifier, Gibbs algorithms, Naive Bayes Classifier.

Unit III (Artificial Neural Network): Neural network representation, Neural Networks as a paradigm for parallel processing, Linear discrimination, Pairwise separation, Gradient Descent, Logistic discrimination, Perceptron, Training a perceptron, Multilayer perceptron, Back propagation Algorithm. Recurrent Networks.

Unit IV (Genetic Algorithms): Basic concepts, Hypothesis space search, Genetic programming, Models of evolution and learning, Parallelizing Genetic Algorithms.
UNIT V (Inductive and Analytical Learning): Learning rule sets, Comparison between inductive and analytical learning, Analytical learning with perfect domain theories: Prolog-EBG.

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Mitchell T.M., Machine Learning, McGraw Hill (1997) 2nd ed.
2. Alpaydin E., Introduction to Machine Learning, MIT Press (2010) 2nd ed.
3. Bishop C., Pattern Recognition and Machine Learning, Springer-Verlag (2006) 2nd ed.
4. Michie D., Spiegelhalter D. J., Taylor C. C., Machine Learning, Neural and Statistical Classification. Overseas Press (2009) 1st ed.

ECE 450G Artificial Neural Networks & Fuzzy Logic 3-0-2

COURSE OUTCOMES (COs)

CO1	To trace the historical developments of Artificial Neural Networks (ANN).
CO2	Understand the basic concepts and models of ANN for solving simple pattern recognition problems.
CO3	Analysis of feed forward and feedback neural networks, involving the key concepts of Back propagation learning and Associative memories.
CO4	To formalize the problem and to solve it by using a neural network.

Unit I: Introduction to Neural Networks: Organization of the Brain, Biological Neuron, Biological and artificial Neuron Models, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential applications of ANN.

Unit II: Essentials of Artificial Neural Networks: Artificial Neuron Model, Types of Neuron Activation Function, ANN Architectures, Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules.

Unit III: Single and multilayer feed Forward Neural Networks: Introduction, Perception Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perception Networks, Limitations of the Perception Model. Generalized Delta Rule, Derivation of Back propagation (BP) Training, Summary of Back propagation Algorithm, Learning Difficulties and Improvements.

Unit IV: Associative Memories: Paradigms of Associative Memory, Hebbian Learning, General Concepts of Associative Memory, Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, Architecture of Hopfield Network, Storage and Recall Algorithm, Stability Analysis.

Unit V: Classical & Fuzzy Sets: Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions. Fuzzification, Membership value assignment, development of rule base and decision making system.

Reference Books:

1) S. Rajasekharan & G. A. Vijayalakshmi, “Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications”, PHI Publication, 2004.
2) John Yen and Reza Langan, “Fuzzy Logic: Intelligence, Control and Information”, Pearson, 2004.
3) Mohamad H. Hassoun, “Fundemanatals of Artificial Neural Networks”, MIT Press.
4) Jian-Kang Wu, “Neural Networks and Simulation methods”, CRC Press.
5) B. Yegnanarayana, “Artificial Neural Networks”, Prentice Hall India.

ECE453G **Cyber Forensics** **3-0-0**

COURSE OUTCOMES (COs)

CO1	Understand the basics of computer forensics
CO2	Analyze and validate forensics data
CO3	To learn to analyze and validate forensics data
CO4	Identify the vulnerabilities in a given network infrastructure

Unit I: Introduction To Computer Forensics : Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud. Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.

Unit II: Evidence Collection And Forensics Tools : Processing Crime and Incident Scenes – Working with Windows and DOS Systems. Current Computer Forensics Tools: Software/ Hardware Tools.

Unit III: **Analysis And Validation** : Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics

Unit IV: Ethical Hacking : Introduction to Ethical Hacking - Footprinting and Reconnaissance - Scanning Networks - Enumeration - System Hacking - Malware Threats – Sniffing

Unit V: Ethical Hacking In Web : Social Engineering - Denial of Service - Session Hijacking - Hacking Web servers - Hacking Web Applications – SQL Injection - Hacking Wireless Networks - Hacking Mobile Platforms.

Text Books:

1. Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, ―Computer Forensics and Investigations‖, Cengage Learning, India Edition, 2016.
2. CEH official Certfied Ethical Hacking Review Guide, Wiley India Edition, 2015.

References

1. John R.Vacca, ―Computer Forensics‖, Cengage Learning, 2005
2. MarjieT.Britz, ―Computer Forensics and Cyber Crime‖: An Introduction‖, 3rd Edition, Prentice Hall, 2013.
3. AnkitFadia ― Ethical Hacking‖ Second Edition, Macmillan India Ltd, 2006
4. Kenneth C.Brancik ―Insider Computer Fraud‖ Auerbach Publications Taylor & Francis Group– 2008.

ECE454G Network Security 3-0-0

COURSE OUTCOMES (COs)

CO1	To have knowledge about vulnerabilities on a network
CO2	To have knowledge about Secret key and Public Key
CO3	To have knowledge about Hash Functions and the way they work
CO4	To have knowledge about authentication on a network
CO5	To have knowkedge about security policies

Unit I- Introduction: Attacks, Services and Mechanisms, Security Attacks, Security Services, Integrity check, **Secret Key Cryptography:** Block Encryption, DES rounds, S-Boxes IDEA: Overview, comparison with DES, Key expansion, IDEA rounds, Uses of Secret key Cryptography; ECB, CBC, OFB, CFB, Multiple encryptions DES**.**

Unit II- Hash Functions and Message Digests: Length of hash, uses, algorithms (MD2, MD4, MD5, SHS) MD2: Algorithm (Padding, checksum, passes.) MD4 and 5: algorithm (padding, stages, digest computation.) SHS: Overview, padding, stages.

Unit III- Public key Cryptography: Algorithms, examples, Modular arithmetic (addition, multiplication, inverse, and exponentiation) RSA: generating keys, encryption and decryption. Other Algorithms: PKCS, Diffie-Hellman, El-Gamal signatures, DSS, Zero-knowledge signatures

Unit IV- Authentication: Password Based, Address Based, Cryptographic Authentication. Passwords in distributed systems, on-line vs offline guessing, storing. Cryptographic Authentication: passwords as keys, protocols, KDC's Certification Revocation, Interdomain, groups, delegation. Authentication of People: Verification techniques, passwords, length of passwords, password distribution, smart cards, biometrics.

Unit V- Security Policies and Security Handshake Pitfalls: What is security policy, high and low level policy, user issues? Protocol problems, assumptions, Shared secret protocols, public key protocols, mutual authentication, reflection attacks, use of timestamps, nonce and sequence numbers, session keys, one-and two-way public key based authentication**.**

References:

1. Atul Kahate, Cryptography and Network Security, McGraw Hill.

2. Kaufman, c., Perlman, R., and Speciner, M., Network Security, Private Communication in a public world, 2nd ed., Prentice Hall PTR., 2002.

3. Stallings, W. Cryptography and Network Security: Principles and Practice, 3rd ed., Prentice Hall PTR.,2003.

4. Stallings, W. Network security Essentials: Applications and standards, Prentice Hall, 2000. 5. Cryptography and Network Security; McGraw Hill; Behrouz A Forouzan.

ECE455G Robotics & Automation 3-0-0

COURSE OUTCOMES (COs)

CO1	Familiarize with anatomy, specifications and types of Robots
CO2	Obtain forward and inverse kinematic models of robotic manipulators
CO3	Plan trajectories in joint space & Cartesian space and avoid obstacles while robots are in motion
CO4	Develop dynamic model and design the controller for robotic manipulators .
CO5	Familiarize with different types of mobile robots, kinematic models, motion control and sensors for mobile robots

Unit I: Introduction to automation: Basic elements of an automated system, advanced automation functions, levels of automation, process industries versus discrete manufacturing industries, continuous versus discrete control, computer process control. Hardware components for automation and process control, sensors, actuators, analog to digital converters, digital to analog converters, input/output devices for discrete data

Unit II: Automated production lines: Fundamentals of automated production lines, application of automated production lines, analysis of transfer lines, automated assembly systems, fundamentals of automated assembly systems, quantitative analysis of assembly systems, automatic identification methods, barcode technology, radio frequency identification, other AIDC technologies

Unit III: Industrial Robotics: Robotic configuration, robot anatomy and related attributes, robot control systems, end effectors, sensors in robotics, industrial robot applications, robot accuracy and repeatability, different types of robotics, various generations of robots, degrees of freedom – Asimov's laws of robotics dynamic stabilization of robots.

Unit IV: Spatial descriptions and transformations: Positions, orientations, and frames. Mappings: Changing descriptions from frame to frame. Operators: translations, rotations and transformations, transformation arithmetic transform equations, transformation of free vectors computational considerations, manipulator Kinematics, link description, link-connection description, actuator space joint space and Cartesian spac

Unit V: Robot programming: Introduction, levels of robot programming, requirements of robot programming language, problems pertaining to robot programming languages, offline programming systems, central issues in OLP systems, automating subtasks in OLP systems, simple programs on robot applications

Text Books:

1. Automation, Production systems, and computer integrated manufacturing-MikellP.Groover 3rd edition, Pearson 2009
2. Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International, 2nd edition, 2012

Reference Books

1. Robotics for Engineers –Yoram Koren, McGraw Hill International, 1st edition, 1985.
2. Robotic Engineering - An Integrated approach, Klafter, Chmielewski and Negin, PHI, 1st edition, 2009.
3. An Introduction to Automated Process Planning Systems- Tiess Chiu Chang & Richard A. Wysk

OPEN ELECTIVES

ECE001OE **Emerging Technologies in ICT** **3-0-0**

COURSE OUTCOMES (COs)

CO1	Familiarize with anatomy, specifications and types of Robots
CO2	Obtain forward and inverse kinematic models of robotic manipulators
CO3	Plan trajectories in joint space & Cartesian space and avoid obstacles while robots are in motion
CO4	Develop dynamic model and design the controller for robotic manipulators .
CO5	Familiarize with different types of mobile robots, kinematic models, motion control and sensors for mobile robots

Unit I: E-Commerce Introduction: E-commerce as Business need-commerce Types, Advantages, Disadvantages, e-Commerce Architecture, Internet Payment Systems - Characteristics - 4C Payment Methods - SET Protocol for Credit Card Payment - E-Cash, E-Check - Overview of Smart Card

Unit II: E-mail &; Internet: Introduction, E-mail Account & Its Functions, Search Engine, Surfing Webpages, Basics of Social Networking Site

Unit III: E-Banking Transactions: Inter Banking, Intra Banking, Electronic Payments, (Payment – Gateway Example) Securities in E-banking (SSL, Digital Signatures – Examples) Services Provided: ATM, Smart Card ECS(Electronic Clearing System) e.g. Telephone , Electricity Bills

Unit IV: E – Governance & E – Agriculture E –Governance Models : (G2B,G2C,C2G,G2G), Challenges to E –Governance, Strategies and tactics for implementation of E – Governance, Types of Agriculture information (Soil, Water, Seeds, Market rate) & Technique dissemination , Future trade marketing, Corp Management , Query redresses System, (Information Kiosk, IVR etc.),

Unit V: Case Study: E-learning – Models WBT, CBT, Virtual Campus, LMS & LCMS, Video Conferencing, Chatting Bulleting, Building Online Community, Asynchronous / Synchronous Learning, Case Study

Text Books:

1. Internet (Use of Search Engines Google & yahoo etc.)

2. E–Commerce : C.V.S.Murty

3. Fire Wall and Internet Security: William Cheswick, Stevens, Aviel Rubin

4. The Essential Guide to Knowledge management : Amrit Tiwana

5. Management Information System: Laudon & Laudon

ECE002OE Real Time e-Waste Management Systems 3-0-0

COURSE OUTCOMES (COs)

CO1	Understanding e Waste – its composition
CO2	Understanding e Waste – hazards on a global Front
CO3	Knowing e Waste – Control Measures
CO4	Knowing e waste management & Handling

Unit I: Introduction. E- waste; composition and generation. Global context in e- waste; E-waste pollutants, E waste hazardous properties, Effects of pollutant (E- waste) on human health and surrounding environment, domestic e-waste disposal, Basic principles of E waste management, Component of E waste management, Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials, occupational and environmental health perspectives of recycling e-waste

Unit II: E-waste hazardous on Global trade Essential factors in global waste trade economy, Waste trading as a quint essential part of electronic recycling, Free trade agreements as a means of waste trading. Import of hazardous e-waste in India; India's stand on liberalizing import rules, E-waste economy in the organized and unorganized sector. Estimation and recycling of e-waste in metro cities

Unit III: E-waste control measures Need for stringent health safeguards and environmental protection laws in India, Extended Producers Responsibility (EPR), Import of e-waste permissions, Producer-Public-Government cooperation, Administrative Controls & Engineering controls, monitoring of compliance of Rules, Effective regulatory mechanism strengthened by manpower and technical expertise, Reduction of waste at source

Unit IV: E- waste legislation E-waste (Management and Handling) Rules, 2011; and E-Waste (Management) Rules, 2016 - Salient Features and its likely implication. Government assistance for TSDFs. The international legislation: The Basel Convention; The Bamako Convention. The Rotterdam Convention. Waste Electrical and Electronic Equipment (WEEE) Directive in the European Union, Restrictions of Hazardous Substances (RoHS) Directive.

Reference Books:

1. Hester R.E., and Harrison R.M. 2009. Electronic Waste Management. Science.

2. Fowler B. 2017. Electronic Waste – 1 st Edition (Toxicology and Public Health Issues). Elsevier.

3. Johri R., "E-waste: implications, regulations, and management in India and current global best practices", TERI Press, New Delhi

ECE003OE Introduction to Computer Networking 3-0-0

COURSE OUTCOMES (COs)

CO1	To have Knowledge of various basic concepts of Computer Network
CO2	To know the processes taking place at various network Layers
CO3	Having Knowledge about Routing Algorithms and Transport Protocols
CO4	Be familiar with different security issues and challenges in a computer netwok

Unit I: Introduction to Computer Networks: Network Topologies - LAN, WAN, MAN. Network Topologies (Bus Topology, Star Topology, Ring Topology, Tree Topology)

Unit - II Network Hardware: Routers, Switches, Bridges, Hubs. High Speed Networks, Public switched Networks

Unit - III Open System Interconnection (OSI) model of a Network, TCPIP model, Internet Technology-Transmission and security,

Unit – IV Modems, Basic Definition, Modem Types, Modem Modulation (ASK, FSK, PSK, QAM – Basic concepts), Multiplexing & multiple access techniques, FDM, TDMA, CDMA, OFDM, FDM channel groups, TDM.

Unit - V Synchronous & Asynchronous Transmission, Basics of Coding - Line Encoding, Unipolar Encoding, Polar Encoding, Bipolar Encoding , Manchester Encoding

Text Books: 1. A. S. Tanenbaum (2003), Computer Networks, 4th edition, Pearson Education/ PHI, New Delhi, India.

Reference Books: 1. Behrouz A. Forouzan (2006), Data communication and Networking, 4th Edition, Mc Graw-Hill, India.
2. Kurose, Ross (2010), Computer Networking: A top down approach, Pearson Education, India

ECE004OE Introduction t o Electronic Devices and Circuits 3-0-0

Course Outcomes:

CO1	Understand the principles of semiconductor Physics
CO2	Understand semiconductor junctions.
CO3	Understanding BJT, MOSFET
CO4	Knowing diodes

Unit I- Semiconductor Physics: Review of quantum mechanics and review of crystal structure of semiconductors, Intrinsic and Extrinsic semiconductors, energy bands in intrinsic and extrinsic semiconductors, carrier transport by drift and diffusion, carrier generation and recombination,

Unit II- *Pn* Junction: Basic structure, pn junction under zero, forward and reverse bias, built-in potential barrier, electric field and space charge width, junction capacitance, charge flow in a pn junction, minority carrier distribution, break down mechanisms (qualitative)

Unit III- Bipolar Transistor: Basic structure and principle of operation ,modes of operation, static IV characteristics in active and saturation modes, amplification, minority carrier distribution

Unit IV- MOS Field Effect Transistor: Basics of Zener diode, its VI characteristics, PIN diode, Introduction to MOS its types, Construction, Working, Modes of operation.

Unit V- Special Semiconductor Devices: Basics of Photodiodes, pn unction Solar Cell, Light Emitting Diodes, Laser Diodes, Power Semiconductor Devices

Text/Reference Books:

1. NeamenD.A.andBiswasD.,SemiconductorPhysicsandDevices,McGrawHillEducation
2. StreetmanB.G.andBanerjeeS.K.,SolidStateElectronicDevices,PearsonEducation

ECE005OE Introduction to Digital Logic Circuits 3-0-0

Course Outcomes:

CO1	Various number systems and conversion from one number system to another.
CO2	Understanding Boolean algebra
CO3	Knowing about combinational and sequential circuits.
CO4	Introduction to PLAs and field programmable gate arrays.
CO5	Understanding of Logic families

Unit I- Number System and Boolean Algebra: Number Systems: Binary, octal, and hexa decimal number systems, binary arithmetic, binary codes, excess-3 code, gray code. Boolean algebra: Postulates and theorems, logic functions, Basic concept of Karnaugh, realization using logic gates.

Unit II- Combinational Circuits: Introduction to combinational circuits, realization of basic combinational functions like Adder, Subtractor, Encoder/Decoder, Multiplexer, delays and hazards in combinationa circuits,

Unit III- Sequential Circuits: Basic concepts of Flip-Flops: SR, JK, T, D, Master/Slave FF, triggering of FF, implementation, Registers: shift registers, inter-conversion of shift registers, Counters.

Unit IV- Programmable Logic Devices and Memory: Introduction to PLAs, PALs. Introduction to field programmable gate arrays (FPGAs). Basic concepts of Read-only memory, read/write memory-SRAM and DRAM(basic concepts only)

Unit V- Logic Families: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, TristateTTL, RTL, DCTL, HTLECL, CMOS

Text/ReferenceBooks:

1. Mano M., Digital logic and Computer Design, Prentice Hall India
2. Floyd T.L., Digital Fundamentals, Charles E.Merrill Publishing Company
3. JainR.P., Modern Digital Electronics, Tata Mc Graw Hill

ECE006OE Basics of Communication Engineering 3-0-0

Course Outcomes:

CO1	Understanding Communication Systems.
CO2	Understanding Analog and digital modulation techniques
CO3	Knowing about PCM
CO4	Knowing Multiplexing and de multiplexing

Unit-I Communication Systems: Introduction to Communication System, Elements of communication System, Benefits of Communication, Communication Media, Modulation and Demodulation (brief idea).

Unit-II: Basic concept of Analog and Digital Communication Systems. Introduction to signals, classification of signals, Modulation and need for modulation, Analog Modulation techniques Amplitude modulation, Frequency Modulation (basic definitions and waveforms)

Unit-III: Pulse modulation techniques-pulse amplitude modulation (PAM), Pulse Position Modulation (PPM), Pulse Width Modulation (PWM)

Unit-IV: Digital Communication: Basics of PCM – Samplinq, Quantization, Encoding. Digital Modulation Techniques – ASK, FSK, PSK

Unit-V: Introduction to Multiplexing – Demultiplexing. Basics of FDM and TDM

Text Books:

1. Electronic Communication system; G. Kennedy
2. Electronic Communication Systems (Fundamentals through advanced), W. Tomassi, Pearson Education
3. Electronic Devices and Circuit Theory by Boylestead and Nashelsky.

ECE007OE **Cyber Laws** **3-0-0**

Course Outcomes:

CO1	To understand Cyber Space
CO2	Knowing about Electronic Governance
CO3	Knowing about Cyber crimes
CO4	Knowing about Intellectual property

Unit I: Cyber Space- Fundamental definitions -Interface of Technology and Law – Jurisprudence and-Jurisdiction in Cyber Space - Indian Context of Jurisdiction - Enforcement agencies – Need for IT act - UNCITRAL – E-Commerce basics .Information Technology Act, 2000 - Aims and Objects — Overview of the Act – Jurisdiction

Unit II: Electronic Governance – Legal Recognition of Electronic Records and Electronic Evidence - Digital Signature Certificates - Securing Electronic records and secure digital signatures - Duties of Subscribers - Role of Certifying Authorities - Regulators under the Act -The Cyber Regulations Appellate Tribunal - Internet Service Providers and their Liability– Powers of Police under the Act – Impact of the Act on other Laws . Cyber Crimes -Meaning of Cyber Crimes –Different Kinds of Cyber crimes – Cyber crimes under IPC,

Unit III: Cr.P.C and Indian Evidence Law - Cyber crimes under the Information Technology Act,2000 - Cyber crimes under International Law - Hacking Child Pornography, Cyber Stalking, Denial of service Attack, Virus Dissemination, Software Piracy, Internet Relay Chat (IRC) Crime, Credit Card Fraud, Net Extortion, Phishing etc - Cyber TerrorismViolation of Privacy on Internet - Data Protection and Privacy – Indian Court cases.

Unit IV: Intellectual Property Rights – Copyrights- Software – Copyrights vs Patents debate - Authorship and Assignment Issues - Copyright in Internet - Multimedia and Copyright issues - Software Piracy - Trademarks - Trademarks in Internet – Copyright and Trademark cases,

Unit V: Patents - Understanding Patents - European Position on Computer related Patents, Legal position on Computer related Patents - Indian Position on Patents – Case Law, Domain names - registration - Domain Name Disputes-Cyber Squatting-IPR cases

References:

1. Justice Yatindra Singh: Cyber Laws, Universal Law Publishing Co., New Delhi
2. Farouq Ahmed, Cyber Law in India, New Era publications, New Delhi
3. S.R.Myneni: Information Technology Law(Cyber Laws), Asia Law House, Hyderabad.
4. Chris Reed, Internet Law-Text and Materials, Cambridge University Press.
5. Pawan Duggal: Cyber Law- the Indian perspective Universal Law Publishing Co., New Delhi

ECE008OE **Wireless Home Solutions** **3-0-0**

Course Outcomes:

CO1	To understand Wireless communication
CO2	Understanding Radio propagation and concepts relater to cellular systems
CO3	Knowing about circuit switching & basics of CDMA
CO4	Knowing about applications of wireless communication

Unit I: Overview of wireless communication, cellular communication, different generations and standards in cellular communication system, satellite communication including GPS, wireless local loop, RFID

Unit II: Radio Propagation and Propagation Path-Loss Model: Free-Space Attenuation, Multipath Channel Characteristics, Signal Fading Statistics, Path-Loss Models.

Unit III: Circuit-switched cellular systems: Cellular Concept and Spatial Reuse, Frequency Reuse, GSM: Architecture, Basics of CDMA

Unit IV: Packet-switched cellular systems: - HSDPA (High Speed Downlink Packet Access) - HSUPA (High Speed Uplink Packet Access) - Introduction to LTE. Uplink and Downlink Communication in LTE, Basics of OFDM

Unit V: Applications – Improve Connectivity and Keep Smart Devices Secure, Controlling a device from phone, Aurdino RFID Door Lock, Bulding a mechanical smart switch, Bulding a smart thermostat

ECE010OE **Consumer Electronics** **3-0-0**

Course Outcomes:

CO1	To understand Audio visual systems
CO2	Understanding TV – its working and construction
CO3	Understanding Cable TV
CO4	

Unit I: Audio System: Microphones: construction, working principles and applications of microphones, Basic concept of their types viz: a) Carbon b) moving coil, c) velocity, d) crystal, e) condenser, e) cordless etc. Loud Speaker: Basic working and its types.

Unit II: Television: Monochrome TV Communication: - Elements of TV communication system. - Scanning- its need for picture transmission. – Basic concepts of - Composite Video signal (CVS) , Monochrome picture tube – construction and working,

Unit III: Block diagram of TV camera and the transmitter chain. - Block diagram of a TV receiver: function of each block. Frequency range of various VHF bands and channels used in India. Concept of positive and negative modulation VSB Transmission

Unit IV: Colour TV - Primary colours, tri-stimulus values, trichromatic coefficients, concepts of additive and subtracting mixing of colours, concepts of luminance, Hue and Saturation, Representation of a colour in colour triangle, non-spectral colour, visibility curve –

Unit V: Cable Television: Block diagram and principles of working of cable TV and DTH, cable TV using internet. VCR, VCD and DVD Principle of video recording on magnetic tapes, block diagram of VCR, VHS tape transport mechanism, Video Camera Study of VCD and DVD.

Text Books:

1. Colour Television-principles & practice R.R Gulati by Wiley Eastern Limited, New Delhi
2. Complete Satellite & cable Television R.R Gulati New age International Publisher
3. Colour Television Servicing by RC Vijay BPB Publication, New Delhi
4. Colour Television & Video Technology by A.K. Maini CSB Publishers
5. VCR-principles, maintenance & repair by S.P. Sharma, Tata Mc Graw Hill, New Delhi.