Heritage Institute of Technology

(A Kalyan Bharti Trust Initiative)

(An Autonomous Institute under MAKAUT)

Electronics and Communication Engineering Department

B.TECH. PROGRAMME

SYLLABUS

RELEASE DATE: 27.06.2017

1st Year 1st Semester Syllabus:

Theory							
Sl. No	**Course Code**	**Course Name**	**Contact Hrs per Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	HMTS1101	Business English	2	0	0	2	2
2	CHEM1001	Chemistry I	3	1	0	4	4
3	MATH1101	Mathematics I	3	1	0	4	4
4	ELEC1001	Basic Electrical Engineering	3	1	0	4	4
5	MECH1101	Engineering Mechanics	3	1	0	4	4
		Total Theory	**14**	**4**	**0**	**18**	**18**

Laboratory / Practical							
Sl. No	**Course Code**	**Course Name**	**Contact Hrs per Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	CHEM1011	Chemistry I Laboratory	0	0	3	3	2
2	ELEC1011	Basic Electrical Engineering Laboratory	0	0	3	3	2
3	MECH1012	Engineering Drawing	1	0	3	4	3
4	HMTS1111	Language Practice Laboratory (Level 1)	0	0	2	2	1
		Total Laboratory	**1**	**0**	**11**	**12**	**8**

Sessional							
Sl. No	**Course Code**	**Course Name**	**Contact Hrs per Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	HMTS1121	Extra curricular activities	0	0	2	2	1
		Total Sessional	**0**	**0**	**2**	**2**	**1**
Total of Semester			**15**	**4**	**13**	**32**	**27**

1st Year 2nd Semester Syllabus:

Theory							
Sl. No	**Course Code**	**Course Name**	**Contact Hrs per Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	CSEN1201	Introduction to Computing	3	1	0	4	4
2	PHYS1001	Physics I	3	1	0	4	4
3	MATH1201	Mathematics II	3	1	0	4	4
4	ECEN1001	Basic Electronics Engineering	3	1	0	4	4
5	MECH1201	Engineering Thermodynamics and Fluid Mechanics	3	1	0	4	4
		Total Theory	**15**	**5**	**0**	**20**	**20**

Laboratory							
Sl. No	**Course Code**	**Course Name**	**Contact Hrs per Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	CSEN1211	Introduction to Computing Laboratory	0	0	3	3	2
2	PHYS1011	Physics I Laboratory	0	0	3	3	2
3	ECEN1011	Basic Electronics Engineering Laboratory	0	0	3	3	2
4	MECH1011	Workshop Practice	1	0	3	4	3
		Total Laboratory	**1**	**0**	**12**	**13**	**9**
		Total of Semester	**16**	**5**	**12**	**33**	**29**

2nd Year 1st Semester:

A. Theory							
Sl. No.	**Course Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	**HMTS2001**	Human Values and Professional Ethics	2	0	0	2	2
2	**MATH2001**	Mathematical Methods	3	1	0	4	4
3	**MATH2002**	Numerical and Statistical Methods	3	0	0	3	3
4	**ECEN2101**	Analog Electronic Circuits	3	0	0	3	3
5	**ECEN2102**	Data Structure	3	0	0	3	3
6	**ECEN2103**	Signals and systems	3	0	0	3	3
7	**ECEN2105**	Circuit Theory and Filters	3	1	0	4	4
Total Theory						**22**	**22**

B. Practical							
8	**MATH2012**	Numerical and Statistical Methods Laboratory	0	0	2	2	1
9	**ECEN2111**	Analog Electronic Circuits Laboratory	0	0	3	3	2
10	**ECEN2113**	Signals & Systems Laboratory	0	0	2	2	1
11	**ECEN2112**	Data Structure Laboratory	0	0	2	2	1
12	**ECEN2115**	Circuit Theory and Filters Laboratory	0	0	3	3	2
Total Practical						**12**	**7**
Total of Semester						**34**	**29**

2nd Year 2nd Semester:

A. Theory							
Sl. No.	**Course Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	**CHEM2001**	Basic Environmental Engineering and Ecology	3	0	0	3	3
2	**ECEN2201**	EM Theory & transmission line	3	0	0	3	3
3	**ECEN2002**	Digital Electronics	3	0	0	3	3
4	**ECEN2203**	Analog Communication	3	0	0	3	3
5	**ECEN2204**	Solid State Devices	3	0	0	3	3
6	**PHYS2001**	Physics-II	3	1	0	4	4
7	**HMTS2002**	Indian Culture & Heritage	2	0	0	2	1
Total Theory						**21**	**20**

B. Practical							
8	**ECEN2211**	EM Theory Laboratory	0	0	3	3	2
9	**ECEN2012**	Digital electronics Laboratory	0	0	3	3	2
10	**ECEN2213**	Analog communication Laboratory	0	0	3	3	2
11	**PHYS2011**	Physics-II Laboratory	0	0	3	3	2
12	**HMTS2011**	Language Practice (Level 2) Laboratory	0	0	3	3	2
Total Practical						**15**	**10**
Total of Semester						**36**	**30**

3rd Year 1st Semester:

A. Theory							
Sl. No.	**Course Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	**HMTS3101**	Economics for Engineers	3	0	0	3	3
2	**ECEN3102**	Control Systems	3	1	0	4	4
3	**ECEN3103**	Microelectronics & Analog VLSI Design	3	1	0	4	4
4	**ECEN 3104**	Microprocessors, Microcontrollers & Systems	3	0	0	3	3
5	**ECEN3105**	Digital Communication	3	0	0	3	3
Total Theory						**17**	**17**

B. Practical							
6	**ECEN3112**	Control Systems Laboratory	0	0	3	3	2
7	**ECEN3113**	Microelectronics & Analog VLSI Design Laboratory	0	0	3	3	2
8	**ECEN3114**	Microprocessors, Microcontrollers & Systems Laboratory	0	0	3	3	2
9	**ECEN3115**	Digital Communication Laboratory			3	3	2
Total Practical						**12**	**08**
Total of Semester						**29**	**25**

3rd Year 2nd Semester:

A. Theory							
Sl. No.	**Course Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	**ECEN3201**	Digital VLSI Design	3	0	0	3	3
2	**ECEN3202**	Digital Signal Processing & Applications	3	0	0	3	3
3	**Prof Elective 1**	Theory – PE 1	3	1	0	4	4
4	**Prof Elective 2**	Theory – PE 2	3	1	0	4	4
5	**CSEN3004**	Object Oriented Programming using C++	3	0	0	3	3
6	**HMTS3201**	Principles of Management	2	0	0	2	2
Total Theory						**19**	**19**

B. Practical							
7	**ECEN3211**	Digital VLSI Design Laboratory	0	0	3	3	2
8	**ECEN3212**	Digital Signal Processing & Applications Laboratory	0	0	3	3	2
9	**CSEN3014**	OOPs Laboratory	0	0	2	2	1
	C:Sessional						
10	**ECEN 3221**	Electronic Circuit Design Laboratory	0	0	3	3	2
11	**HMTS3221**	Personality Development				1	1
12	**ECEN3222**	Seminar I				3	2
Total Practical						**8**	**5**
Total of Sessional						**7**	**5**
Total of Semester						**34**	**29**

Professional Elective 1	
Course Code	**Course Name**
ECEN3231	Computer Communication & Networking
ECEN3232	Computer Architecture
ECEN3233	Real Time Embedded Systems
ECEN3234	Telecommunication Systems

Professional Elective 2	
Course Code	**Course Name**
ECEN3241	Fiber Optic Communication
ECEN3242	Power Electronics
ECEN3243	Antenna Design and Radar Technology

4th Year 1st Semester:

A. Theory							
Sl. No.	**Course Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	**ECEN4101**	RF & Microwave Engineering	3	1	0	4	4
2	**ECEN 4102**	Coding & Information Theory	3	0	0	3	3
3	**ECEN 4103**	Advanced Communication Systems	3	0	0	3	3
4	**Free Elective 1**	Theory – FE 1	3	0	0	3	3
Total						**13**	**13**

B. Practical							
5	**ECEN4111**	RF & Microwave Engineering Laboratory	0	0	3	3	2
6	**ECEN4113**	Advanced Communication Systems Laboratory	**0**	**0**	3	3	2
Total Practical						**6**	**4**

C. Sessionals							
8	**HMTS4121**	Professional Development	0	0	3	3	2
9	**ECEN4131**	Industrial Training Evaluation	**4 wks during 6th -7th Sem-break**				2
10	**ECEN4132**	Seminar II				**3**	2
11	**ECEN4191**	Project- I	0	0	6	6	4
Total sessional							**10**
Total of Semester						**31**	**27**

Free Elective 1(for ECE students)	
Course Code	**Course Name**
MATH4181	Operations Research and Optimization Techniques
CHEN4182	Project Management
AEIE4182	Introduction to Embedded Systems
INFO4182	Cloud Computing
CSEN4181	Fundamentals of Operating System
CSEN4182	Web Intelligence and Big Data
BIOT4181	Biosensors

Free Elective 1(offered by ECE department)	
Course Code	**Course Name**
ECEN4181	VLSI Design Automation
ECEN4182	Control Systems
ECEN4183	Principles of Communication Systems

4th Year 2nd Semester:

A. Theory							
Sl. No.	**Course Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	**HMTS4201**	Organizational Behaviour	2	0	0	2	2
2	**Free Elective 2**	Theory – FE 2	3	0	0	3	3
3	**Prof Elective 3**	Theory – PE 3	3	1	0	4	4
Total Theory						**9**	**9**

B. Sessionals							
4	**ECEN4231**	Comprehensive Viva Voce	-	-	-	-	3
5	**ECEN4291**	Project-II	0	0	12	12	8
Total Sessional					**12**	**12**	**11**
Total of Semester						**21**	**20**

Free Elective 2 (for ECE students)	
Course Code	**Course Name**
CHEN4282	Total Quality Management & Assurance
AEIE4281	Sensor Technology
MATH4281	Probability and Stochastic Processes
CSEN4281	Fundamentals of RDBMS
CSEN4282	Mobile Computing
BIOT4282	Non- Conventional Energy
INFO4281	Cryptography & Network Security
INFO4282	Soft Computing

Prof Elective 3	
Course Code	**Course Name**
ECEN4241	Remote Sensing using Satellites
ECEN4242	Computer Organization
ECEN4243	Alternative Energy Sources

Free Elective 2 (offered by ECE department)	
Course Code	**Course Name**
ECEN4281	Cellular and Satellite Communications
ECEN4282	VLSI Design
ECEN4283	VLSI Testing and Verification

ECE Department B.Tech., 1st Year, 1st Semester:

Course Name : BUSINESS ENGLISH					
Course Code: HMTS1101					
Contact hrs per week:	L	T	P	Total	Credit points
	2	0	0	2	2

Course Outcome:

1. Analyse the dynamics of business communication and communicate accordingly.
2. Write business letters and reports
3. Learn to articulate opinions and views with clarity
4. Appreciate the use of language to create beautiful expressions
5. Analyse and appreciate literature.
6. Communicate in an official and formal environment.

Module I: [5L]

Communication Skill
Definition, nature & attributes of Communication
Process of Communication
Models or Theories of Communication
Types of Communication
Levels or Channels of Communication
Barriers to Communication

Module II: [12L]

Business Communication- Scope & Importance
Writing Formal Business Letters
Writing Reports
Organizational Communication: Agenda & minutes of a meeting, notice, memo, circular
Project Proposal
Technical Report Writing
Organizing e-mail messages
E-mail etiquette
Tips for e-mail effectiveness

Module III: [10L]

Language through Literature
Modes of literary & non-literary expression
Introduction to Fiction, (An Astrologer's Day by R.K. Narayan and Monkey's Paw by W.W. Jacobs), Drama (The Two Executioners by Fernando Arrabal) or (Lithuania by Rupert Brooke) & Poetry (Night of the Scorpion by Nissim Ezekiel and Palanquin Bearers by Sarojini Naidu)

Module IV: [3L]

Grammar in usage (nouns, verbs, adjectives, adverbs, tense, prepositions, voice change) -to be dealt with the help of the given texts.

References:

1. Armand Matterlart and Michele Matterlart, Theories of Communication: A Short Introduction, Sage Publications Ltd., 1998.

2. Chan, Janis Fisher, and Diane Lutovich. Professional Writing Skills. San Anselmo, CA: Advanced Communication Designs, 1997.

3. Geffner, Andrew P. Business English. Hauppauge, New York: Barron's Educational Series, 1998.

4. Good, Edward C. Mightier Than the Sword. Charlottesville: Word Stone Publications, 1989.

5. Edward P.Bailey, Writing and Speaking at Work: A Practical Guide for Business Communication, Prentice-Hall, 7th edn, 2004.

6. Kitty O. Locker, Business and Administrative Communication, McGraw-Hill/ Irwin, 7th edn, 2004.

7. Lillian Chaney and Jeanette Martin, Intercultural Business Communication, Prentice Hall, 4th edn, 2005.

8. Yudkin, Marcia. Persuading on Course Name. Lansing, IL: Infinity Publishing, 2001.

Course Name : CHEMISTRY 1					
Course Code: CHEM 1001					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

COURSE OUTCOME:

CHEM 1001.1	Knowledge of understanding the operating principles and reaction involved in batteries and fuel cells and their application in automobiles as well as other sectors to reduce environmental pollution.
CHEM 1001.2	An ability to design and conduct experiments, as well as to organize, analyzes, and interprets data
CHEM 1001.3	An ability to identify and formulate polymers and have a knowledge of various polymers like polyethene, PVC, PS, Teflon, Bakelite, Nylon which have engineering applications
CHEM 1001.4	Knowledge of synthesizing Nanomaterials and their applications in industry, carbon nano tube technology is used in every industry now-a-days
CHEM 1001.5	An ability of synthesizing bio fuels as a renewable and environment friendly alternative source for natural fuel
CHEM 1001.6	Elementary knowledge of IR and UV spectroscopy is usable in structure elucidation and characterisation of various molecules

Module I: [10 L]

Thermodynamics & Spectroscopy

Chemical Thermodynamics & Thermochemistry

Concept of Thermodynamic system, Introduction to first law of thermodynamics, Enthalpy Heat Capacity, Reversible and Irreversible processes, Adiabatic changes, Application of first law of thermodynamics to chemical processes, 2nd law of thermodynamics, Evaluation of entropy, Work function and free energy, Phase Changes, Clausius Clapeyron Equation, Chemical Potential, Gibbs Duhem Relation, Activity and Activity coefficient.

Spectroscopy

Electromagnetic Radiation, Basic idea of UV-visible & IR spectroscopy.

Module II: [10 L]

Structure & Bonding

Chemical Bonding

Covalent bond, VSEPR Theory, Molecular Orbital Theory, Hydrogen bond, Intermolecular forces-vander Waals forces, Ionization energy, Electronegativity, Electron affinity, Hybridisation, Dipole moment

Solid State Chemistry

Introduction to stoichiometric defects (Schottky & Frenkel) and non – stoichiometric defects (Metal excess and metal deficiency). Role of silicon and germanium in the field of semiconductor.

Ionic Equilibria and Redox Equlibria

Acid Base Equilibria in water, Strength of acids and bases, Hydrogen ion exponent, Ionic product of water, Salt Hydrolysis and Henderson Equation, Buffer solutions, pH indicator, Common ion Effect, Solubility product, Fractional Precipitation, Redox Equilibria,

Structure and reactivity of Organic molecule

Inductive effect, resonance, hyperconjugation, electromeric effect, carbocation, carbanion and free radicals.
Brief study of some addition, eliminations and substitution reactions.

Module III: [10 L]

Electrochemistry & Reaction Dynamics

Conductance

Conductance of electrolytic solutions, specific conductance, equivalent conductance, molar conductance, ion conductance, effect of temperature and concentration (Strong and Weak electrolyte). Kohlrausch's law of independent migration of ions, transport numbers and hydration of ions. Conductometric titrations: SA vs SB & SA vs WB; precipitation titration KCl vs $AgNO_3$.

Electrochemical Cell

Cell EMF and thermodynamic derivation of the EMF of a Galvanic cell (Nernst equation), single electrode potentials, hydrogen half-cell and calomel half cell (construction, representation, cell reaction, expression of potential, discussion, application) Storage cell, fuel cell (construction, representation, cell reaction, expression of potential, discussion, application). Application of EMF measurement on a) the change in thermodynamic function (ΔG, ΔH, ΔS) b) the equilibrium constant of a reversible chemical reaction c) the valency of an ion.

Kinetics

Reaction laws: rate expression, order and molecularity, zero, first and second order kinetics. Pseudounimolecular reaction, Arrhenius equation.
Mechanism and theories of reaction rates (Collision theory and Transition state theory,).
Catalysis: Homogeneous catalysis (Definition, example, mechanism, kinetics).

Module IV: [10 L]

INDUSTRIAL CHEMISTRY & POLYMERIZATION

Industrial Chemistry

Solid Fuel: Coal, Classification of coal, constituents of coal, carbonization of coal (HTC and LTC), Coal analysis: Proximate and ultimate analysis.
Liquid fuel: Petroleum, classification of petroleum, Refining, Petroleum distillation, Thermal cracking, Octane number, Cetane number, Aviation Fuel (Aviation Gasoline, Jet Gasoline), Bio-diesel.
Gaseous fuels: Natural gas, water gas, coal gas, bio gas.

Polymerization

Concepts, classifications and industrial applications. Polymer molecular weight (number avg. weight avg. viscosity avg.: Theory and mathematical expression only), Poly dispersity index (PDI). Polymerization processes (addition and condensation polymerization), degree of polymerization, Copolymerization, stereo-regularity of polymer, crystallinity (concept of T_m) and amorphicity (Concept of T_g) of polymer.

Preparation, structure and use of some common polymers: plastic (PE: HDPE, LDPE, PVC, Bakelite, PP), rubber (natural rubber, SBR, NBR) and Vulcanization., fibre(nylon 6.6, Nylon 6, Polyester).
Conducting and semi-conducting polymers.

Text Books:

1. Engineering Chemistry, Gourkrishna Dasmohapatra, Vikas Publishing House
2. A Text book of Engineering Chemistry, Shashi Chawla, Dhanpat Rai & Co Pvt Ltd
3. Engineering Chemistry, K. L. Chugh, Kalyani Publishers.

Reference Books:

1. General & Inorganic Chemistry, R. P. Sarkar, Fuels and Combustion, New Central Book Agency P Ltd
2. L. Finar, Organic Chemistry, Addison Wesley Longman, Inc
3. Organic Chemistry, Morrison & Boyd, Prentice Hall of India
4. Physical Chemistry, K. L. Kapoor, McMillan
5. P. C. Rakshit, Physical Chemistry, Sarat Book House (7th Edition).

Course Name : MATHEMATICS I					
Course Code: MATH1101					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Course Outcome:

After successfully completing this course the students will be able to:

MATH1101.1 Apply the concept of rank of matrices to find the solution of a system of linear simultaneous equations.

MATH1101.2 Develop the concept of eigen values and eigen vectors.

MATH1101.3 Combine the concepts of gradient, curl, divergence, directional derivatives, line integrals, surface integrals and volume integrals.

MATH1101.4 Analyze the nature of sequence and infinite series

MATH1101.5 Choose proper method for finding solution of a specific differential equation.

MATH1101.6 Describe the concept of differentiation and integration for functions of several variables with their applications in vector calculus.

Module I: [10L]

Matrix:

Matrices and their basic attributes, Determinant of a square matrix, Minors and Cofactors, Laplace's method of expansion of a determinant, Product of two determinants, Adjoint of a determinant, Jacobi's theorem on adjoint determinant. Singular and non-singular matrices, Adjoint of a matrix, Inverse of a non-singular matrix and its properties, Orthogonal matrix and its properties, Special Complex Matrices: Hermitian, Unitary, Normal(definition only), Rank of a matrix and its determination using elementary row and column operations, Solution of simultaneous linear equations by :Cramer's Rule and Matrix inversion method, Consistency and inconsistency of a system of homogeneous and inhomogeneous linear simultaneous equations, Characteristic Equation and computation of eigenvalues and eigenvectors of a square matrix (of order 2 or 3), Cayley-Hamilton theorem and its applications(with special reference to higher power of matrices, e.g. Idempotent and Nilpotent matrices)

Module II: [10 L]

Mean Value Theorems & Expansion of Functions:

Rolle's theorem: its geometrical interpretation and its application, Concavity and Convexity of curves, Mean Value theorems – Lagrange & Cauchy and their application, Taylor's theorem with Lagrange's and Cauchy's form of remainders and its application, Expansions of functions by Taylor's and Maclaurin's theorem, Maclaurin's infinite series expansion of the functions: $\sin x, \cos x, e^x, \log(1+x), (a+x)^n, n$ being an integer or a fraction (assuming that the remainder $R_n \to 0$ as $n \to \infty$ in each case).

Infinite Series:

Preliminary ideas of sequence, Infinite series and their convergence/divergence, Infinite series of positive terms, Tests for convergence: Comparison test, Cauchy's Root test, D' Alembert's Ratio test(statements and related problems on these tests), Raabe's test, Proof of e being irrational, Alternating series, Leibnitz's Test (statement, definition) illustrated by simple examples, Absolute convergence and Conditional convergence,

Module III: [10 L]

Successive differentiation:

Higher order derivatives of a function of single variable, Leibnitz's theorem (statement only and its application, problems of the type of recurrence relations in derivatives of different orders and also to find $(y_n)_0$).

Calculus of Functions of Several Variables:

Recapitulation of some basic ideas of limit and continuity of functions of single variable, Introduction to functions of several variables with examples, Knowledge of limit and continuity, Determination of partial derivatives of higher orders with examples, Homogeneous functions and Euler's theorem and related problems up to three variables, Chain rules, Differentiation of implicit functions, Total differentials and their related problems, Jacobians up to three variables and related problems, Maxima, minima and saddle points of functions and related problems.

Module-IV: [10 L]

Multiple Integration and Vector Calculus:

Concept of line integrals, Double and triple integrals. Vector function of a scalar variable, Differentiation of a vector function, Scalar and vector point functions, Gradient of a scalar point function, divergence and curl of a vector point function, Directional derivative, Related problems on these topics, Green's theorem, Gauss Divergence Theorem and Stoke's theorem (Statements and applications).

Reduction formula:

Reduction formulae both for indefinite and definite integrals of types:

$\int \sin^n x, \int \cos^n x, \int \sin^m x \cos^n x, \int \cos^m x \sin nx, \int \frac{dx}{(x^2+a^2)^n}, m, n$ are positive integers.

References

1. Advanced Engineering Mathematics: Erwin Kreyszig by Wiley India
2. Engineering Mathematics: B.S. Grewal (S. Chand & Co.)
3. Higher Engineering Mathematics: John Bird (Elsevier)
4. Advanced Engineering Mathematics: Wiley and Barrett (Tata McGraw-Hill)
5. Calculus: M. J. Strauss, G. L. Bradley and K. L. Smith (Pearson Education)
6. Engineering Mathematics: S. S. Sastry (PHI)

7. Advanced Engineering Mathematics: M.C. Potter, J.L. Goldberg and E.F. Abonfadel (OUP),Indian Edition.
8. Linear Algebra(Schaum's outline series): Seymour Lipschutz, Marc Lipson (McGraw Hill Education)
9. Vector Analysis(Schaum's outline series): M.R. Spiegel, Seymour Lipschutz, Dennis Spellman (McGraw Hill Education)
10. Introduction to Real Analysis: S.K.Mapa (Sarat Book Distributors)

Course Name : BASIC ELECTRICAL ENGINEERING					
Course Code: ELEC1001					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:

After attending the course, the students will be able to

- Analyse DC electrical circuits using KCL, KVL and network theorems like Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem.
- Analyse DC Machines; Starters and speed control of DC motors.
- Analyse magnetic circuits.
- Analyse single and three phase AC circuits.
- Analyse the operation of single phase transformers.
- Analyse the operation of three phase induction motors.

Module-I: [12L]

DC Network Theorem: Kirchhoff's law, nodal analysis, mesh analysis, Superposition theorem, Thevenin's theorem, Norton theorem, Maximum power transfer theorem, star-delta conversion.

DC Machines: Construction, EMF equation, Principle of operation of DC generator, open circuit characteristics, external characteristics, Principle of operation of DC motor, Speed-torque characteristics of shunt and series machine, starting of DC motor, speed control of dc motor.

Module-II: [8L]

Electrostatics: Gauss's law and its applications to electric field and potential calculation. Capacitor, capacitance of parallel plate capacitor, spherical capacitor and cylindrical capacitor.

Electromagnetism: Amperes law, Biot-savart's law, Ampere's circuital law and their applications, Magnetic circuits, analogy between magnetic and electric circuits, Faraday's law, self and mutual inductance. Energy stored in a magnetic field, Hysteresis and Eddy current losses.

Module-III: [10L]

AC single phase system: concept of alternating signal, average and RMS values of alternating signal, peak factor, form factor, phase and phase difference, phasor representation of alternating quantities, phasor diagram, AC series , parallel and series parallel circuits, Active power, Reactive power, power factor, Resonance in RLC series and parallel circuit, Q factor, bandwidth.

Three phase system: balanced three phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams. Power measurement by two wattmeter method.

Module-IV: [10L]

Single phase transformer: Construction, EMF equation, no load and on load operation and their phasor diagrams, Equivalent circuit, Regulation, losses of a transformer, open and short circuit tests, efficiency.

3-phase induction motor: Concept of rotating magnetic field, principle of operation, Construction, equivalent circuit and phasor diagram, torque-speed/slip characteristics, Starting of Induction Motor.

Text Books:

1. Basic Electrical engineering, D.P Kothari & I.J Nagrath, TMH, Second Edition
2. Basic Electrical Engineering, V.N Mittle & Arvind Mittal, TMH, Second Edition
3. Basic Electrical Engineering, Hughes
4. Electrical Technology, Vol-I,Vol-II,Surinder Pal Bali, Pearson Publication
5. A Text Book of Electrical Technology, Vol. I & II, B.L. Theraja, A.K. Theraja, S.Chand & Company

Reference Books:

1. Electrical Engineering Fundamentals, Vincent Del Toro, Prentice-Hall
2. Advance Electrical Technology, H.Cotton, Reem Publication
3. Basic Electrical Engineering, R.A. Natarajan, P.R. Babu, Sictech Publishers
4. Basic Electrical Engineering, N.K. Mondal, Dhanpat Rai
5. Basic Electrical Engineering, Nath & Chakraborti
6. Fundamental of Electrical Engineering, Rajendra Prasad, PHI, Edition 2005.

Course Name : ENGINEERING MECHANICS					
Course Code: MECH 1101					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

COURSE OUTCOME:

After going through the course, the students will be able to

CO1: Understand basic concepts of vector algebra as applied to engineering mechanics.

CO2: Analyze free body diagram of a system under equilibrium / non equilibrium along with the consideration of frictional forces.

CO3: Interpret dynamics of members/ links in a mechanism and evaluate inertia force with the help of D' Alembert's principle.

CO4: Know how to evaluate mechanical stability from CG calculations.

CO5: Apply MI values required for engineering design calculations.

CO6: Apply the principles of work - energy and impulse- momentum for analysis of dynamic systems.

Module-I: [10L]

Importance of Mechanics in Engineering ; Definition of Mechanics; Concepts of particles & rigid bodies;

Vector and scalar quantities; Vector algebra –definition and notation; Types of vectors – equal , equivalent , free , bound , sliding ; Addition , subtraction of vectors ; Parallelogram law , triangle law , vector polygon ; Scalar multiplication of vectors ; Resolution of vectors in Cartesian co–ordinate system ; Unit vector, unit co–ordinate vectors ($\hat{i}$, $\hat{j}$, $\hat{k}$) ; Direction cosines ; Addition/ subtraction of vectors in components form.

Definition of force vector ; Dot product , cross product and the application ; Important vector quantities (position vector , displacement vector) ; Moment of a force about a point and about an axis , moment of a couple ; Representation of force and moments in items of $\hat{i}$, $\hat{j}$, $\hat{k}$. Principle of transmissibility of force (sliding vector); Varignon's theorem for a system of concurrent forces with proof; Resolution of a force by its equivalent force-couple system; Resultant of forces.

Module-II: [10L]

Type of forces – collinear, concurrent, parallel, concentrated, distributed; Active and reactive forces, different types of reaction forces; Free body concept and diagram; Concept and equilibrium of forces in two dimensions; Equations of equilibrium; Equilibrium of three concurrent forces -- Lami's theorem.

Concept of friction: Laws of Coulomb's friction; Angle of friction, angle of repose, coefficient of friction -- static and kinematic.

Module-III: [12L]

Distributed force system; Centre of gravity; Centre of mass & centroid; Centroid of an arc; Centroid of plane areas – triangle, circular sector, quadrilateral and composite area consisting of above figures.

Area moment of inertia: Moment of inertia of a plane figure; Polar moment of inertia of a plane figure; Parallel axes theorem.

Concept of simple stress and strain ; Normal stress , shear stress , normal strain, shear strain; Hooke's law; Poisson's ratio; stress- strain diagram of ductile and brittle material; Proportional limit, elastic limit, yield point , ultimate stress, breaking point; Modulus of elasticity.

Module-IV: [16L]

Introduction to dynamics: Kinematics & kinetics; Newton's laws of motion; Law of gravitation and acceleration due to gravity; Rectilinear motion of particles with uniform & non – uniform acceleration.
Plane curvilinear motion of particles: Rectangular components (projectile motion), normal and tangential components.
Kinetics of particles: D'Alembert's principle and free body diagram; Principle of work & energy; Principle of conservation of energy.
Impulse momentum theory: Conservation of linear momentum

References:

1. Engineering Mechanics:- Statics and Dynamics by Meriam & Kreige , Wiley india
2. Engineering Mechanics:- Statics and Dynamics by I.H. Shames, P H I
3. Engineering Mechanics by Timoshenko , Young and Rao , TMH
4. Element of strength of materials by Timoshenko & Young, E W P
5. Fundamentals of Engineering Mechanics by Nag & Chanda – Chhaya Prakashani.

Course Name : CHEMISTRY I LABORATORY					
Course Code: CHEM 1011					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

List of Experiments:

1. To determine the alkalinity in a given water sample.
2. Estimation of iron using $KMnO_4$: self indicator.
3. Estimation of iron using $K_2Cr_2O_7$: redox sensitive indicator.
4. To determine total hardness and amount of calcium and magnesium separately in a given water sample.
5. To determine the value of the rate constant for the hydrolysis of ethyl acetate catalyzed by hydrochloric acid.
6. Heterogeneous equilibrium (determination of partition coefficient of acetic acid between n-butanol and water).
7. Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.
8. pH- metric titration for determination of strength of a given HCl solution against a standard NaOH solution.
9. Iodometric estimation of Cu^{2+}.
10. To determine chloride ion in a given water sample by Argentometric method (using chromate indicator solution)

Course Name : BASIC ELECTRICAL ENGINEERING LABORATORY					
Course Code: ELEC1011					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

The students are expected to

- Get an exposure to common electrical apparatus and their ratings.
- Make electrical connections by wires of appropriate ratings.
- Understand the application of common electrical measuring instruments.
- Understand the basic characteristics of different electrical machines.

List of Experiments:

1. Characteristics of Fluorescent lamps
2. Characteristics of Tungsten and Carbon filament lamps
3. Verification of Thevenin's & Norton's theorem.
4. Verification of Superposition theorem
5. Verification of Maximum Power Transfer theorem
6. Calibration of ammeter and voltmeter.
7. Open circuit and Short circuit test of a single phase Transformer.
8. Study of R-L-C Series / Parallel circuit
9. Starting and reversing of speed of a D.C. shunt Motor
10. Speed control of DC shunt motor.
11. No load characteristics of D.C shunt Generators
12. Measurement of power in a three phase circuit by two wattmeter method.

Course Name : ENGINEERING DRAWING					
Course Code: MECH 1012					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	1	**0**	**3**	**4**	**3**

1. Importance of engineering drawing; Acquaintance with different drafting equipment & accessories;
2. Introduction to lines : Practising different types of lines; Basic concepts in Lettering : Practising vertical & inclined letters (Practice Sheet 1)
3. Different systems of dimensioning with practice.Introduction to the concept of scale of drawing. (Practice Sheet 2)
4. Introduction to concept of orthographic projection: 1st angle and 3rd angle projection method; Symbols; projection of points. (Practice Sheet 3)
5. Projection of straight lines for different orientation including inclined to both the planes. (Practice Sheet 4)
6. Projection of plane surfaces inclined to HP and parallel to VP; Inclined to VP and Parallel to HP (Practice Sheet 5)
7. Projection of solids: Cube, rectangular prism, Hexagonal prism, Cylinder, Pyramid, Cone. (Practice Sheet 6)
8. Section of solids and their projections on principal and auxiliary planes for true shape: Cylinder, hexagonal pyramid. (Practice Sheet 7)
9. Isometric projections: Basic concepts, isometric scale; Isometric projection and view.
10. Practice with simple laminar and solid objects. (Practice Sheet 8)

References:

1. "Elementary Engineering Drawing" by Bhatt, N.D; Charotan Book Stall, Anand
2. "Engineering Graphics" by Narayana, K.L. and Kannaaiah P; TMH
3. "Engineering Graphics" by Lakshminarayanan, V. and Vaish Wanar, R.S, JainBrothers.

Course Name : LANGUAGE PRACTICE LABORATORY (LEVEL 1)					
Course Code: HMTS 1111					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

Course Objectives:

The learner will

1. Acquire the techniques to become an effective listener.
2. Acquire the skill to become an effortless speaker.
3. Organize and present information for specific audience.
4. Communicate to make a positive impact in professional and personal environment.
5. Engage in research and prepare authentic, formal, official documents.
6. Acquire reading skills for specific purpose.

Module I: [3P]

Introduction to Linguistics (Phonology)
Phonetics-Vowel and Consonant Sounds (Identification &articulation)
Word- stress
Intonation (Falling and rising tone)
Voice Modulation
Accent training

Module II: [3P]

Listening Skills
Principles of Listening
Approaches to listening
Guidelines for Effective Listening
Listening Comprehension
Audio Visual (Reviews)

Module III: [2P]

Discourse Analysis-
Spoken Discourse
Conversational Skills/Spoken Skills
Analysing Speech dynamics
(Political Speeches
Formal Business Speeches)

Module IV: [9P]

Writing Skill-
Descriptive, narrative and expository writing

Writing with a purpose---Convincing skill, argumentative skill/negotiating Skill (These skills will be repeated in oral skills).
Writing reports/essays/articles—logical organization of thoughts
Book review

References:

1. Munter, Mary. Guide to Managerial Communication. 5th ed. Upper Saddle River, NJ: Prentice Hall, 1999.
2. Cypres, Linda. Let's Speak Business English. Hauppauge, NY: Barron's Educational Series, 1999. Crystal, David. 1971. Linguistics. Baltimore: Penguin Books.
3. Larsen-Freeman, D. (1986). "Techniques and principles in language teaching." Oxford: Oxford University Press.
4. Littlewood, W. (1981). "Language teaching. An introduction." Cambridge: Cambridge University Press.
5. Savignon, S. J., & Berns, M. S. (Eds.). (1983). "Communicative language teaching: Where are we going? Studies in Language Learning," 4(2). (EDRS No. ED 278 226, 210 pages)

Course Name : EXTRA CURRICULAR ACTIVITIES					
Course Code: HMTS 1121					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

Objective: This course aims at instilling a sense of social responsibility. This objective can be achieved by bringing in awareness about the contemporary issues relevant to the GenX and Gen Y through enlightened discussions and active participation. Since the course has 1 credit detailed planning regarding the area of activities and method of evaluation should be charted at the start of the semester.

Module I:

Project Work

Development of projects based on integral and holistic developmental models to be implemented in rural areas or underdeveloped areas in the peripheral areas of cities. This could include a wide area of activity –
from taking up a research projects to analyse the need of a particular under-developed area to trying to implement a project already formulated. This could also relate to mobilizing funds for a specific project.

Module II:

Action-oriented schemes

e.g.Organising Blood –donation camps
Conducting child –healthcare services
Helping the old and sick
(in coordination with NGOs and other institutes)

Module III:

Society and Youth

Developing Awareness among the youth about social issues both local and global for e.g. Eradication of social evils like drug abuse, violence against women and others.

Module IV:

Youth and Culture

Generating new ideas and help the participants to be creative and innovative for e.g.Enacting street plays, encouraging creative writing by organizing workshops and competitions. Active participation of the students in the nation building process by making positive changes in the social and individual space.

ECE Department B.Tech., 1st Year, 2nd Semester

Course Name : INTRODUCTION TO COMPUTING					
Course Code: CSEN 1201					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Course Outcomes:

CO 1: Understand and remember functions of the different parts of a computer.

CO 2: Understand and remember how a high-level language (C programming language, in this course) works, different stages a program goes through.

CO 3: Understand and remember syntax and semantics of a high-level language (C programming language, in this course).

CO 4: Understand how code can be optimized in high-level languages.

CO 5: Apply high-level language to automate the solution to a problem.

CO 6: Apply high-level language to implement different solutions for the same problem and analyze why one solution is better than the other.

Learning Objective: Introduction to the concept of computer and computation and solving of problems using C as a programming language. Coverage of C will include basic concepts, arithmetic and logic, flow control, and data handling using arrays, structures, pointers and files.

Module I: [13L]

Fundamentals of Computer

History of Computers, Generations of Computers, Classification of Computers.

Basic Anatomy of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices. Assembly language, high level language, compiler and assembler (basic concepts).

Binary & Allied number systems (decimal, octal and hexadecimal) with signed and unsigned numbers (using 1's and 2's complement) - their representation, conversion and arithmetic operations. Packed and unpacked BCD system, ASCII. IEEE-754 floating point representation (half- 16 bit, full- 32 bit, double- 64 bit). Binary Arithmetic & logic gates. Boolean algebra – expression, simplification, Karnaugh Maps.

Basic concepts of operating systems like MS WINDOW, LINUX. How to write algorithms & draw flow charts.

Module II: [5L]

Basic Concepts of C

C Fundamentals:

The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements.

Operators & Expressions:

Arithmetic operators, relational and logical operators, type, conversion, increment and decrement operators, bit wise operators, assignment operators and expressions, precedence and order of evaluation. Standard input and output, formatted output -- printf, formatted input scanf.

Module III: [8L]

Program Structures in C

Flow of Control:

Statement and blocks, if-else, switch-case, loops (while, for, do-while), break and continue, go to and labels.

Basic of functions, function prototypes, functions returning values, functions not returning values. Storage classes - auto, external, static and register variables – comparison between them. Scope, longevity and visibility of variables.

C preprocessor (macro, header files), command line arguments.

Module IV: [14L]

Data Handling in C

Arrays and Pointers:

One dimensional arrays, pointers and functions – call by value and call by reference, array of arrays. Dynamic memory usage– using malloc(), calloc(), free(), realloc(). Array pointer duality.

String and character arrays; C library string functions and their use.

User defined data types and files:

Basic of structures; structures and functions; arrays of structures.

Files – text files only, modes of operation. File related functions – fopen(), fclose(), fscanf(), fprintf(), fgets(), fputs();

Text Books:

1. Schaum's outline of Programming with C – Byron Gottfried
2. Teach Yourself C- Herbert Schildt
3. Programming in ANSI C – E Balagurusamy

Reference Books:

1. C: The Complete Reference – Herbert Schildt
2. The C Programming Language- D.M.Ritchie, B.W. Kernighan

Course Name : PHYSICS 1					
Course Code: PHYS 1001					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Course Outcome:

PHYS 1001.1	Interpret oscillations under different conditions, with the understanding of Resonance phenomena followed by calculation of Q factor
PHYS 1001.2	Analyze the Quantum phenomenon like Black body radiation , Compton effect and origin of X-ray spectrum
PHYS 1001.3	Understand the wave character of light through the phenomenon of interference, diffraction and polarization.
PHYS 1001.4	Study of various crystal structures and classification of different crystal planes.
PHYS 1001.5	Explain the working principle of LASER, and apply the knowledge in different lasing system and their engineering applications in holography
PHYS 1001.6	Understand the dual nature of matter, Heisenberg's uncertainty relation and it's various application.

Module I: [22 L]

Optics

1.Interference :

The principle of superposition of waves, Superposition of waves: Two beam superposition, Multiple-beam superposition, coherent and incoherent superposition. Two source interference pattern (Young's double slit), Intensity distribution. Interference in thin films, wedge shaped films and Newton's rings, applications of interference. Newton's rings: Determination of wavelength of light, refractive index of liquid.

2 Diffraction:

Diffraction of light waves at some simple obstacles. Fraunhoffer diffraction through double slit and diffraction grating, grating spectra, resolving power of grating.

3. Polarisation & Fibre Optics:

Elementary features of polarization of light waves.Production and analysis of linearly, elliptic and Circularly polarized light, polaroids and application of polarizations. fibre optics - principle of operation, numerical aperture, acceptance angle

4 Laser

Characteristics of Lasers, Spontaneous and Stimulated Emission of Radiation, Meta-stable State, Population Inversion, Lasing Action, Einstein's Coefficients and Relation between them, Ruby Laser, Helium-Neon Laser, Semiconductor Diode Laser, Applications of Lasers.

Module II : [8L]

Waves & Oscillation

Superposition of two linear SHMs (with same frequency), Lissajous' figures. Damped vibration – differential equation and its solution, Critical damping, Logarithmic decrement, Analogy with electric circuits. Forced vibration – differential equation and solution, Amplitude and Velocity resonance, Sharpness of resonance and Quality factor. Progressive wave- Wave equation and its differential form, Difference between elastic (mechanical) and electromagnetic waves.

Module III: [9L]

Quantum Mechanics

Need for Quantum physics-Historical overviews, Particle aspects of radiation-Black body radiation, Compton scattering, pair production., Origin of X-ray spectrum. Wave aspect of particles- matter wave, de Broglie Hypothesis, Heisenberg Uncertainty principles- Statement, Interpretation and application.

Module IV: [6L]

Introduction of Crystallography

Space Lattice**,** Unit Cell, Lattice Parameters, Crystal Systems, Bravais Lattices, Miller Indices and its applications, Crystal Planes and Directions, Inter Planar Spacing of Orthogonal Crystal Systems, Atomic Radius, Co-ordination Number and Packing Factor of SC, BCC, FCC. Bragg's law and its applications.

Text Books:

1. Atomic Physics Vol 1 – S.N. Ghoshal
2. Optics – Ajoy Ghak
3. Waves & Oscillation – N.K. Bajaj
4. Quantum Physics of Atoms , Molecules, Solids, Nuclei and particles – Eisberg and Resnick

Reference Books:

1. Introduction to Special Relativity – Robert Resnick
2. Prespective on Modern Physics - Arthur Beiser
3. Optics – Jenkins and White
4. University Press – Sears & Zemansky
5. Introduction to modern Physics – Mani and Meheta
6. Optics – Brijlal and Subrahmanyam

Course Name : MATHEMATICS II					
Course Code: MATH1201					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

COURSE OUTCOME:

After successfully completing this course the students will be able to:

MATH1201. 1. Demonstrate the knowledge of probabilistic approaches to solve wide range of engineering problem.

MATH1201. 2. Recognize probability distribution for discrete and continuous variables to quantify physical and engineering phenomenon.

MATH1201. 3. Develop numerical techniques to obtain approximate solutions to mathematical problems where analytical solutions are not possible to evaluate.

MATH1201. 4. Analyze certain physical problems that can be transformed in terms of graphs and trees and solving problems involving searching, sorting and such other algorithms.

MATH1201. 5. Apply techniques of Laplace Transform and its inverse in various advanced engineering problems.

MATH1201. 6. Interpret differential equations and reduce them to mere algebraic equations using Laplace Transform to solve easily.

Module I: [10 L]

Ordinary differential equations (ODE)-

First order and first degree: Exact equations, Necessary and sufficient condition of exactness of a first order and first degree ODE (statement only), Rules for finding Integrating factors, Linear and non-linear differential equation, Bernoulli's equation. General solution of ODE of first order and higher degree (different forms with special reference to Clairaut's equation).

Second order and first degree:

General linear ODE of order two with constant coefficients, C.F. & P.I., D-operator methods for finding P.I., Method of variation of parameters, Cauchy-Euler equations.

Module II: [10L]

Basics of Graph Theory

Graphs, Digraphs, Weighted graph, Connected and disconnected graphs,Complement of a graph, Regular graph, Complete graph, Subgraph,; Walks, Paths, Circuits, Euler Graph,Cut sets and cut vertices, Matrix representation of a graph, Adjacency and incidence matrices of a graph,Graph isomorphism, Bipartite graph.

Tree:

Definition and properties, Binary tree, Spanning tree of a graph, Minimal spanning tree, properties of trees, Algorithms: Dijkstra's Algorithm for shortest path problem, Determination of minimal spanning tree using DFS, BFS, Kruskal's and Prim's algorithms.

Module III: [10L]

Improper Integral:

Basic ideas of improper integrals, working knowledge of Beta and Gamma functions (convergence to be assumed) and their interrelations.

Laplace Transform:

Introduction to integral transformation, functions of exponential order, Definition and existence of LT (statement of initial and final value theorem only), LT of elementary functions, Properties of Laplace Transformations , Evaluation of sine , cosine and exponential integrals using LT, LT of periodic and step functions Definition and properties of inverse LT Convolution Theorem (statement only) and its application to the evaluation of inverse LT, Solution of linear ODEs with constant coefficients (initial value problem) using LT.

Module IV: [10L]

Three Dimensional Geometry

Equation of a plane. General form. Transformation to the normal form. Intercepts. Equation of the plane through three given points. Equation of a plane passing through the intersection of two planes. Angle between two intersecting planes. Bisectors of angles between two intersecting planes. Parallelism and perpendicularity of two planes.

Canonical equation of the line of intersection of two intersecting planes. Angle between two lines. Shortest distance between two lines. Condition of coplanarity of two lines. Length of the perpendicular from a point to a given line.

References:

1. Advanced Engineering Mathematics, Erwin Kreyszig, (Wiley Eastern)
2. Graph Theory: V. K. Balakrishnan, (Schaum's Outline, TMH)
3. A first course at Graph Theory: J. Clark and D. A. Holton (Allied Publishers LTD)
4. Introduction to Graph Theory: D. B. West (Prentice-Hall of India)
5. Graph Theory: N. Deo (Prentice-Hall of India)
6. Engineering Mathematics: B.S. Grewal (S. Chand & Co.)
7. Higher Engineering Mathematics: John Bird (4th Edition, 1st Indian Reprint 2006, Elsevier)
8. Calculus: Strauss, Bradley and Smith (3PrdP edition, Pearson Education)
9. Engineering Mathematics (Volume 2): S. S. Sastry (Prentice-Hall of India)
10. Introductory Course in Differential Equations: Daniel A. Murray (Longmans & Green).
11. Co-ordinate Geometry – S. L. Loney.
12. Analytical Geometry And Vector Algebra- R M Khan

Course Name : BASIC ELECTRONICS ENGINEERING					
Course Code: ECEN1001					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Course outcomes:

1. Categorize different semiconductor materials based on their energy bands and analyze the characteristics of those materials for different doping concentrations based on previous knowledge on semiconductors acquired.
2. Describe energy band of P-N Junction devices and solve problems related to P-N Junction Diode both from device and circuit perspectives.
3. Design different application specific circuits associated with diodes operating both in forward and reverse bias.
4. Analyze various biasing configurations of Bipolar Junction Transistor and categorize different biasing circuits based on stability.
5. Categorize different field-effect transistors based on their constructions, physics and working principles and solve problems associated with analog circuits based on operational amplifiers.
6. Design and implement various practical purpose electronic circuits and systems meant for both special purpose and general purpose and analyze their performance depending on the type of required output and subsequently the applied input.

Module I: [10 L]

Semiconductors:
Crystalline material, Energy band theory, Fermi levels; Conductors, Semiconductors and Insulators: electrical properties, band diagrams. Semiconductors: intrinsic and extrinsic, energy band diagram, electrical conduction phenomenon, P-type and N-type semiconductors, drift and diffusion carriers.

Diodes and Diode Circuits:
Formation of P-N junction, energy band diagram, built-in-potential forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics, Zener Diode and its Application, Zener and Avalanche breakdown.
Simple diode circuits, load line, piecewise linear model; Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency, idea of regulation.

Module II: [10 L]

Bipolar Junction Transistors:
Formation of PNP / NPN junctions, energy band diagram; transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off, active and saturation modes of operation, transistor action, input & output characteristics, load line & amplifier operation and current amplification factors for CB and CE modes. Biasing and Bias stability: calculation of stability factor.

Module III: [9 L]

Field Effect Transistors:
Junction field effect transistor (JEET): Principle of operation, JFET parameters, eqv. Circuit, JFET biasing, self bias, design of bias circuits, load line, amplifier characteristics.

MOSFETs:
Construction & principle of operation of p- & n-channel enhancement & depletion mode MOSFETs, drain & transfer characteristics, threshold voltage & its control.

Cathode Ray Osilloscope:
Construction and working principle of CRO, Lissajous pattern.

Module IV: [9 L]

Feed Back Amplifier:
Concept-block diagram, properties, positive and negative feedback, loop gain, open loop gain, feedback factors; topologies of feedback amplifier; effect of feedback on gain, condition of oscillation, Barkhausen criteria.

Operational Amplifier:
Introduction to integrated circuits, operational amplifier and its terminal properties; Application of operational amplifier; Concept of op-amp saturation, inverting and non-inverting mode of operation, Adders, Subtractors, Voltage follower, Integrator, Differentiator, Basic Comparator Circuit.

References:

1. Boylestad & Nashelsky:Electronic Devices & Circuit Theory
2. R.A Gayakwad:Op Amps and Linear IC's, PHI
3. D. Chattopadhyay, P. C Rakshit : Electronics Fundamentals and Applications
4. Adel S. Sedra, Kenneth Carless Smith: Microelectronics Engineering
5. Millman & Halkias: Integrated Electronics.
6. Salivahanan: Electronics Devices & Circuits.
7. Albert Paul Malvino: Electronic Principle.

Course Name : ENGINEERING THERMODYNAMICS & FLUID MECHANICS					
Course Code: MECH1201					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

COURSE OUTCOME:

After going through the course, the students will be able

- To analyze a thermodynamic system and calculate work transfer in various quasi-static processes.
- To understand and apply the first law and 2nd law of thermodynamics.
- To analyze thermal efficiency of Otto, Diesel cycles.
- To understand physical properties of fluids
- To apply mass, momentum and energy conservation principles to incompressible fluid flow.
- To describe fluid flow and analyze acceleration of fluid particles.

Module I: [10 L]

Basic concepts of Thermodynamics:
Introduction; Macroscopic and microscopic concept; Definition of Thermodynamic systems; Surrounding, universe; Open, closed and isolated systems; Concept of control volume; Thermodynamic properties: intensive, extensive & specific properties; state.

Thermodynamic equilibrium; Change of state; Thermodynamic processes and cycles; Quasi-static processes; Reversible processes; Zeroth law of Thermodynamics -concept of temperature.

Heat & Work:
Definition of Thermodynamic work; Work transfer-displacement work for a simple compressible system, path function, PdV work in various quasi-static processes(isothermal, isobaric, adiabatic, polytropic, isochoric); Free expansion; Indicated diagram (P-V diagram)
.
Definition of heat; Heat transfer-a path function; Similarities and dissimilarities between heat and work.

Module II: [8 L]

First law of Thermodynamics:
Statement; 1st law for a closed system executing a cycle; Concept of stored energy; Energy as a property, different forms of stored energy, internal energy, first law for a non-flow process; Flow work; Definition of enthalpy, C_p, C_v; Energy of an isolated system; Flow energy; First law for an open system - steady flow energy equation; Examples of steady flow devices(nozzle and diffuser, turbine, pump, compressor, boiler, condenser and throttling device); PMM-I

Module III: [10 L]

Second law of Thermodynamics:
Qualitative difference between heat and work; Definition of source & sink: cyclic heat engine, heat pump and refrigerator, thermal efficiency of heat engine, C.O.P of heat pump and refrigerator; Kelvin-Plank and Clausius statements of second law; Equivalence of the two statements.

Reversible process; Irreversible process; Factors for irreversibility; Carnot cycle and Carnot efficiency; Reversible heat engine and heat pump; PMM-ll

Entropy: Mathematical statement of Clausius Inequality: Entropy as a property; Entropy principle; T-s plot for reversible isothermal, adiabatic, isochoric & isobaric processes.

Air standard Cycles:
Otto cycle & Diesel cycle, P-V & T-s plots, Net work done and thermal efficiency.

Module IV: [10 L]

Properties & Classification of Fluid:
Definition of fluid; Concept of Continuum; Fluid properties- density, specific weight, specific volume, specific gravity; Viscosity : definition , causes of viscosity , Newton's law of viscosity, dimensional formula and units of viscosity, kinematic viscosity; Variation of viscosity with temperature. Ideal and Real fluids; Newtonian and Non-Newtonian fluids; No-slip condition.
Compressibility and Bulk modulus of elasticity.
Difference between compressible and incompressible fluids.

Fluid Statics:
Introduction; Pascal's Law--statement and proof; Basic Hydrostatic Law and its proof; Variation of pressure with depth in incompressible fluid, piezometric head, pressure head; Unit and scales of pressure measurement.
Measurement of fluid pressure: Piezometer, Manometers -Simple and Differential U-tube manometer, Inverted tube manometer, Inclined tube manometer.
Characteristics and choice of manometric fluid.

Module V: [10 L]

Fluid Kinematics:
Definition; Flow field and description of fluid motion(Eulerian & Lagrangian method), steady and unsteady flow, uniform and non-uniform flow-examples.
Acceleration of a fluid particle-local acceleration, convective acceleration. Stream line, Stream tube, Path line and Streak line; Laminar and Turbulent flow, Reynolds Number. Equations of streamlines and path lines.
Continuity equation for unidirectional flow and for differential form in 3-D Cartesian coordinate system.

Dynamics of Ideal fluids:
Introduction, Euler's equation of motion along a streamline; Bernoulli's equation-

assumptions and significance of each term of Bernoulli's equation.
Application of Bernoulli's equation-problem on pipe line. Measurement of flow rate: Venturimeter and orificemeter .
Static pressure, Dynamic pressure, Stagnation pressure-measurement of velocity by Pitot tube.

References:

1. Engineering Thermodynamics- Nag, P.K. - T. M.H
2. Fundamentals of Thermodynamics- Sonntag, Borgnakke & Van Wylen, Wiley India
3. Thermodynamics- an Engineering approach - 6e, Cengel & Boles, TM
4. Fluid Mechanics & Hydraulic Machines – R.K. Bansal, Laxmi Publications Ltd, India
5. Introduction to Fluid Mechanics and Fluid Machines- S.K. Som, G. Biswas, & S. Chakraborty , T.M.H
6. Fluid Mechanics – A.K. Jain, Khanna Publishers.

Course Name : INTRODUCTION TO COMPUTING LABORATORY					
Course Code: CSEN1211					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Basic Computation & Principles of Computer Programming Laboratory

Softwares to be used: Cygwin and notepad++, Tiny C

Day 1: LINUX commands and LINUX based editor
Day 2: Basic Problem Solving
Day 3: Control Statements (if, if-else, if-elseif-else, switch-case)
Day 4: Loops - Part I (for, while, do-while)
Day 5: Loops - Part II
Day 6: One Dimensional Array
Day 7: Array of Arrays
Day 8: Character Arrays/ Strings
Day 9: Basics of C Functions
Day 10: Recursive Functions
Day 11: Pointers
Day 12: Structures and Unions
Day 13: File Handling

Course Name : PHYSICS I LABORATORY					
Course Code: PHYS 1011					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

List of Experiments:

1. Determination of Young's modulus by Flexure Method and calculation of bending moment and shear force at a point on the beam.
2. Determination of modulus of rigidity by Static/Dynamic Method.
3. Determination of thermal conductivity of a good conductor by Searle's Method.
4. Determination of thermal conductivity of a bad conductor by Lee's and Chorlton's Method.
5. Determination of dielectric constant of a given dielectric material.
6. Use of Carey Foster's bridge to determine unknown resistance.
7. Determination of wavelength of light by Newton's ring method.
8. Determination of wavelength of light by Fresnel's biprism method.
9. Determination of wavelength of light by Laser diffraction method.
10. Determination of dispersive power of the material of a given prism.
11. Determination of co-efficient of viscosity of a liquid by Poiseulle's capillary flow method.

Course Name : BASIC ELECTRONICS ENGINEERING LABORATORY					
Course Code: ECEN1011					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

List of Experiments:

1. Familiarisation with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multimeters etc.
2. Familiarisation with measuring and testing equipment like CRO, Signal generators etc.
3. Study of I-V characteristics of Junction diodes.
4. Study of I-V characteristics of Zener diodes.
5. Study of Half and Full wave rectifiers with Regulation and Ripple factors.
6. Study of I-V characteristics of BJTs in CB mode
7. Study of I-V characteristics of BJTs in CE mode
8. Study of I-V characteristics of Field Effect Transistors.
9. Determination of input-offset voltage, input bias current and Slew rate of OPAMPs.
10. Determination of Common-mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
11. Study of OPAMP circuits: Inverting and Non-inverting amplifiers, Adders, Integrators and Differentiators.

Course Name : WORKSHOP PRACTICE					
Course Code: MECH1011					
Contact hrs per week:	L	T	P	Total	Credit points
	1	0	3	4	3

Job 1: General awareness of a typical workshop.

Theory requirements: Workshop definition, various shops in a typical workshop, Carpentry, Fitting, Foundry; Sheet Metal Shop, Welding and Brazing Shop, Machine Shop , Forging & Blacksmithy, Safety precautions to be followed in a workshop, Familiarization of Various safety devices and their uses.

Job 2: Making of a wooden pattern.

Theory requirements: Market forms of converted Timber ,eg, log, balk, plank,batten, beam ,Types of Wood, Hard Wood, Soft Wood, particle board; Seasoning of wood, Natural seasoning, Artificial seasoning, Carpentry Tools-Marking Tools, Cutting Tools, Planing Tools, Boring Tools, Striking Tools , Holding & Misc. Tools, Carpentry Processes (marking, sawing, planning, chiselling, boring, grooving, joining etc.), Safety precautions in Carpentry Shop.

Job 3: Making of a matched profile form MS plate.

Theory requirements: Work Bench, Fitting Tools (Bench Vice,Chisel,Hammer,Different types of Files, (Rough,Bastard, Second Cut, Half Round, Triangular File),Saw(Hack saw etc.), Scriber, Punch, Try Square, Angle Plate, caliper (outside & inside), Universal Surface Gauge, Centre Punch, Prick Punch, Drill (Flat,straight fluted, taper shank twist drill).

Fitting Operations,Filing, Marking, Drilling, Tapping (Rougher,Intermediate, Finisher taps), Tap Drill size (D=T-2d), Sawing, Dieing . Safety precautions in Fitting Shop.

Job 4: Making of an internal and external thread.

Theory requirements : Thread standards and thread classifications, Internal Thread,External Thread, Thread Nomenclature (Major dia, Minor dia, Pitch dia, pitch, Lead, TPI, Metric, BSP , Nominal size), Specifications of threaded fasteners (in Metric System). Safety precautions in Dieing and Tapping.

Job 5: Making of a green sand mould using the pattern made under Job no. 2.

Theory requirements: Mould making, Preparation of sand, (silica, clay, moisture, and misc items and their functions), Properties of a good sand mould, General procedure for making a good sand mould, Different tools used for preparation of a mould, Explanation of various terms , Cope and Drag Box, Runner, Riser, Gating and its utility, Parting sand, Vent holes.

Job 6: Demonstration of metal melting and casting

Theory requirements: Metal melting furnaces: Ladles, Using of Tongs, Molten metal pouring procedure, Safety precautions in pouring molten metal in a mould.

Job 7. Making of a stepped pin in a centre lathe. (2 Classes)

Theory requirements: Machining and common machining operations , Lathe M/c and its specifications, Head stock, Tailstock, Chuck-Self centering chuck , 4 jaw chuck, Bed, Carriage, Feed mechanism, Screw cutting mechanism, various lathe operations like turning, facing, grooving, chamfering, taper turning ,Thread cutting, Knurling, Parting, Cutting speed, Feed, Depth of cut , Different types of cutting tools-Safety precautions in a machine shop.

Job 8: Making of square prism from a round shaft by Shaping Machine

Theory requirements: Description of a Shaping machine, Base , Column, Saddle, Clapper box, Quick return mechanism, Feed Mechanism, Table, Rotation of table, Adjustment of stroke length, Adjustment of starting point of cut. Safety Precautions while working in Shaping Machine.

Job 9: Making of square prism from a round shaft by Milling Machine

Theory requirements: Description of a milling machine, Specification of a Milling machine, Types of Milling-Up Milling, Down Milling, Vertical Milling Machine, Horizontal Milling Machine , Safety precautions while working in Milling Machine.

Job 10 : Arc Welding practice and making of a welded joint

Theory requirements: Welding, Weldability, Types of Welding, MMAW, Gas Welding, Electrode , Functions of Flux, Equipment for MMAW, Different types of Flames in Gas Welding and Gas Cutting (Neutral-Oxidising-Reducing Flames), Different types of welding joints, AC Welding , DC Welding; Safety precautions in Welding Shop.

Job 11 : Sheet Metal forming & Brazing

Theory requirement: Specification of sheet metal, SWG vs. mm, HR sheet, CR sheet, GI Sheet, Stainless Steel Sheet, Aluminum sheets, Tin Plates, Sheet metal working Tools, Micrometer, Chisels, Punches, Hammers, Mallets, Hand Shear or Snippets, Various sheet metal forming operations, Shearing, Marking, Punching, Drilling, Bending, Drawing, Brazing, Safety precautions in Sheet Metal Working Shop.

References:

1. Elements of Workshop Technology (Vol- I and II)- Hajra Choudhury, Media Promoter &Publishers Privet Limited.

2. Workshop Technology (Vol- I and II) – Chapman , Viva Books Privet Limited.

ECE Department B.Tech., 2nd Year 1st Semester

Course Name : HUMAN VALUES AND PROFESSIONAL ETHICS					
Course Code : HMTS-2001					
Contact Hours per week	L	T	P	Total	Credit Points
	2	0	0	2	2

COURSE OUTCOME:

The student will

i) be aware of the value system and the importance of following such values at workplace

ii) learn to apply ethical theories in the decision making process

iii) follow the ethical code of conduct as formulated by institutions and organizations

iv) Implement the principles governing work ethics

v) Develop strategies to implement the principles of sustainable model of development

vi) Implement ecological ethics wherever relevant and also develop eco-friendly technology

Module I:

Human society and the Value System
Values: Definition, Importance and application.
Formation of Values: The process of Socialization
Self and the integrated personality
Morality, courage, integrity
Types of Values:
Social Values: Justice, Rule of Law, Democracy, Indian Constitution, Secularism
Aesthetic Values: Perception and appreciation of beauty
Organizational Values: Employee: Employer--- rights, relationships, obligations
Psychological Values: Integrated personality and mental health
Spiritual Values &their role in our everyday life
Value Spectrum for a Good Life, meaning of Good Life
Value Crisis in Contemporary Society
Value crisis at----
Individual Level
Societal Level
Cultural Level
Value Crisis management --- Strategies and Case Studies

Module II:

Ethics and Ethical Values
Principles and theories of ethics
Consequential and non-consequential ethics
Egotism,Utilatirianism, Kant's theory and other non-consequential perspectives
Ethics of care, justice and fairness, rights and duties
Ethics-- Standardization
Codification
Acceptance
Application
Types of Ethics---Ethics of rights and Duties
Ethics of Responsibility
Ethics and Moral judgment
Ethics of care
Ethics of justice and fairness
Work ethics and quality of life at work
Professional Ethics
Ethics in Engineering Profession;
moral issues and dilemmas, moral autonomy(types of inquiry)
Kohlberg's theory, Giligan's theory(consensus and controversy)
Code of Professional Ethics Sample Code of ethics like ASME, ASCE. IEEE,Institute of Engineers,Indian Institute of materials management, Institute of Electronics and telecommunication engineers
Violation of Code of Ethics---conflict, causes and consequences
Engineering as social experimentation, engineers as responsible experimenters (computer ethics, weapons development)
Engineers as managers, consulting engineers, engineers as experts, witnesses and advisors, moral leadership
Conflict between business demands and professional ideals
social and ethical responsibilities of technologies.
Whistle Blowing: Facts, contexts, justifications and case studies
Ethics and Industrial Law
Institutionalizing Ethics: Relevance, Application, Digression and Consequences

Module III:
Science, Technology and Engineering
Science, Technology and Engineering as knowledge and profession
----Definition, Nature, Social Function and Practical application of science
Rapid Industrial Growth and its Consequences
Renewable and Non- renewable Resources: Definition and varieties
Energy Crisis
Industry and Industrialization
Man and Machine interaction
Impact of assembly line and automation
Technology assessment and Impact analysis
Industrial hazards and safety
Safety regulations and safety engineering
Safety responsibilities and rights
Safety and risk, risk benefit analysis and reducing risk
Technology Transfer: Definition and Types
The Indian Context

Module IV:

Environment and Eco- friendly Technology
Human Development and Environment
Ecological Ethics/Environment ethics
Depletion of Natural Resources: Environmental degradation
Pollution and Pollution Control
Eco-friendly Technology: Implementation, impact and assessment

Sustainable Development: Definition and Concept
Strategies for sustainable development
Sustainable Development--- The Modern Trends
Appropriate technology movement by Schumacher and later development
Reports of Club of Rome.

References:

1. Tripathi,A.N., Human Values, New Age International, New Delhi,2006.
2. Ritzer, G., Classical Sociological Theory, The McGraw Hill Companies, New York,1996.
3. Doshi,S.L., Postmodern Perspectives on Indian Society, Rawat Publications, New Delhi,2008.
4. Bhatnagar, D.K., Sustainable Development, Cyber Tech Publications, New Delhi, 2008.
5. Kurzwell,R., The age of Spiritual Machines, Penguin Books, New Delhi,1999.
6. Weinberg, S.K., Social Problems in Modern Urban Society, Prentice Hall,Inc.,USA, 1970.
7. Giddens, Anthony 2009. Sociology. London: Polity Press (reprint 13th Edition).

Course Name : MATHEMATICAL METHODS					
Course Code : MATH 2001					
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

COURSE OUTCOME:

After successfully completing this course the students will be able to:

MATH2001.1 Construct appropriate mathematical models of physical systems.

MATH2001.2 Recognize the concepts of complex integration, Poles and Residuals in the stability analysis of engineering problems.

MATH2001.3 Generate the complex exponential Fourier series of a function and make out how the complex Fourier coefficients are related to the Fourier cosine and sine coefficients.

MATH2001.4 Interpret the nature of a physical phenomena when the domain is shifted by Fourier Transform e.g. continuous time signals and systems.

MATH2001.5 Develop computational understanding of second order differential equations with analytic coefficients along with Bessel and Legendre differential equations with their corresponding recurrence relations.

MATH2001.6 Master how partial differentials equations can serve as models for physical processes such as vibrations, heat transfer etc.

Module I : Functions of Complex Variables (12L)

Complex numbers and its geometrical representation .
Functions of a complex variable – Limits, Continuity , Differentiability .
Analytic Functions , Cauchy- Riemann equations , Necessary and sufficient conditions for analyticity of complex functions(Statement only) , Harmonic functions.
Line Integral on complex plane , Cauchy-Goursat theorem , Cauchy's Integral Formula.
Taylor's and Laurent's series expansion .
Zeros, Different types of Singularities. Definitions of poles and residues , Residue Theorem , Evaluation of real integrals using residue theorem.

Module II: Fourier Series , Integrals and Transforms (12L)

Definite Integral , Orthogonality of Trigonometric Functions , Power Series and its convergence .
Periodic Functions , Even and Odd Functions , Dirichlet's Conditions , Euler Formulas for Fourier coefficients , Fourier series representation of a function, e.g. Periodic square wave, Half wave rectifier, Unit step function.
Half Range series , Parseval's Identity.
Fourier Integral theorem , Fourier transform , Fourier sine and cosine transform, Linearity, Scaling , Frequency Shifting and Time shifting properties, Convolution Theorem.
Discussion of some physical problems : e.g Forced oscillations.

Module III : Series solutions to Ordinary Differential equations and Special Functions (12L)

Series solution of ODE: Ordinary point , Singular point and Regular Singular point, series solution when $x = a$ is an ordinary point, Frobenius method.

Legendre's Equation , Legendre's polynomials and its graphical representation.

Bessel's equation , Bessel's function of first kind and its graphical representation.

Finite Difference Method and its application to Boundary Value Problem.

Module IV: Partial Differential Equations (12L)

Introduction to partial differential equations, Formation of partial differential equations, Linear and Nonlinear pde of first order, Lagrange's and Charpit's method of solution .

Second order partial differential equations with constant coefficients , Illustration of wave equation, one dimensional heat equation, Laplace's equation, Boundary value problems and their solution by the method of separation of variables.

Solution of Boundary value problems by Laplace and Fourier transforms.

References:

1. Complex Variables and Applications, Brown Churchill, MC Graw Hill
2. Complex Variable, Murrey R. Spiegel, Schaum's Outline Series
3. Theory of Functions of a Complex Variable, Shanti Narayan, P. K. Mittal S. Chand
4. Larry C. Andrew, B. K. Shivamoggi, Integral Transforms for Engineers and Applied Mathematicians, Macmillan
5. Fourier Analysis with Boundary Value Problem, Murrey R. Spiegel, Schaum's Outline Series
6. Mathematical Methods, Potter, Merle C., Goldberg, Jack. PHI Learning
7. Ordinary and Partial Differential Equations, M. D. Raisinghania, S. Chand
8. Elements of Partial Differential Equation, Ian Naismith Sneddon, Dover Publications
9. Advanced Engineering Mathematics, Kreyszig, Willey
10. Higher Engineering Mathematics, B. V. Ramana, Tata McGraw-Hill

Course Name : NUMERICAL AND STATISTICAL METHODS					
Course Code : MATH2002					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:
After completing the course students will be able to

1. Apply numerical methods to obtain approximate solutions to mathematical problems where analytic solutions are not possible.
2. Develop algorithmic solutions for problems like system of linear equations, integration, ordinary differential equations which are pertinent to many physical and engineering problems.
3. Apply probabilistic methods to engineering problems where deterministic solutions are not possible. Analyze probability distributions required to quantify phenomenon whose true value is uncertain.
4. Find numerical solutions to algebraic and transcendental equations appearing in a vast range of engineering problems e.g in the study of Ideal and non ideal gas laws, pipe friction , design of electric circuits.
5. Apply numerical methods to find solutions to linear system of equations appearing in spring-mass systems , resistor circuits, steady state analysis of a system of reactors.
6. Solve problems in data analysis , least-cast treatment of wastewater where the knowledge of interpolation will be required. Compute numerical solution to integrals to find root mean square current.

MODULE-I : NUMERICAL SOLUTION TO LINEAR AND NON-LINEAR EQUATIONS (8L)

SOLUTION OF NON-LINEAR ALGEBRAIC EQUATIONS AND TRANSCENDENTAL EQUATIONS:

Bisection Method, Newton-Raphson Method, Regula-Falsi Method.

SOLUTION OF LINEAR SYSTEM OF EQUATIONS:

Gauss elimination method, Gauss-Seidel Method, LU Factorization Method.

MODULE-II : NUMERICAL SOLUTION TO INTEGRATION AND ORDINARY DIFFERENTIAL EQUATIONS (8L)

INTERPOLATION AND INTEGRATION:

Newton's Forward and Backward Interpolation Method, Lagrange's Interpolation, Trapezoidal and Simpson's $1/3^{rd}$ Rule.

SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS:

Euler's and Modified Euler's Method , Runge-Kutta Method of 4^{th} order.

MODULE-III : FUNDAMENTALS OF PROBABILITY (5L)

Prerequisites- Set Theory.
Random experiment, Sample space , Events .
Definition of Probability ,
Addition law of probability, Multiplication law and Conditional Probability.
Bayes' Theorem (Statement only)

MODULE-IV : PROBABILITY DISTRIBUTIONS AND STATISTICS (15L)

Random Variables – Discrete and Continuous, Probability Mass Function, Probability Density and Cumulative Distribution Functions, Mathematical Expectation and Variance.
Special Distributions: Binomial, Poisson, Uniform, Exponential and Normal.
Measures of Central Tendency and Dispersion – Mean, Median, Mode and Standard Deviation for grouped and ungrouped frequency distribution.
Simple Correlation and Regression.

References:

1. Miller & Freund's Probability and Statistics for Engineers, R.A.Johnson, Prentice Hall of India
2. Numerical Mathematical Analysis, J.B.Scarborough, Oxford and IBH Publishing Co. Pvt. Ltd.
3. Numerical Methods (Problems and Solution), Jain, Iyengar , & Jain New Age International Publishers
4. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons
5. A First course in Probability, Sheldon Ross, Pearson

Course Name : NUMERICAL AND STATISTICAL METHODS LAB					
Course Code : MATH2012					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

Course outcome:
After completing the course the student will be able to:

1. Reproduce customized programs to solve problems based on Numerical Methods.
2. Develop algorithms to handle large systems of equations appearing in physical and engineering problems.

Development of computer programs in C for the following problems:

1. Regula-Falsi Method
2. Newton-Raphson Method
3. Gauss-elimination Method
4. Gauss-Seidel Method
5. Newton's Forward Interpolation
6. Lagrange's Interpolation
7. Trapezoidal and Simpson's $1/3^{rd}$ rule
8. Euler's and Modified Euler's Method
9. Runge-Kutta method of 4^{th} order
10. Computation of Mean , Median , Mode and Standard Deviation for grouped and ungrouped frequency distribution
11. Computation of Correlation coefficient and Regression equation for Bivariate data.

Course Name : ANALOG ELECTRONIC CIRCUITS					
Course Code : ECEN2101					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:
After completing the course the student will be able to:

1. Apply the previous knowledge gathered from Basic Electrical and Basic Electronics papers.
2. Understand the concepts of BJT and biasing techniques of BJT based amplifier circuits.
3. Analyze frequency response of amplifier circuits.
4. Design different type's sinusoidal oscillators and multivibrator circuits.
5. Construct algebraic equations based amplifier and analog computers using OP-AMP.
6. Design different types of Power Amplifier Circuits.

MODULE 1: Analog Signals and Devices

Introduction to Analog Signal [1L]:
Basic concepts on analog, discrete and digital signals, simple signal processing circuits (clippers, clampers)

Bipolar Junction Transistors (BJT)[2L]:
DC operating point, BJT characteristics & parameters, emitter bias with and without emitter resistance, operating point (Q point) and its stability.

Small Signal BJT Amplifiers[6L]:
AC equivalent circuit; Hybrid and re model.Applications of AC equivalent circuits in amplifier design; input impedance, output impedance,voltage gain, current gain for CE, CB and CC configurations.

MODULE 2: Amplifiers and Oscillators

Feedback & Oscillator Circuits [6L]:
Concept of feedback. Analysis of practical feedback amplifiers; Input and output impedance of different topologies, Sinusoidal Oscillators; Phase-shift, Wien-Bridge, Hartley, colpitt and crystal Oscillators.

Frequency Responses and Multistage Amplifiers [6L]:
Frequency response of CE, RC-coupled amplifiers; effect of external, parasitic and wiring capacitors on cut-off frequencies, Miller capacitance, effect of frequency dependent h_{fe}, Giacoletto (hybrid π) model of BJT, gain band-width product, unity-gain frequency

MODULE 3: Operational Amplifiers (OPAMPs)

Fundamentals of OPAMP [4L]:
Basic building blocks of OPAMP. Current source and current mirror circuits. Types of differential amplifier, AC and DC analysis of differential amplifiers; dual-input, balanced-output and dual-input, unbalanced-output. Frequency response of OPAMP.

Applications of OPAMP [6L]:
Log-antilog amplifier, realization of basic algebraic equations using OPAMPs, designing of analog computers. Instrumentation amplifier. Precision rectifier.

MODULE 4: Analog Circuit Design and Applications

Power Amplifiers [3L]:
Class A; Calculation of DC power, AC power and efficiency of RC-coupled and transformer coupled class A amplifiers. , Class B amplifiers; Calculation of DC power, AC power and efficiency, push-pull configurations. Class AB; concept and cross-over distortion, Class C amplifier.

Applications Analog IC [2L]:
555 Timer IC; Astable, Mono-stable operations

Text Books:

1. Adel S. Sedra & Kenneth Carless Smith, Microelectronic Circuits, Oxford University Press
2. Robert L. Boylestad, Electronic Devices and Circuit Theory, Prentice Hall
3. Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, Prentice Hall of India Private Limited

Reference:

1. Behzad Razavi, Fundamentals of Microelectornics, Wiley India Pvt Ltd
2. Millman & Halkias, Integrated Electronics, Tata McGraw-Hill Education
3. Salivahanan, Linear Integrated Circuits, Tata McGraw-Hill Education
4. D. Roy Choudhury, Linear Integrated Circuits, New Age International
5. Anant Agarwal & Jeffrey H. Lang, Foundations of Analog and Digital Electronic Circuits, Elsevier

Course Name : ANALOG ELECTRONIC CIRCUITS LABORATORY					
Course Code : ECEN2111					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

COURSE OUTCOME:

After completing the following experiments, students will be able to:

1. Identify the various circuit arrangements pertaining to this lab
2. Understand the functioning of equipments like Function Generators.
3. List the components required for conducting the experiments
4. Design various analog circuits and study their outputs.

List of Experiments:

1. Design and study of clipper and clamper circuits using diodes
2. Design a RC-coupled CE amplifier and study its frequency response, input impedance, output impedance.
3. Design an astable multivibrator using 555 Timer IC
4. Design a mono-stable multivibrator using Timer IC
5. Precision rectifier; full wave, half wave
6. Design a RC phase shift oscillator
7. Design Wien-Bridge oscillator
8. Triangular wave form generator
9. Square wave generator
10. Schmitt trigger oscillator

Course Name : DATA STRUCTURE & ALGORITHM					
Course Code : ECEN2102					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcome:
After completing the course the student will be able to:

1. Apply the previous knowledge gathered from the courses on programming language and discrete mathematical structures.
2. Solve problems related to linear data structures, algorithms and time complexities.
3. Understand the concepts of stack, queue and recursion and apply them for problem solving.
4. Design advanced data structures using non-linear data structures applying the knowledge and concepts of trees and graphs.
5. Evaluate operations like searching, sorting, hashing, traversing and collision resolution techniques.
6. Construct solutions to real life scenarios and explore the wide range of applications.

Module –I: [8L] Linear Data StructureI

Introduction (2L):
Why we need data structure?
Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type.
Algorithms and programs, Basic idea of pseudo-code.Algorithm efficiency and analysis, time and space analysis of algorithms – order notations.

Array (2L):
Different representations – row major, column major. Sparse matrix - its implementation and usage.

Linked List (4L):
Singly linked list, circular linked list, doubly linked list.

Module -II: [7L] Linear Data Structure II

Stack and Queue (5L):
Stack and its implementations (using array, using linked list), applications.
Queue, circular queue, deque. Implementation of queue- both linear and circular (using array, using linked list), applications. Basic concept of deque.

Recursion (2L):
Principles of recursion – use of stack, differences between recursion and iteration, tail recursion.

Module –III: [11L] Nonlinear Data structures

Trees (7L):
Basic terminologies, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), Binary search tree- operations (creation, insertion, deletion, searching). Height balanced binary tree – AVL tree (only basic concept, insertion, deletion with examples only).

Graphs (4L):
Graph representations/storage implementations – adjacency matrix, adjacency list,
Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS)

Module – IV: [10L] Searching, Sorting,Hashing:

Sorting Algorithms (6L):
Bubble sort, insertion sort, selection sort, merge sort, quicksort, heap sort, radix sort.

Searching (2L):
Sequential search, binary search

Hashing (2L):
Hashing functions, collision resolution techniques (Open and closed hashing).

Reference:

1. “Data Structures And Program Design In C”, 2/E by Robert L. Kruse, Bruce P. Leung.
2. “Data Structures in C” by Aaron M. Tenenbaum.
3. “Fundamentals of Data Structures of C” by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
4. “Data Structures” by S. Lipschutz.

Course Name : DATA STRUCTURE LAB					
Course Code : ECEN2112					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

List of Experiments:

1. Implementation of array operations.
2. Stacks and Queues: adding, deleting elements Circular Queue: Adding & deleting elements Merging Problem.
3. Evaluation of expressions operations on Multiple stacks & queues.
4. Implementation of linked lists: inserting, deleting, inverting a linked list.
5. Implementation of stacks & queues using linked lists.
6. Sparse Matrices : Multiplication, addition.
7. Recursive and Nonrecursive traversal of Trees.
8. DFS and BFS.
9. Application of sorting and searching algorithms.

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Course Name : SIGNALS AND SYSTEMS					
Course Code : ECEN2103					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcome:
After completing the course the student will be able to :

1. Apply the previous knowledge of mathematics of differential calculus.
2. Categorize and identify different types of signals and systems.
3. Analyze frequency domain characteristics of signals using Fourier series, Fourier transforms and Laplace Transform.
4. Implement the concepts of transformation tools to design of communication systems and filters.
5. Analyze random signals and its properties, hence extending the concept towards in communications systems.
6. Evaluate the response of different systems using different mathematical tools.

Module 1: Introduction to Signal and Systems: (10 L)

1.1. **Classification of Signals**:– Discrete and continuous signal, Periodic aperiodic, even – odd, energy and power signals, Deterministic and random signals, complex exponential and sinusoidal signals, periodicity, unit impulse, unit step, Transformation of independent variable of signals, time scaling, time shifting.

1.2. **Properties of Systems**:- Linearity, Causality, time invariance and stability. Dirichlet's conditions, Distortionless systems, Invertible systems- Frequency response of LTI discrete time system, discrete time invariant system describe by constant coefficient linear difference equation, Impulse response of an LTI recursive system.

Module 2: Analysis of continuous time and discrete time signals: (10 L)

2.1 Convolution in continuous time, , Continuous time Fourier Series, Fourier transformation of continuous time signals and their properties.

2.2. Laplace transformation- analysis and characterization of LTI systems with examples and properties. Computation of impulse response and transfer function using Laplace transform. Parseval's theorem.

2.3. Convolution in discrete time, Correlation of discrete time signals, Discrete time Fourier Series, Fourier transformation of discrete time signals and their properties.

Module 3: Application of Signal and Systems theory: (8 L)

3.1 Sampling Theorem, Types of sampling, Aliasing, Pre-alias filter, Reconstruction of a signal from its samples, Modulation for communication, Sampling of Band-pass signals, Filtering, Hilbert Transform.

3.2 Concept of digital low pass, high pass, band pass and band stop filters with ideal magnitude response, All pass transfer function, zero phase transfer function, Minimum and Maximum phase transfer function.

Module 4: Random Signal And System, Noise (8 L)

Definitions, distribution & density function, mean values &moments, function of two random variables, concept of correlation, random processes, spectral densities, response of LTI system to random inputs, Noise sources in circuits, noise in communication circuits and systems, noise voltage.

Text Book:

1 A.V.Oppenheim, A.S.Willsky and S.H.Nawab -Signals &Systems, Pearson
2 S.Haykin & B.V.Veen, Signals and Systems- John Wiley
3 P.Ramesh Babu & R.Anandanatarajan- Signals and Systems 4/e- Scitech

References:

1 J.G.Proakis & D.G.Manolakis- Digital Signal ProcessingPrinciples, Algorithms and Applications.
2 B.P.Lathi- Signal Processing & Linear Systems- Oxford
3 A.Nagoor Kani- Signals and Systems- McGraw Hill
4 Digital signal Processing by S.K. Mitra-Tata McGraw Hill

Course Name : SIGNALS AND SYSTEMS LABORATORY					
Course Code : ECEN2113					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

COURSE OUTCOME:
After completing the following experiments, students will be able to:

1. Understand the concepts of signal synthesis, Sampling techniques using Sampling theorem
2. Describe the process of generating various continuous and discrete signals.
3. Understand the concepts of convolution theorem in its different domains.
4.Analyze the auto and cross correlation of signals

List of Experiments:

Hardware Experiments-:

1. To Study Signal Synthesis via sum of harmonics using spectrum analyzer.

2. Study of sampling theorem.

Software Experiments-:

1. To study the generation of different type of continuous and discrete signals.

2. To study the different operation of signals.

3. To study convolution theorem in time and frequency domain.

4. To study the autocorrelation and crosscorrelation of signal.

5. To study the Fourier transform and Laplace transform.

6. Magnitude and phase response of the filters.

Course Name : CIRCUIT THEORY AND FILTERS					
Course Code : ECEN2105					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course outcome:
After completing the course the student will be able to:

1. Apply the previous knowledge gathered from Basic Electrical Engineering for understanding the basic concepts of this subject.
2. Solve problems in various electric circuits using Network Theorems.
3. Analyze complex circuits in Laplace domain.
4. Understand the application of Graph theory to solve various network behaviour.
5. Evaluate the output of various Two port network without going through the detailed configuration.
6. Design various types of filters using SPICE software.

Module-I:
Network equations: Formulation of Node & Mesh equations. Loop and node variable analysis of transformed circuits. Network Theorems: Thevenin's, Norton's, Superposition and Reciprocity theorem applied to circuits containing dependent sources. [8L]
Coupled Circuits: Coefficient of coupling, Dot convention, Analysis of coupled circuits. [3L]

Module-II:
Laplace Transform: Concept of complex frequency. Properties of Laplace transform linearity, differentiation, integration, initial value theorem and final value theorem. Transform of standard periodic and non periodic waveforms. Circuit elements and their transformed equivalents, Independent and dependent sources and equivalence of sources, treatment of mutual couplings in t & s domain. Transient and steady state response of RL, RC, LC and RLC with or without stored energy. Concept of natural frequency and damping. Sketching transient response, determination of time domain specifications. Concept of Convolution theorem and its application. [10L]

Module-III:
Graph theory: Graph of network: Concept of path, tree, tree branch, tree link, loop, tie set and cut set. Incidence Matrix, tie-set Matrix and f-cut set matrix and their properties. Loop currents and node-pair potentials, formulation of loop and node equilibrium equations in view of graph theory. [5L]

Two port networks: Open circuit Impedance & Short circuit Admittance parameter, Transmission parameters, Hybrid parameters and inverse hybrid parameters. Inter relation between parameters. Inter connection between two port networks. Driving point & transfer impedance & admittance. [5L]

Module-IV:
Filter Circuits: Concept of filters, Classification of filters. Analysis and synthesis of Low pass, High pass, Band pass and Band reject filters using operational amplifier. Filter approximations: Butterworth, Chebyshev filters. [6L]

SPICE: Structure of a SPICE program, active and passive device/element statements, different study like DC analysis, transient analysis and ac analysis statement in SPICE.

Plotting and printing statement, input and output Impedance calculation using SPICE, voltage and current controlled components in SPICE. [3L]

Total: 40L

Text Books:

1. Networks and Systems, D. Roy Chowdhury, New Age International Publishers
2. Circuit theory, Dr. Abhijit Chakrabarty, Dhanpat Rai & Co Pvt. Ltd.
3. Network Analysis, M.E. Valkenburg, Pearson Education .
4. Fundamental of Electric circuit theory, D. Chattopadhay & P.C. Rakshit, S. Chand.

Reference Books:

1. Engineering Circuit Analysis, W.H. Hyat, J.E. Kemmerly & S.M. Durbin,The Mc Graw Hill Company.
2. Modern Network Analysis, F.M.Reza & S.Seely, McGraw Hill.

Course Name : CIRCUIT THEORY AND FILTERS LAB					
Course Code : ECEN2115					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

List of Experiments:

1. Determination of Laplace transform and Inverse Laplace transform of different using MATLAB.
2. Generation of Periodic, Exponential, Sinusoidal, Damped Sinusoidal, Step, Impulse, Ramp signal using MATLAB in both discrete and analog form;
3. Representation of Poles and Zeros in s-plane, determination of partial fraction expansion in s-domain and cascade connection of second-order systems using MATLAB;
4. Find out the transfer function of an electrical Network containing RL, RC & RLC and find out pole- zero
5. Transient response of R-L and R-C network using SPICE
6. Transient response of R-L and R-C network using hardware components
7. Transient response of R-L-C series and parallel circuit using SPICE and hardware verification
8. Verification of Network theorems (Reciprocity, Compensation theorem) using SPICE software
9. Determination of Impedance (Z), Admittance (Y) and Transmission (T) parameter of a two port network using SPICE or circuit maker.
10. Determination of Impedance (Z), Admittance (Y) and Transmission (T) parameter of a two port network using hardware.
11. Design of Butterworth Low Pass and High Pass filters: Simulation / Hardware.
12. Design of Band Pass and Band Reject filters using Butterworth Low Pass and High Pass filters: Simulation /Hardware.

ECE Department B.Tech., 2nd Year, 2nd Semester

Course Name : BASIC ENVIRONMENTAL ENGINEERING & ECOLOGY					
Course Code : CHEM2001					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcome:
After completing the course the student will be able to:

1. Importance of ecology
2. Sources of pollution and control of the same
3. Association of health hazards with pollution

Module 1: [9L]
Environment & Ecology (General discussion)
Basic ideas of environment and its component 1L

Mathematics of population growth: exponential and logistic and associated problems, definition of resource, types of resource, renewable, non-renewable, potentially renewable, Population pyramid and Sustainable Development. 2L
General idea of ecology, ecosystem – components, types and function. 1L
Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundarban); Food chain [definition and one example of each food chain], Food web. 2L
Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphorus, Sulphur]. 2L
Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity. 1L

Module 2: [9L]
Air pollution and control
Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause. 1L
Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Acid rain: causes, effects and control. Earth's heat budget, carbon capture, carbon footprint. 2L
Lapse rate: Ambient lapse rate, adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion). Atmospheric dispersion, Maximum mixing depth. 2L
Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN. 1L
Smog: Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green house gases, effect of ozone modification 1L

Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP, cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference). 2L

Module 3: [9L]

Water Pollution and Control

Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals,pesticides, 2L

River/Lake/ground water pollution: River: DO, 5 day BOD test, Unseeded and Seeded BOD test, BOD reaction rate constants, COD. 1L

Lake: Eutrophication [Definition, source and effect]. Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only) 1L

Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening].

Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] 2L

Water pollution due to the toxic chemicals effects: Lead, Mercury, Cadmium, Arsenic 1L

Noise Pollution

Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise]. Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, L_{10} (18hr Index), effective perceived noise level.

Noise pollution control. 2L

Module 4: [9L]

Land Pollution

Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes, electronic waste 2L

Recovery and disposal method- Open dumping, Land filling, incineration, composting, recycling. 2L

Social Issues, Health and Environment

Environmental disasters: Bhopal gas tragedy, Chernobyl disaster, Three Mile Island disaster, cancer and environment: carcinogens, teratogens and mutagens (general aspect) 2L

Environmental impact assessment, Environmental audit, Environmental laws and protection act of India. 1L

Energy audit, Green building, Green sources of energy, Concept of Green Chemistry, Green catalyst, Green solvents (replacement of VOC) 2L

References/Books:

1. Masters, G. M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd., 1991.
2. De, A. K., "Environmental Chemistry", New Age International.
3. Asim K. Das, Environmental Chemistry with Green Chemistry, Books and Allied P. Ltd
4. S. C. Santra, Environmental Science, New Central Book Agency P. Ltd
5. GourKrishna Das Mahapatra, Basic Environmental Engineering and Elementary Biology, Vikas Publishing House P. Ltd.

Course Name : EM THEORY & TRANSMISSION LINE					
Course Code : ECEN2201					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcome:
After completing the course the student will be able to:

1. Calculate gradient, divergence and curl respectively for scalars and vectors in different coordinate systems.
2. Calculate electric and magnetic fields for given boundary conditions.
3. Solve one-dimensional electromagnetic wave (EMW) equations in order to find power transmissions and reflections.
4. Compare transmission lines by estimating transmission coefficient, reflection coefficient, standing wave, VSWR, input impedance of lossless and distortion-less transmission line terminating at matched and unmatched load.
5. Do experiment with half-wave dipole antenna and analyze radiation pattern of the antenna.
6. Develop skills to formulate equations for estimating and/or calculating chracteristics of the medium and nature of the wave propagating through some special mediums.

Electromagnetic Theory

1. Vector calculus - orthogonal Coordinate System, Transformations of coordinate systems; Del operator; Gradient, Divergence, Curl - their physical interpretations; Laplacian operator. **[3]**

2. Coulomb's law, electric field intensity, charge distribution; Gauss' law, flux density and electric field intensity. Divergence theorem. Current Densities, Conductors, Poisson's & Laplace's equations. Uniqueness theorem, Biot-Savart law, Ampere's law, Relation between J & H, Vector magnetic Potential, Stokes' theorem. **[5]**

3. Faraday's law & Lenz's law. Displacement Current, J_c- JD Relation, Maxwell's equations, Time-harmonic fields, Wave Equation, Boundary Conditions between media interface; Uniform Plane wave; Plane Wave Propagation in Lossy Dielectric, Loss-less Dielectric, Good Conductor, Free space; Poynting Theorem, Power flow, Poynting vector, Skin Depth, Surface Resistance; Reflection and Transmission for normal incidence**. [10]**

Transmission Lines

4. Transmission Lines; Concept of Lumped parameters and Distributed parameters. Line Parameters, Transmission line equations and solutions, Physical significance of the solutions, Propagation constant, Characteristic Impedance; Wavelength; Velocity of Propagation; Distortion-less Line, Reflection and Transmission coefficients; Standing Waves, VSWR, Input Impedance, Smith Chart -Applications; Load Matching Techniques / Quarter wave Matching, Bandwidth problem; Low loss RF transmission lines, line as circuit elements. **[10]**

Radiation of E M Waves

5. Antenna Concepts, Antenna Characteristic; Hertzian dipole (Radiation Fields, Radiation Resistance, Radiation patterns, Directive Gain); Properties and typical applications of Half-wave dipole, Loop antenna, Yagi-Uda array, Array Antennas. **[6]**

Text Books:

1. Principles of Electromagnetics, 4th Edition, Matthew O H Sadiku, Oxford University Press.
2. Electromagnetic Field Theory & Transmission Lines, G.S.N. Raju, Pearson Education.
3. Electromagnetic Waves Shevgaonkar, Tata-McGaw-Hillr –R K.
4. Antenna Theory: Analysis and Design, 3rd edition, C.A. Balanis, Wiley India.

Reference Books:

1. Engineering Electromagnetics, 2ed Edition - Nathan Ida, Springer India.
2. Fields & Waves in Communication Electronics, S. Ramo, J. R. Whinnery & T. Van Duzer, John Wiley
3. Electromagnetic Theory & Applications, A. K. Saxena, Narosa Publishing House Pvt. Ltd.
4. Engineering Electromagnetics, 7thEdition-W.H.Hayt & J.A.Buck, Tata-McGraw-Hill
5. Electromagnetic Waves and Transmission Lines- by G.Prasad, J.Prasad and J.Reddy-Scitech.

Course Name : E.M THEORY & TRANSMISSION LINE LABORATORY					
Course Code : ECEN2211					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

COURSE OUTCOME:

After completing the following experiments, students will be able to:

1. Understand the behavior of Transmission Lines and study standing wave patterns.
2. Describe the use of Smith chart using MATLAB
3. Generate radiation patterns of various antennas
4. Evaluate parameters like Gain, directivity etc of antennas like Yagi Uda.

List of Experiments:

[At least THREE experiments from Module I and FOUR experiments from Module II]

Module I:

1. Plotting of Standing Wave Pattern along a transmission line when the line is open-circuited, short-circuited and terminated by a resistive load at the load end.
2. Measurement of Input Impedance of a terminated coaxial line using shift in minima technique.

3. Study of Smith chart on MATLAB platform.

4. Simulation study of Smith chart - Single and double stub matching.

Module II:

5. Radiation Pattern study of dipole antenna.

6. Radiation Pattern study of a folded-dipole antenna.

7. Radiation pattern study of Helical Antenna.

8. Parametric study (Gain, Directivity, HPBW and FNBW) of three, five and seven element Yagi Uda configurations.

9. Radiation pattern study of a Pyramidal Horn Antenna.

10. Spectrum analysis of different analog signals (sine, triangular, square) using spectrum analyzer.

Course Name : DIGITAL ELECTRONICS					
Course Code : ECEN2002					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcome:
After completing the course the student will be able to:

1. Apply the concept of Boolean algebra to minimize logic expressions by algebraic method, K-map method, and Tabular method.
2. Construct different Combinational circuits like Adder, Subtractor, Multiplexer, De-Multiplexer, Decoder, Encoder, etc.
3. Design various types of Registers and Counters Circuits using various Flip-Flops.
4. Understand the concept of different types of A/D and D/A conversion techniques.
5. Construct basic gates using RTL, DTL, TTL, ECL and CMOS logic families.
6. Use the concept of Flip flops to analyze different memory systems like RAM, ROM, EPROM, EEROM, etc.

Module-1:
Data and number systems; Binary, Octal and Hexadecimal representation and their conversions; BCD,, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic. Boolean algebra, De- Morgan's theorem,Various Logic gates- their truth tables and circuits; Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, K- map method, Tabular method. [8]

Module-2:
a) Combinational circuits- Adder and Subtractor, BCD adder, BCD subtractor, Applications and circuits of Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and Parity Generator. [7]
b) Memory Systems: Concepts and basic designs of RAM, ROM, EPROM, EEROM, Programming logic devices and gate arrays. (PLAs and PLDs) [5]

Module-3:
Sequential Circuits- Basic memory element-S-R, J-K, D and T Flip Flops,Interconversions of Flip-Flop, State table and state transition diagram, sequential circuits design methodology, FSM (Mealy and Moore machine), various types of Registers and counters (Synchronous, asynchrounous, Irregular , cascaded, ring, johnson) and their design, Lockout and its remedy. [8]

Module-4:
a) Different types of A/D(Flash, SAR, Counter type, Dual slope) and D/A(R-2R, weighted resistor) conversion techniques.[4]

b) Logic families- RTL , DTL, TTL, ECL, and CMOS, their operation and specifications. Realization of basic gates using above logic families.[4]

Total: 40 hours

Textbooks:

1. Morries Mano- Digital Logic Design- PHI .
2. R.P.Jain-Modern Digital Electronics, 2/e , Mc Graw Hill
3. Virendra Kumar-Digital technology, New Age Publication
4. S.Salivahanan, S.Arivazhagan- Digital Circuit & Design- Bikas Publishing

Reference:

1. H.Taub & D.Shilling, Digital Integrated Electronics- Mc
2. Tocci, Widmer, Moss- Digital Systems,9/e- Pearson 7.
3. Leach & Malvino—Digital Principles & Application, 5/e, Mc Graw Hill
4. Floyed & Jain- Digital Fundamentals-Pearson. 11.

Course Name : DIGITAL ELECTRONICS LAB					
Course Code : ECEN2012					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

COURSE OUTCOME:

After completing the following experiments, students will be able to:

1. Identify various digital circuit configurations like BCD t to Excess-3, Four-bit parity generator etc.
2. Design simple mathematical circuits and study the outputs.
3. Construct various Flip flops and see the outputs.
4. Experiment with construction of various types of counters.

List of Experiments:

1. Code conversion circuits- BCD to Excess-3 and vice-versa.
2. Four-bit parity generator and comparator circuits.
3. Construction of simple arithmetic circuits-Adder, Subtractor.
4. Construction of simple Multiplexer circuits using logic gates.
5. Realization of different combinational circuits using Multiplexers.
6. Design of 4-bit Priority Encoder using logic gates.
7. Realization of RS-JK and D flip-flops using Universal logic gates.
8. Realization of Asynchronous Up/Down counter.
9. Realization of Synchronous Up/Down counter.
10. Design of Sequential Counter with irregular sequences.
11. Realization of Ring counter and Johnson's counter.

Course Name : ANALOG COMMUNICATION					
Course Code : ECEN2203					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcome:
After completing the course the student will be able to:

1. Understand & apply the concepts of various types of signals, techniques for signal transmission and signal modulation from the knowledge gathered earlier.
2. Identify various parameters associated with Amplitude Modulation, time and frequency domain representations, side band frequencies etc and apply these knowledge to solve numerical problems.
3. Understand principles of various generation and detection techniques of Amplitude Modulation.
4. Identify and apply detailed knowledge of Angle modulation and demodulation techniques.
5. Analyze various multiplexing techniques and radio receivers.
6. Understand system noise and apply this knowledge to compare the noise performance of Analog Communication systems.

Module -1: [9L]

Introduction to Analog Communication: Introduction to basic elements of communication systems, signal transmission through linear systems, Condition for distortion less transmission of signals through networks. Different types of distortion and their effect on the quality of output signals. Concept of modulation, its needs.

Continuous Wave Linear Modulation:
a) Amplitude modulation(AM-DSB/TC): Time domain representation of AM signal (expression derived using a single tone message), modulation index, frequency domain (spectral) representations, illustration of the carrier and side band components; transmission bandwidth for AM; Phasor diagram of an AM signal; Calculation of Transmitted power & sideband power & Efficiency ; concept of under, over and critical modulation of AM-DSB-TC.
b) Other Amplitude Modulations: Double side band suppressed carrier (DSBSC) modulation: time and frequency domain expressions, bandwidth and transmission power for DSB. Single side band modulation (SSB) both TC & SC and only the basic concept of VSB, Spectra and band-width.

Module -2: [9L]

Generation & Detection of Amplitude Modulation:
a) Generation of AM: Gated, Square law modulators, Balanced Modulator.
b) Generation of SSB: Filter method, Phase shift method and the Third method
Demodulation for Linear Modulation:
Demodulation of AM signals: Detection of AM by envelope detector , Synchronous detection for AM-SC, Effects of Frequency & Phase mismatch, Corrections.

Module -3: [8L]

Angle Modulation:

a) **Frequency Modulation (FM) and Phase Modulation (PM):** Time and Frequency domain representations, Spectral representation of FM and PM for a single tone message, Bessel's functions and Fourier series.; Phasor diagram;

b) **Generation of FM & PM:** Narrow and Wide-band angle modulation, Basic block diagram representation of generation of FM & PM, Concept of VCO & Reactance modulator

c) **Demodulation of FM and PM:** Concept of frequency discriminators and phase discriminators, Phase Locked Loop.

Module – 4: [10L]

a) **Multiplexing :** Frequency Division Multiplexing, Time Division Multiplexing,

b) **Radio Receivers** –Basic block diagram of TRF, Superhetrodyne principle.

Random Signals and Noise in Communication System:

i) Noise in Communication systems – Internal & External noise, Noise Temperature, Signal-to-Noise ratio, White noise, thermal noise, Figure of Merit.

iii)Noise performance in Analog Communication systems: SNR calculation for DSB/TC, DSB-SC, SSB-TC, SSBSC & FM.

Total 36 Hours

Text Books:

1. B.P.Lathi -Communication Systems- BS Publications
2. Taub and Schilling , "Principles of Communication Systems", 2nd ed., Mc-Graw Hill
3. Singh & Sapre—Communication Systems: 2/e, TMH
4. S Sharma, Analog Communication Systems- Katson Books

References:

1. Carlson—Communication System,4/e , Mc-Graw Hill
2. Proakis & Salehi Fundamentals of Communication Systems- Pearson
3. V Chandra Sekar – Analog Communication- Oxford University Press
4. P K Ghosh- Principles of Electrical Communications- University Press
5. L.W.Couch Ii, "Digital and Analog Communication Systems", 2/e, Macmillan Publishing
6. Blake, Electronic Communication Systems- Cengage Learning

Course Name : ANALOG COMMUNICATION LAB					
Course Code : ECEN 2251					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	3	3	2

COURSE OUTCOME:
After completing the following experiments, students will be able to:

1. The students will learn to analyze AM and FM signals using spectrum analyzer.
2. They will be able to design AM demodulator.
3. The students will be in a position to design VCO and FM demodulator.
4. They will be able to design pre-emphasis and de-emphasis circuits.

List of Experiments:

1. Measurement of modulation index varying modulating signal amplitude of an AM signal.
2. Design of an AM demodulator (Envelope detector).
3. Study of the spectral analysis of AM Signal.
4. Design of a voltage controlled oscillator (VCO).
5. Measurement of modulation index varying modulating signal amplitude of a FM signal.
6. Design of a FM demodulator using PLL.
7. Study of the spectral analysis of FM signal.
8. Study of Pre-Emphasis and De-Emphasis circuits

Course Name : SOLID STATE DEVICES					
Course Code : ECEN2204					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcome:

After completing the course the student will be able to:

1. Apply the previous knowledge of Basic electronics Engineering to appreciate the contents of this paper.
2. Understand both the particle and wave natures of electrons in Solid State Devices.
3. Identify unknown extrinsic semiconductor type using Hall Effect.
4. Describe working principles of different devices using mathematical models and energy band diagrams.
5. Justify different operations of solid state devices using relative position of Fermi energy levels across p-n junctions in devices.
6. Evaluate performance of different hetero junctions in semiconductor devices.

Module - 1: Semiconductor Physics (12L)

Recapitulation of Quantum Mechanics, Kronig Penny Model, Energy Band diagram, E-K diagram, Direct and Indirect Band-gap semiconductors, concept of effective mass, Carrier distribution in solid, concept of density of state (only expression), Fermi-Dirac distribution, Fermi level, Intrinsic and Extrinsic semiconductors, idea of Degeneracy and Non-Degeneracy, Fermi level shift with the changes in doping and temperature. (7L)

Semiconductor under equilibrium: Carrier Concentration in terms of effective Density of States, Mass-Action Law. (2L)

Semiconductor under non-equilibrium: Drift and Diffusion of carrier with expressions, Scattering Effect, Hall Effect, Piezo-electric effect, Excess Carrier Generation and recombination with expression, concept of quasi Fermi-level. (3L)

Module - 2: Diodes: **(12L)**

Basic concepts about Homo & Hetero junctions

Homo-junctions: p-n junction physics: derivations and plots of depletion charge, electric field, potential profiles; energy band diagram, depletion width, p-n junction capacitances, Varactor diode, Derivation of p-n junction current, junction resistances; concepts about linearly graded and abrupt junctions. (5L)

Basic operations of different diodes: Breakdown diodes, Tunnel diode, Photo diodes (P-N, P-I-N, APD), Photoconductor, Solar cell; Basic concept about Spontaneous and Stimulated emissions, LED. (4L)

Hetero-junctions: Physics of Metal-Semiconductor & Semiconductor-Semiconductor hetero-junctions, Rectifying & Non-rectifying natures of Hetero-junctions, basic concept of potential-well & 2D electron gas. (3L)

Module - 3: Bipolar Junction Transistors (BJT): (8L)

Physic of BJT: Basic device operating principle, minority carrier distributions, Different modes of operations and respective band diagrams, input output characteristics of BJT in CB & CE modes, base width modulation, Early effect, punch through, thermal runaway; concepts about large and small signal modeling of the device, Eber's Moll model, Hybrid-π model. (6L)

Basic operations of different transistors: Photo-transistor, TRIAC, DIAC, UJT, SCR. (2L)

Module - 4: Field Effect Transistors (FET): (8L)

JFET: Device construction and physics, principle of operation, V-I characteristics. (2L)

MOSFET: Physics of 2-terminal MOS structures with proper band diagrams; MOSFET classifications: Enhancement and Depletion type MOSFETs, basic operations and V-I characteristics of both the devices; concepts of Threshold voltage and Flat-band voltage, small signal model of MOSFET, Introduction to CMOS technology. (6L)

Text Books :

1. Neamen- Semiconductor Physics and Devices- TMH
2. Bhattacharya & Sharma- Solid State Electronic Devices- Oxford
3. Streetman & Banerjee- Solid State Electronic Devices- PHI

Reference Books :

1. Milman, Halkias & Jit- Electronics Devices and Circuits- TMH
2. Bell-Electronics Devices and Circuits-Oxford
3. Bogart, Bisley & Rice- Electronics Devices and Circuits- Pearson
4. Boylestad & Nashelsky- Electronics Devices and Circuit Theory- Pearson

Course Name : PHYSICS II					
Course Code : PHYS2201					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcome:
After completing the course the student will be able to:

1. Ideas about classical, statistical and quantum mechanics
2. Dielectric and magnetic properties
3. Superconductivity

Module 1:

Classical Mechanics:
Constraints. Generalised coordinates. Lagrange's equation of motion. Hamiltonian formulation, Hamilton's equation of motion.

Course should be discussed along with simple physical problems.

(4 L)

Quantum Mechanics:
Physical interpretation of wave function Ψ(normalization and probability interpretation). Concept of probability and probability density. Operator. Commutator. Formulation of quantum mechanics and basic postulates . Operator correspondence . Time dependent Schrödinger's equation . Formulation of time independent Schrödinger's equation by method of separation of variables. Expectation values. Application of Schrödinger equation-Particle in an infinite square well potential (1-D and 3-D potential well), discussion on degenerate energy levels.

(**6 L)**

Module 2:
Statistical Mechanics:
Concept of energy levels and energy states. Macrostates. Microstates and thermodynamic probability. Equilibrium macrostate. MB, FD and BE statistics (no deduction necessary). Fermions, Bosons (definitions in terms of spin, examples). Physical significance and application. Classical limit of quantum statistics. Fermi distribution at zero and non –zero temperature. Fermi Level.

(6 L)

Applications of Statistical Mechanics
Planck's Black body radiation. Fermi level in intrinsic and extrinsic semiconductors. Intrinsic semiconductors and carrier concentration. Extrinsic semiconductors and carrier concentration. Equation of continuity. Direct & indirect band gap semiconductors.

(4L)

Module 3:
Dielectric Properties:
Electric dipole moment. Dielectric constant. Polarizability. Electric susceptibility. Displacement vector. Electronic, ionic and orientation polarizations. Calculation of polarizabilities - Internal fields in solids. Piezo-electricity, pyro-electricity and ferro-electricity.

(**5L)**

Magnetic Properties:
Permeability, field intensity, magnetic field induction, magnetization, magnetic susceptibility. Origin of magnetic moment, Bohr magneton. Classification of dia, para and ferro magnetic materials on the basis of magnetic moment. Domain theory of ferro magnetism. Explanation of hysteresis curve. Soft and hard magnetic materials. Properties of anti-ferro and ferri magnetic materials. Ferrites and their applications. Concept of perfect diamagnetism.

(5L)

Module 4:

Band Theory of Solids:
Electron in a periodic potential. Bloch theorem. Kronig-Penny model (qualitative treatment). Origin of energy band formation in solids. Classification of materials into conductors, semi conductors & insulators. Concept of effective mass of an electron and hole.

(6L)

Super Conductivity
Introduction (experimental survey). General properties of super conductivity. Effect of magnetic field. Meissner effect . Explanation in view of wave mechanical property. Hard and soft superconductors. Thermal properties of superconductor. London equations and penetration depth.

(**4L)**

Course Name : PHYSICS II LAB					
Course Code : PHYS2211					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

List of Experiments:

Group 1: Experiments on Electricity and Magnetism

1. Determination of dielectric constant of a given dielectric material.
3. Determination of resistance of ballistic galvanometer by half deflection method and study of variation of logarithmic decrement with series resistance.
4. Determination of the thermo-electric power at a certain temperature of the given thermocouple.
5. Determination of specific charge (e/m) of electron.

Group 2: Quantum Physics

6. Determination of Planck's constant.
7. Determination of Stefan's radiation constant.
8. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
9. Determination of Rydberg constant by studying Hydrogen/ Helium spectrum

Group 3: Modern Physics

10. Determination of Hall co-efficient of semiconductors.
11. Determination of band gap of semiconductors.
12. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells.

Note: A candidate is required to perform at least 5 experiments taking one from each group. Emphasis should be given on the estimation of error in the data taken.

Recommended Text Book:

Quantum Physics

- Atomic Physics – S.N. Ghoshal – S Chand
- Quantum Physics– Eisberg and Resnick – Wiley
- Quantum Mechanics – A.K. Ghatak and S. Lokenathan –Springer

Classical Mechanics

- Introduction to Classical Mechanics – R.G Takwale & P S Puranik –Tata MaGraw Hill
- Classical Mechanics – N C Rana & P S Joag – Tata MaGraw Hill

Solid State Physics

- Atomic Physics – S.N Ghoshal
- Elementary Solid State Physics – M.Ali Omar – Pearson Education
- Solid State Physics – A.J Dekkar – Macmillan
- Introduction to Solid state Physics – C.Kittel

Statistical Mechanics

- Thermodynamics, Kinetic Theory, and Statistical Mechanics–Sears and Salinger–Narosa

Course Name : INDIAN CULTURE AND HERITAGE					
Course Code : HMTS2002					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	2	**0**	**0**	**2**	**1**

Module-I:

Indian Religion &Philosophy

1. Orthodox Indian Philosophy:

2. Unorthodox Indian philosophy:

3. Essentials of Hinduism

4. An overview of Jainism, Buddhism, Sikhism, Islam, Christianity religions

Module -II:

Values and Personality

1. Aspects of Indian Values
2. Essentials of Personality Building
3. Ethics at work place
4. Aspects of Leadership qualities

Module -III:

Indian Scriptures

1. Selections from the Vedas

2. Select verses from Upanishad

3. An overview of Gita

4. XVIth chapter of Gita

Module- IV:

Indian Psychology
1. Aspects of Yoga Philosophy
2. Mind and its workings according to Yoga
3. Law of Karma
4. Selections from Manusmriti

References:

1. Indian Philosophy by S.C. Chatter and D. M. Dutta, Calcutta University Press
2. Spiritual Heritage of India, Swami Prabhavananda, Sri Ramakrishna Math, Chennai
3. Raja Yoga by Swami Vivekananda, Advaita Ashrama, Mayavati
4. Vedic Selection, Calcutta University Press
5. Gita by Swami Swarupananda, Advaita Ashrama, Kolkata
6. Upanishads by any press
7. Carving a Sky (MSS) by Samarpan
8. Essentials of Hinduism (MSS) by Samarpan
9. The Call of the Vedas — Bharatiya Vidya Bhavan

Course Name : LANGUAGE PRACTICE LAB LEVEL II					
Course Code : HMTS2022					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

COURSE OUTCOME:

The learner will
1. Acquire the techniques to become an effective listener.
2. Acquire the skill to become an effortless speaker.
3. Organize and present information for specific audience.
4. Communicate to make a positive impact in professional and personal environment.
5. Engage in research and prepare authentic, formal, official documents.
6. Acquire reading skills for specific purpose.

Module 1:

Formal verbal communication:

- Introduction to formal verbal communication, Interpersonal Skills & Public Speaking: Building Positive Relationships, Focusing on Solving Problems, Time Management, Dealing with Criticism: Offering Constructive Criticism, Responding to Criticism – Managing Conflict: Approaches to Conflict, Resolving Conflict

- Conversational skills in the business scenario: One-to-one and Group communication, Gender and Culture Sensitivity, Etiquette, Sample Business Conversation, Telephonic Conversation

Module II:

Presentation skills

- Speech Purposes - General: Informative Speeches, Persuasive Speeches, Entertaining Speeches, Methods of Speaking: Speaking from a Manuscript, Speaking from Memory, Impromptu Delivery, Extemporaneous Delivery, Analyzing the Audience, Nonverbal Dimensions of Presentation

- Organising the Presentation: the Message Statement, Organising the Presentation: Organizing the Speech to Inform, The Conclusion, Supporting Your Ideas – Visual Aids: Designing and Presenting Visual Aids, Selecting the Right Medium, Post-presentation Discussion

Module III:

Group Discussion

- Introduction to Group Communication
  Factors in Group Communication, Status – Group Decision Making: Reflective Thinking, Brainstorming, Body Language, Logical Argument, The Planning Process, Strategies for Successful GDs, Role of Social Awareness (Newspapers, Magazines, Journals, TV News, Social Media), Practice GDs

Module IV:

Job Application and Personal Interview

- **Job Application** Letter: Responding to Advertisements and Forced Applications, Qualities of Well-Written Application Letters: The You-Attitude, Length, Knowledge of Job Requirement, Reader-Benefit Information, Organization, Style, Mechanics – Letter Plan: Opening Section, Middle Section, Closing Section

- **Resume and CV:** Difference, Content of the Resume – Formulating Career Plans: Self Analysis, Career Analysis, Job Analysis, Matching Personal Needs with Job Profile – Planning your Resume – Structuring the Resume: Chronological Resume, The Functional Resume, Combination Chronological and Functional Resume – Content of the Resume: Heading, Career Goal or Objectives, Education, Work Experience, Summary of Job Skills/Key Qualifications, Activities, Honours and Achievements, Personal Profile, Special Interests, References

- **Interviewing**
  Types of Interviews, Format for Interviews: One-to-one and Panel Interviews, Employment Interviews, Frequently Asked Questions, Dress Code, Etiquette, Questions for the Interviewer, Simulated Interviews

Marks: 100
Module I- 20 marks
Module II- 30 marks
Module III- 20 marks
Module IV- 30 marks

References:

1. Carter, R. And Nunan, D. (Eds), The Cambridge guide to Teaching English to Speakers of Other Languages, CUP, 2001

2. Edward P. Bailey, Writing and Speaking At Work: A Practical Guide for Business Communication, Prentice Hall, 3rd Ed., 2004

3. Munter, M., Guide to Managerial Communication: Effective Business Writing and Speaking, Prentice Hall, 5th Ed., 1999

4. Raman, M. and Sharma, S., Technical Communication: Principles and Practice, 2nd Ed., 2011

ECE Department B.Tech.,3rd. Year, 1st. Semester

Course Name : E C O N O M I C S F O R E N G I N E E R S					
Course Code : HMTS3101					
Contact Hours per	L	T	P	Total	Credit Points
	3	0	0	3	3

Module 1:

Market: Meaning of Market, Types of Market, Perfect Competition, Monopoly, Monopolistic and Oligopoly market.
The basic concept of economics – needs, wants, utility.
National Income-GDP, GNP. Demand & Supply, Law of demand, Role of demand and supply in price determination, Price Elasticity.
Inflation: meaning, reasons, etc. **(6L)**

Module 2:

Business: Types of business, Proprietorship, Partnership, Joint-stock company, and cooperative society – their characteristics.
Banking: role of commercial banks; credit and its importance in industrial functioning. Role of central bank: Reserve Bank of India.
International Business or Trade Environment. **(4L)**

Module 3:

Financial Accounting-Journals. Ledgers, Trial Balance, Profit & Loss Account, Balance Sheet.
Financial Statement Analysis (Ratio and Cash Flow analysis). **(8L)**

Cost Accounting- Terminology, Fixed, Variable and Semi-variable costs.
Break Even Analysis. Cost Sheet. Budgeting and Variance Analysis.
Marginal Cost based decisions. **(6L)**

Module 4:

Time Value of Money: Present and Future Value, Annuity, Perpetuity.
Equity and Debt, Cost of Capital. **(4L)**

Capital Budgeting: Methods of project appraisal - average rate of return - payback period - discounted cash flow method: net present value, benefit cost ratio, internal rate of return.
Depreciation and its types, Replacement Analysis, Sensitivity Analysis. **(8L)**

Evaluation: Max marks-100
Internal Test-30
Semester Test-70

References:

1. R**.** Narayanswami, Financial Accounting- A Managerial Perspective. Prentice-Hall of India Private Limited. New Delhi
2. Horne, James C Van, Fundamentals of Financial Management. Prentice-Hall of India \ Private Limited, New Delhi
3. H. L. Ahuja., Modern Economic Theory. S. Chand. New Delhi.
4. Newman, Donald G., Eschenbach, Ted G., and Lavelle, Jerome P. Engineering Economic Analysis. New York: Oxford University Press. 2012.

Course Name : C O N T R O L S Y S T E M S					
Course Code : ECEN3102					
Contact Hours per	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:
After completing the course the student will be able to:

1. Apply their previous knowledge of Mathematics and Signals & Systems.
2. Understand mathematical models of physical systems and study their nature, configuration and relevant mapping into equivalent models.
3. Apply the concept and classification of control systems to identify, analyze and solve stability related issues in time response, error analysis and stability analysis in an advanced way.
4. Evaluate, categorize and justify the margin of stability with respect to the system's nature using frequency domain analysis tools.
5. Categorize different methods of evaluating system behavior with the help of simulation models.
6. Design controllers according to desired performance specifications which can be applied to system design in higher semesters.

MODULE – I:

INTRODUCTION
Concepts of Control Systems- Open Loop and Closed Loop Control Systems - their differences- Different examples of Control Systems - Classification of Control Systems, Feed-Back Characteristics, Effects of feedback. Mathematical models – Differential equations, Impulse Response and Transfer Functions -Translational and Rotational mechanical systems. [4L]

TRANSFER FUNCTION REPRESENTATION
LTI system- its advantage in analysis. Laplace transform- its use in transfer function analysis. Transfer Function of linear systems- presence or absence of initial condition. Block diagram representation of systems considering electrical systems as examples -Block diagram algebra – Representation by Signal Flow Graph - Transfer function using Mason's Gain Formula. [5L]

MODULE –II:

TIME DOMAIN ANALYSIS
Standard test signals - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants. [5L]

STABILITY ANALYSIS
The concept of stability- Difference between absolute and relative stability. – Routh's stability criterion – its advantages and limitations.
Root Locus Technique: The Root Locus concept - construction of Root Loci-effects of adding poles and zeros to G(s)H(s) on the root loci. [5L]

MODULE – III :

FREQUENCY DOMAIN ANALYSIS
Introduction, Frequency domain specifications-Bode diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin & Gain margin-Stability Analysis from Bode Plots. [6L]
Polar Plots, Nyquist Plots Stability Analysis. [4L]

MODULE –IV:

CLASSICAL CONTROL DESIGN TECHNIQUES
Compensation techniques – Lag, Lead, Lead-Lag Controllers design in frequency Domain, PID Controllers. [5L]

STATE SPACE ANALYSIS OF CONTINUOUS TIME SYSTEMS
Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and its properties – Concepts of Controllability and Observability. [6L]

Text Books:

1. Automatic Control Systems– by B. C. Kuo, John Wiley and Sons.
2. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International (P) Ltd.
3. Modern Control Engineering – by Katsuhiko Ogata , Prentice Hall of India Pvt. Ltd.
4. Modern Control Systems- by R.C. Dorf & R.H. Bishop- Addison- Wesley Longman.

References:

1. Control Systems Engg. by Norman S. Nise , John Wiley.
2. Control System Engineering by Ananda Natarajan , P. Ramesh Babu, Scitech Pub.
3. Automatic Control Systems- Basic analysis and design- by A. Wolovich- Oxford University Press.

Course Name : CONTROL SYSTEMS LABORATORY					
Course Code : ECEN3112					
Contact Hours per	L	T	P	Total	Credit Points
	0	0	3	3	2

COURSE OUTCOME:

After completing the following experiments, students will be able to:

1. Understand Control systems , mathematical models and transfer functions
2. Analyze techniques in different domains
3. Predict Control design techniques
4. Describe State space analysis

List of Experiments for Control Systems Laboratory:

1. Familiarization with MATLAB Control System Toolbox and SIMULINK.
2. Study of the effect of feedback on systems.
3. Study of first order systems having different time constants.
4. Study of second order systems having different damping ratios.
5. Verification and validation of time domain specifications of second order systems.
6. Study of steady state errors for different 'types' of systems.
7. Study of system stability using Root Locus Technique.
8. Study of system stability using Nyquist plot.
9. Study of system stability using Bode plot.
10. Study of system relative stability using Nyquist Plot and Bode Plot .
11. Study of system representation using State Model.
12. Determination of PI, PD and PID controller action on first order simulated process

Course Name: MICROELECTRONICS & ANALOG VLSI DESIGN					
Course Code : ECEN3103					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:
After completing the course the student will be able to:

1. Understand the fundamentals of MOSFET Device Physics.
2. Correlate the fundamental understanding with the evolving VLSI Design Trends and Challenges.
3. Understand the IC Fabrication Process Flow leading to the practical realization of the scaled MOSFETs.
4. Analyze analog VLSI sub-circuits and design them namely, current mirrors, voltage, and current references.
5. Design circuits of practical importance e.g., amplifiers.
6. Apply the knowledge of analog sampled data circuits to synthesize practical circuits such as switched- capacitor filters.

Module I: Introduction and the MOS Transistor: [8L]

Unit1: Evolution of Microelectronics, Moore's Law, Process Node Definition, Evolution of Process Technology, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI, GSI), ITRS, VLSI Design Trend and Challenges.

Unit2: Knowledge about MOS, Structure and Principle of operation of enhancement-mode MOS transistor, MOS-Characteristics, MOS Capacitors, Short Channel MOS, NMOS vs PMOS.

Module II: Fabrication Flow: [10L]

Unit1: IC Process Flow, clean environment, Wafer Growth and Preparation, CVD Techniques, Epitaxy, Oxidation (Dry and Wet), Photo Lithography: Contact, Proximity, Projection, Photo Resist, Etching (Wet and Dry), Diffusion, Ion Implantation, Metallization and interconnects. VLSI Process Integration. Assembly & Packaging of VLSI devices.

Unit2: CMOS Fabrication flow step by step using self aligned techniques (N-well Process), CMOS Fabrication Process Overview and Structure for N-Well, P-Well, Twin Tub, Lamda and Micron rules, SOI, FINFET. Yield loss & Reliability analysis in VLSI design.

Module III: Analog VLSI Sub-circuits: [10L]

Analog VLSI Design Steps, Basic Building Blocks of Analog VLSI Chips, large signal and small signal analysis and equivalent circuit model, small signal parameters for low frequency and high frequency model, MOS Switch, MOS Diode, Active Load/Resistors,

Voltage Dividers, Current Mirror, CMOS Current Mirror & Sink (Cascode), CMOS Voltage Reference, CMOS Bandgap Reference (Basic Circuit Only).

Module IV: Analog VLSI Circuits: [10L]

Unit1: Common-Source, Common-Drain and Common-Gate single stage amplifiers, Differential Amplifier: Common Mode, Differential Mode, Transfer Characteristic Curves, CMRR, Differential Amplifier with Active Load.

Unit2: CMOS OPAMP, Switched Capacitor Filter .

Text Book:

1. VLSI Technology 2ND Edition, Author: Sze, S.M.; MCGRAW HILL COMPANIES .
2. CMOS Analog Circuit Design (second edition) Phillip E. Allen and Douglas R. Holberg (Oxford) .
3. Microelectronic Circuits- A.S. Sedra & K.C.Smith- Oxford International student edition.

References:

4. The MOS Transistor (second edition) Yannis Tsividi s (Oxford) .
5. Design of Analog CMOS Integrated Circuit, B. Razavi, Mc, Graw Hill .

Course Name: MICROELECTRONICS & ANALOG VLSI DESIGN LABORATORY					
Course Code : ECEN3113					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

After completing the following experiments, students will be able to:

1 Understand Basics of microelectronics and VLSI design
2. Categorize various types of MOS, IC manufacturing Process - the steps
3. Analyze Analogue VLSI circuits – the intricacies
4. Design important Circuits like OP AMP and their analysis

List of Experiments:

Sub Micron and Deep Sub Micron Technology based Experiments:

1. Introduction to Tanner Design & Layout Tools and SPICE Analysis:
    a. Familiarity with Tanner CAD Tools (S-Edit, W-Edit, L-Edit, DRC, LVS)
    b. Familiarity with T-Spice
    c. NMOS, PMOS VI Characteristics
    d. Transient analysis of CMOS Inverter Circuit
2. Tanner Tool Based Analog Experiments:
    a. MOS as Resistors, Current Source, Sink, Current Mirror
    b. DC, Transient and AC analysis of Single Stage Amplifier
    c. Circuit Analysis of Differential Amplifier

Course Name: MICROPROCESSORS, MICROCONTROLLERS & SYSTEMS					
Course Code : ECEN3104					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcomes:
After completing the course the student will be able to:

1. Understand the basics of microprocessor and microcontroller with the help of previous knowledge of Digital Electronics.
2. Develop the concepts of MPU, timing and control signals I/O devices, types of BUS, etc that form the background of this course.
3. Develop the ALP for given problems with flowchart and learn about the interrupts stack and subroutine.
4. Learn and apply the architecture of 8086 family.
5. Analyze and solve memory interfacing and I/O interfacing problems and develop idea about several peripheral devices.
6. Analyze the architecture of microcontroller 8051 with respect to I/I ports, Memory, Counters and Timers etc.

Module I: Introduction [4L]
MPU, I/O devices, Memory, Timing and Control Signals, Bussed Architecture, Tristate logic, Latch, Address Bus, Data Bus and Control Bus.

Module II: Microprocessor

8085 [10L]
Intel 8085 Microprocessor Architecture – Signals – Addressing modes – Instruction classification Instruction set—Timing diagram – Memory Mapped and Peripheral I/O- ALP format – Programming 8085 – 8-bit and 16-bit Operation including stack-subroutine – Interrupt structure of 8085 microprocessor, Processing of vectored and Non-vectored interrupts, Latency time and Response time; Handling multiple interrupts.

8086 [8L]
Intel 8086 microprocessor - Architecture - Signals- Segmented Memory – EU and BIU - Instruction Set-Addressing Modes – Minimum and Maximum Modes of Operation- Even and Odd Memory Bank- Basics of Assembly Language Programming.

Module III: I/O Interfacing [8L]
Memory interfacing and I/O interfacing with 8085– PPI 8255 – Programmable keyboard display –Interface 8279 – Programmable interrupt controller 8259 –Programmable DMA controller 8257 –USART 8251 –Programmable interval timer 8253. ADC & DAC Interfacing.

Module IV: Microcontroller & Systems

8051 [6L]
Architecture of 8051 Microcontroller – Signals – I/O ports – Memory – Counters and Timers – Serial Data I/O – Interrupts. Interfacing - Keyboard, LCD, Stepper Motor Control.

Text Books:

1. Microprocessor Architecture, Programming & Application with 8085-R. Gaonkar (Penram International).
2. Ray & Bhurchandi, Advanced Microprocessors & Peripherals, Mc Grawhill Education.
3. The 8051 Microcontroller and Embedded systems - Mazidi, Mazidi and McKinley (Pearson).
4. Microprocessor and Programmed Logic by Kenneth L Short.2nd Edition, Pearson.

Reference Books:

1. Microprocessors and microcontrollers -N. Senthil Kumar, M. Saravanan and Jeevananthan, Oxford University Press
2. An Introduction to Microprocessor and Applications –Krishna Kant (Macmillan).
3. Fundamentals of Microprocessor and Microcontrollers by B. Ram. Dhanpat Rai Publications
4. Microprocessors and Microcontrollers by A. Nagoorkani Mc Grawhill Education.

Course Name: MICROPROCESSORS, MICROCONTROLLERS & SYSTEMS LABORATORY					
Course Code : ECEN3114					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Course outcomes:
After completing the following experiments, students will be able to:
1. Select proper instructions and build different assembly language program for 8085 microprocessor

2. Understand the assembly language programming concept of microprocessor

3. Design the interfacing of input/output devices with 8085 microprocessor using partial and absolute address decoding

4. Build assembly language program to control input/output devices for various applications

5. Analyze the processing of analog signal and generation of various analog signals using interfacing circuit

6. Realize the programming concept of hardware interrupts in 8085 microprocessor

List of Experiments:
1. Write an Assembly Language Program (ALP) using 8085 to

(a) Store a certain data byte in memory location.

(b) Exchange the content of memory locations.

(c) Find the 2's complement of the number and store it in a certain memory location.

(d) Find the square of first nine natural numbers from look up table.

(e) Add two 8-bit numbers stored in consecutive memory locations.

2. Write an ALP using 8085 to multiply two 8-bit numbers by shift and add method.

3. Write an ALP using 8085 to convert HEX Number to ASCII number.

4. Write an ALP using 8085 to arrange a series of numbers in (a) ascending order (b) descending order.

5. Write an ALP using 8085 to generate a Fibonacci series.

6. Write an ALP using 8085 to pack and unpack a BCD number.

7. Interfacing of peripheral devices with the 8085 microprocessor using 8255 PPI.

(a) To perform the addition of two hex numbers and display the result.

(b) To obtain the complement of a hex number and display the result.

(c) To scroll a bit using a delay subroutine.

8. Write an ALP to convert an analog voltage (0-5 Volts) using the 0809 A/D Converter and display the corresponding digital value suitably using 8085 microprocessor and with 8255 PPI.

9. Write an ALP to display a data in the 7-segment display using 8085 and 8255 PPI.

10. Write an ALP to:

(a) Perform the addition of two 8-bit numbers using 8051 microcontroller.

(b) Swap the nibbles of an 8-bit data (without using the SWAP instruction) using the 8051 microcontroller.

11. One novel experiment beyond the scope of the syllabus.

Course Name: DIGITAL COMMUNICATION					
Course Code : ECEN3105					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

After completing the course the student will be able to:

1. Apply the concepts of various techniques for analog signal transmission and modulation from the knowledge gathered earlier.
2. List the functions of different components of a digital communication system and understand Pulse code Modulation System.
3. Identify some mathematical concepts like probability theory and random process and design the source coder and channel coder blocks of the digital communication system using these concepts.
4. Analyze error performance of a digital communication system in presence of noise and other interferences and apply this knowledge to solve numerical problems.
5. Understand performance of Digital modulation and demodulation techniques in various transmission environments and concept of OFDM and Spread Spectrum Communication system.
6. Design a digital communication system and evaluate the performance of the system in presence of noise.

Module I: [8L]

Elements of Digital Communication System, Pulse code modulation : Sampling, Quantization, quantization noise, linear and non linear quantization, Companding, A-Law and μ -law companding, Source encoding, Differential pulse code modulation, linear predictive coders, Delta modulation, Adaptive delta modulation.

Module II: [13L]

Probability Theory and Random Processes: Concept of probability, Conditional probability, communication example, joint probability, statistical independence, random variable-continuous and discrete, cumulative distribution function, Probability Distribution Function – Gaussian and Rayleigh, mean, variance, random process, stationary and ergodic processes, correlation coefficient, covariance, autocorrelation function and its properties, power spectral density.

Different type of line coding : Properties of line coding – Polar/Unipolar/Bipolar NRZ and RZ, Manchester, Differential encoding and their PSDs, pulse shaping, Inter Symbol Interference (ISI), Eye pattern, Nyquist criterion for zero ISI, equalizer, zero forcing equalizer, Regenerative repeater, Bit synchronization, Frame synchronization.

Module III: [8L]

Signal Vector Representation: Analogy between signal and vector, distinguishability of signal, orthogonal and orthonormal basis functions, orthogonal signal space, message point, signal constellation, geometric interpretation of signals, likelihood functions, Schwartz inequality.

Baseband transmission: Baseband signal receiver, integrate and dump type filter, probability of error calculations, optimum filters, coherent reception, matched filter and its transfer function, Probability of error of matched filter, Concept of error function, complementary error function and Q function.

Module IV: [9L]

Digital Modulation Techniques: Types of Digital Modulation, coherent and non-coherent Binary Modulation Techniques, Geometrical representation, generation, detection, error probability and power spectra of basic digital carrier modulation techniques: ASK, PSK and FSK. Concept of QAM and M-ary Communication, M-ary phase shift keying, average probability of symbol error for coherent M-ary PSK, power spectra of MPSK, Quadrature Phase Shift Keying (QPSK), Generation, detection, error probability and power spectra of QPSK signal, Offset Quadrature Phase shift Queuing (OQPSK), Minimum Shift Keying (MSK), signal constellation of MSK waveforms, error probability of MSK signal, Gaussian Minimum Shift Keying: GMSK, Basic Concept of OFDM and Spread Spectrum Modulation

TEXT BOOKS:

1. Digital Communications, S. Haykin, Wiley India.
2. Principles of Communication Systems, H. Taub and D.L.Schilling, TMH Publishing Co.
3. Digital Communications, J.G.Proakis, TMH Publishing Co.
4. B.P. Lathi, Modern Digital and Analog Communication System, Oxford University Press.
5. Electronic Communications Systems, Wayne Tomasi, Pearson Education.

REFERENCE BOOKS:

1. Digital Communications Fundamentals and Applications, B. Sklar and P.K.Ray, Pearson.
2. Digital Communication, A. Bhattacharya, TMH Publishing Co.
3. Wireless Communication and Networks : 3G and Beyond, I. Saha Misra, TMH Education.
4. L.W. Couch II, Modern Communication System, Prentice Hall India.
5. Roden, Analog & Digital Communication Systems, 5e, SPD
6. Communication Systems (Analog and Digital), Sanjay Sharma, Katson Books

Course Name: Digital Communication Laboratory					
Course Code : ECEN3115					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	3	3	2

Course Outcomes:

After completing the following experiments, students will be able to:

1. Understand, design and implement PN sequences with shift registers, Pulse Amplitude Modulators and demodulators etc.

2. Describe Line codes like polar/ uni polar NRZ, RZ.

3. Analyze various digital modulation and demodulation schemes.

4. Acquire an insight into Digital Communication systems in totality

List of Experiments:

1. Design and implementation of 7-length PN sequences using shift register.
2. Implementation and study of Pulse Amplitude Modulation and demodulation.
3. Study of Pulse Width Modulation and Demodulation
4. Implementation and study of Line Codes : polar/unipolar NRZ , RZ.
5. Implementation and Study of BASK Modulator.
6. Implementation and Study of BASK Demodulator
7. Implementation and Study of BFSK Modulator
8. Implementation and Study of BFSK Demodulator
9. Implementation and Study of BPSK modulator
10. Experiment beyond curriculum.

ECE Department B.Tech., 3rd. Year, 2nd Semester

Course Name: DIGITAL VLSI DESIGN					
Course Code : ECEN3201					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcomes:
After completing the course the student will be able to:

Students will be able to relate to different MOS structures and functions in order to apply the knowledge in building CMOS circuits
2. Students can classify between VLSI Design Cycle, Style and Methodology.
3. Students will be able to determine logic and performance of CMOS combinational and sequential logic.
4. Students will be able to construct physical layout design and stick diagram of digital gates.
5. Students will be able to make use of various synthesis flow and HDL modeling in ASIC Semi custom design.
6. Students will be able to interpret Si testing and debug related algorithms and fault modeling.

Module I: VLSI Design Flow and CMOS Combinational Circuits: [14L]

Unit1: VLSI Design Cycle . Short channel threshold voltage. Design Heirarchy, Layers of Abstraction, Y-Chart, Design Styles, Full Custom Design, Std Cell based Semi Custom Design, Gate Array Design, PLD, FPGA: CLB, LUT, MUX.

Unit 2: Switching Characteristics of MOS Transistors: Capacitive Effects, Process Characteristic Time Constant, propagation delay models, switching delay in logic circuits. High field effects.

Unit 3 : Inverter Characteristics and CMOS Combinational Logic : MOS inverters, CMOS inverter, DC characteristics, Noise Margin and Switching point, switching characteristics, dynamic power dissipation issues. Propagation delay & Delay equation. Static CMOS Logic gate design, pseudo-nMOS gates, pass transistor logic, Logical effort, transmission gate, TG logic, basic idea of dynamic and domino logic.

Module II: CMOS Sequential Circuits and Physical Design[10L]

Unit 1 : Bistability principle, SR Latch circuit, clocked JK Latch/ Master-Slave JK, CMOS D-latch & Edge triggered flip-flop, basic idea of DRAM and SRAM.

Unit 2 : CMOS Cross Section, Layout and Mask layers, Inverter Layout, Lambda Rule vs Micron Rule, Std Cell Layout Topology, Stick Diagram, Euler Path Algorithm .

Module III: Synthesis and HDL [8L]

Unit 1 : Synthesis – High level, Logic level, Brief ideas on partitioning, floorplanning, placement, routing and compaction

Unit 2 : Why HDL ? Frontend Design Flow using HDL (Behavioral, RTL and Gate Level), Verilog Coding, Verilog Modeling: Behavioral, Data-Flow, Structural and Mixed, FSM Example: Mealy Machine and Moore Machine.

Module IV:Test Methodology of VLSI Circuits: [6L]

Unit 1: Si Testing: Why Testing, Challenge of Si-Testing, Manufacturing Defects, Die (Inter and Intra) Variation, Yield, DPM, Logical Fault Modelling: Stuck at Faults (D-Algorithm), Bridging Fault, Transistor Stuck open/Stuck Short, ATPG, DFT, Scan Design, BIST.

Text Books:

1. Principles of CMOS VLSI Design, A Systems Perspective, Author: Neil Weste, Kamran Eshraghian, Addison Wesley, 2nd Edition, 2000 .
2. CMOS VLSI Design, A Circuits and Systems Perspective (3rd Edition) Author: Neil Weste, David Harris, Ayan Banerjee. Pearson, 2011. Fundamental of VLSI Devices – Y. Taur & T.H. Ning- Cambridge University Press.

Reference Books:

3. CMOS Digital Integrated Circuits, Analysis and Design, Author: Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill (3rd Edition), 2006 .
4. Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall
5. VLSI Design and EDA TOOLS, Author: Angsuman Sarkar, Swapnadip De, Chandan Kumar Sarkar, SCITECH PUBLICATIONS (India) Pvt. Ltd., 2011.

Course Name: DIGITAL VLSI DESIGN LABORATORY					
Course Code : ECEN3211					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:
After completing the following experiments, students will be able to:

1. Understand Basics of designing logic gates, LUT etc.
2. Categorize CMOS sequential circuits, Stick diagram etc. and their implications
3. List the Usages of HDL, state machine models
4. Gain insight into Testing of ICs, different techniques.

List of Experiments:

1. Sub Micron and Deep Sub Micron Technology based Experiments:
   Backend Design flow using Tanner Design & Layout Tools and SPICE Analysis
   a. Transient analysis of CMOS Inverter Circuit
   b. DC & Parametric analysis of CMOS Inverter
   c. Layout Design and Verification of CMOS Inverter Using Tanner Tools
   d. Implementation of Various Logic Gates
   e. Implementation of Various Sequential Gates

2. Introduction to XILINX-Vivado Simulator, Verilog Coding and Test Bench Simulation
   a. Logic Design and Verification of Digital Gates, Mux, Encoder, Decoder
   b. Logic Design and Verification of a 15 Bit Ripple-Carry Adder
   c. Logic Design and Verification of Sequential Gates: D-Latch, Flop
   d. Logic Design and Verification of a Finite State Machine

3. FPGA Programming Flow using XILINX Hardware Kits: Implementing and verifying many of above experiments in FPGA hardware Kits.

Course Name : DIGITAL SIGNAL PROCESSING & APPLICATIONS					
Course Code : ECEN3202					
Contact Hours per	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcomes:
After completing this course, the students will be able to:

1 Use concepts of trigonometry, complex algebra, Fourier transform, z-transform to analyze the operations on signals and acquire knowledge about Systems

2 Apply computational tools to evaluate fourier transform on a digital computer , implementation of many signal processing algorithm and designed hardware .

3 Design, implementation, analysis and comparison of digital filters for processing of discrete time signals

4 Application of multirate signal processing for conversion of A/D and D/A and can design multiplexing system for communication.

5 Student can analyze the application of microprocessor with architecture and instruction sets optimized DSP operation.

6 Assess the techniques, skills, and modern engineering tools necessary for analysis of different communication signals and filtering out noise signals in engineering practice. Also develop creative and innovative designs that achieve desired performance criteria within specified objectives and constraints, understand the need for lifelong learning and continuing professional education.

MODULE I: [7L]

Introduction to Discrete time signals and systems:

Concept of discrete-time signal and systems: basic idea regarding sampling and reconstruction of signals, arithmetic operations on sequences, representation of systems, impulse response, derivation for the output sequence, concept of convolution, graphical, analytical methods to compute convolution supported with examples and exercises, properties of convolution, interconnections of LTI systems with physical interpretations, stability and causality conditions, recursive and non-recursive systems

Z-Transform:

Definition, mapping between s-plane and z-plane, unit circle, convergence and ROC, properties of Z-transform, Z-transform on sequences with examples and exercises,

characteristic families of signals along with ROCs, convolution, correlation and multiplication using Z-transform, initial value theorem, Parseval's relation, inverse Z-transform by contour integration, power series & partial-fraction expansions with examples and exercises.

MODULE II: [8L]

Discrete Fourier Transform:

Concept and relations for DFT/IDFT, Twiddle factors and their properties, computational burden on direct DFT, DFT/IDFT as linear transformations, DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circular convolution, computation of circular convolution by graphical, DFT/IDFT and matrix methods, linear filtering using DFT, aliasing error, filtering of long data sequences – Overlap-Save and Overlap-Add methods with examples and exercises.

Fast Fourier Transform:

Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithms, signal flow graphs, Butterflies, computations in one place, bit reversal, examples for DIT & DIF FFT Butterfly computations and exercises.

MODULE III : [13 L]

Filter Concepts:

Introduction to the concept of Digital Filters, frequency response and filter characteristics, basic concepts of IIR and FIR filters .

IIR Filters:

Introduction to analog filter design: Butterworth and Chebyshev filters design, Transformation techniques: Impulse invariant method and bilinear transformation, Warping effect and prewarping. Design procedure for low pass digital Butterworth and Chebyshev filter design.

FIR Filters:

Linear phase filters: Condition for filter to have linear phase response and its frequency response (Type I, II, III, IV),

Design techniques: Fourier series method, Gibb's phenomenon, Windowing method (Rectangular, Hamming and Hanning window). Comparative advantages & disadvantages of FIR & IIR Filters.

MODULE IV: [8L]

Realization of Digital Filters

Direct form I, Direct Form II, Cascade form structure, Parallel form structure.

Multirate Signal Processing

Introduction: Advantage of Multirate Digital Signal Processing

Decimation: Time domain characteristic, frequency domain characteristic, aliasing effect and anti-aliasing filter specification.

Interpolation: Time domain characteristic, frequency domain characteristic .

Introduction to Digital Signal Processor
Evaluation of DSP processor, DSP architecture, TMS320C3XX .

Text Books:

1. Digital Signal Processing – Principles, Algorithms and Applications, J.G.Proakis & D.G.Manolakis, Pearson Ed.
2. Digital Signal processing – A Computer Based Approach, S.K.Mitra, TMH Publishing Co
3. Digital Signal Processing, P. Rameshbabu, Scitech Publications (India).
4. Digital Signal Processing, A. Nagoor Kani, TMH Education .
5. Theory and application of digital signal processing- L.R. Rabiner & B. Gold- PHI.
6. Analog & digital Signal Processing- A. Ambardar- Books/Cole Pub.

References:

6. Digital Signal Processing,Tarun Kumar Rawat,Oxford Press
7. Digital Signal Processing, S.Salivahanan, A.Vallabraj & C. Gnanapriya, TMH Publishing Co .
8. Digital Signal Processing; A Hands on Approach, C. Schuler & M.Chugani, TMH Publishing Co.
9. Digital Signal Processing S. Poornachandra & B. Sasikala, MH Education .
10. Digital Signal Processing; Spectral Computation and Filter Design Chi-Tsong Chen, Oxford University Press .
11. Texas Instruments DSP Processor user manuals and application notes.

Course Name: DIGITAL SIGNAL PROCESSING & APPLICATIONS LABORATORY					
Course Code : ECEN3212					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

After completing the following experiments, students will be able to:

1. Understand the basics of sampling, convolution etc, Z-transform
2. Identify DFT and FFT and their applications
3. Analyze Filters – IIR and FIR
4. Categorize Digital filters, multirate signal processing etc

Simulation Laboratory using standard Simulator:

1. Convolution of two sequences using graphical methods and using commands-verification of the properties of convolution.
2. Z-transform of various sequences – verification of the properties of Z-transform.
3. Twiddle factors – verification of the properties.
4. DFTs / IDFTs using matrix multiplication and also using commands.
5. Circular convolution of two sequences using graphical methods and using commands, differentiation between linear and circular convolutions.
6. Verifications of the different algorithms associated with filtering of long data sequences and Overlap –add and Overlap-save methods.
7. Butterworth filter design with different set of parameters.
8. Chebyshev filter design with different set of parameters.
9. FIR filter design using rectangular, Hamming and Blackman windows.

Hardware Laboratory using Xilinx FPGA:

1. Writing of small programs in VHDL and downloading onto Xilinx FPGA.
2. Mapping of some DSP algorithms onto FPGA.

Course Name: COMPUTER COMMUNICATION & NETWORKING (PROF ELECTIVE 1)					
Course Code : ECEN3231					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Course outcomes:
After completing the course the student will be able to:

1. Understanding of the fundamental concepts of computer networking.
2. Apply the basic taxonomy and terminology of the computer networking area.
3. Identify the different types of network devices and their functions within a network.
4. Understand internetworking principles, routing principles and algorithms such as IP, IPv6, distance vector, and link state.
5. Conclude advanced networking concepts and advanced courses in computer networking.
6. Gain expertise in some specific areas of networking such as the design and maintenance of individual networks.

Module I [8 L]:

Overview of Data Communication and Networking: Introduction; Data communications: components, data representation (ASCII,ISO etc.), direction of data flow (simplex, half duplex, full duplex); network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN,WAN); Internet: brief history, Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study. Physical Level.

Module II [10L]:

Overview of data(analog & digital), signal(analog & digital), transmission (analog & digital) & transmission media (guided & unguided); Circuit switching: time division & space division switch, TDM bus; Telephone Network; Module II Data link Layer: Types of errors, framing(character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ, HDLC; Medium Access sub layer.

Module III [10L]:

Point to Point Protocol, LCP, NCP, Token Ring; Reservation, Polling, Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA Traditional Ethernet, fast Ethernet(in brief); Module III Network layer: Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing : IP addressing, subnetting.

Module IV [10L]:

Routing : techniques, static vs. dynamic routing , Unicast Routing Protocols: RIP, OSPF, BGP; Other Procols: ARP, IP, ICMP, IPV6;. Transport layer: Process to Process delivery;

UDP; TCP; Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm, Module IV Application Layer; Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW; Security: Cryptography (Public, Private Key based), Digital Signature, Firewalls. Modern topics: ISDN services & ATM, DSL technology, Cable Modem: Architecture & Operation in brief Wireless LAN: IEEE 802.11, Introduction to blue-tooth.

Books:

1. B. A. Forouzan – "Data Communications and Networking (3rd Ed.) " – TMH
2. A. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI
3. W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education
4. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP
5. Black, Data & Computer Communication, PHI

Course Name: COMPUTER ARCHITECTURE (PROF ELECTIVE 1)					
Course Code : ECEN3232					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

Course outcomes:
The students will acquire understanding of the following:

1.Overview of computer architectures, BUS, ALU etc.
2. Memory – types of memories,cache, virtual memory etc.
3.Pipeline concept, RISC, CISC, Flynn's classification.
4.VHDL programming, processor architectures like superscalar.

Module I[8L]:
Computer Organization & Architecture, Basic functional Unit, Computer component structure [Eg. Structure of IAS Computer, IBM Machine configuration], Harvard & Von Neumann architecture, BUS architecture, ALU designs [combinational ALU & sequential ALU], Instruction set: Instruction format & types

Module II[10L]:
Memory Organization: Memory system overview, Cache memory organizations, Techniques for reducing cache misses; Hierarchical memory technology: Inclusion, Coherence and locality properties; Virtual memory organization, mapping and management techniques, memory replacement policies

Module III[8L]:
CPU Organization: Fundamentals, Processor-memory communication [Clock cycles and Timing Diagram], Instruction cycle, RISC & CISC based architecture. Pipelining: Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards and structural hazards, techniques for handling hazards, Flynn's classification –SISD, SIMD, MISD, MIMD architectures, Pipeline optimization techniques.

Module IV[10L]:
Instruction-level parallelism: basic concepts, techniques for increasing ILP, superscalar, super pipelined and VLIW processor architectures, Array and Vector processors. Overview of HDL: VHDL basics programming concept, Structural, dataflow, behavioural & mixed style modeling techniques.

Text & Reference books:
1. William Stallings —" Computer Organization & Architecture Designing for performance" , 8/e , Pearson
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky —"Computer Organization", 5/e, MGH
3. Mano M.M—"Computer System Architecture", 3/e,Pearson
4. Kai Hwang & Naresh Jotwani-- " Advanced Computer Architecture Parallelism, Scalability,Programmability",2/e, MGH
5. Pedroni---"Circuit Design And Simulation With VHDL", 2/e, PHI

Course Name: REAL TIME EMBEDDED SYSTEMS (PROF ELECTIVE 1)					
Course Code : ECEN3233					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Course Outcomes:
After completing the course the student will be able to:

1. Understand microprocessors and microcontrollers – their operation and programming.
2. Identify RISC processors from CISC processors and apply them in circuits.
3. Analyse operations of different serial and parallel buses and interrupts.
4. Evaluate different hardware designs and memory configurations.
5. Write RTOS for complex processor-based designs.
6. Design processor and controller based intelligent systems for real life problems.

Module I [8L]:
Introduction to Embedded System : Embedded system VS General computing systems, Purpose of Embedded systems, Design challenge – optimizing design metrics, embedded processor technology, Microprocessor and Microcontroller, Hardware architecture of the real time systems. A/D converter and D/A Converter, RISC vs CISC.

Module II [12L]:
Devices and Communication Buses: I/O types, serial and parallel communication devices, wireless communication devices, timer and counting devices, watchdog timer, real time clock, serial bus communication protocols UART RS232/RS85, parallel communication network using ISA, PCI, PCT-X, Internet embedded system network protocols, USB, Bluetooth. Different types of I/O devices and interfacing: Keypad, LCD, VGA. Design of Control Unit – hardwired and micro programmed control. Horizontal and Vertical instruction. Introduction to I/O interfaces: Interrupts, Interrupt hardware, Enabling and disabling interrupts, Concepts of handshaking, Polled I/O, Memory mapped I/O, Priorities, Stack and Queues. Vectored interrupts, Direct memory access, DMA controller. Sensors and actuators.

Module III [10L]:
Memory: SRAM, DRAM, EEPROM, FLASH, CACHE memory organizations, (direct, associative, set associative mapping), Virtual memory, organization, mapping and management techniques, memory replacement policies. Program Modeling Concepts ; Fundamental issues in Hardware software co-design, Unified Modeling Language (UML), Hardware Software trade-offs DFG model, state machine programming model, model for multiprocessor system. Introduction to ARM SOC architecture, Processor design, ARM Instruction set, ARM organization and implementation.

Module IV [8L]:
Real Time Operating Systems : Operating system basics, Tasks, Process and Threads, Multiprocessing and multitasking, task communication, task synchronization, qualities of good RTOS. Resource Management/scheduling paradigms: static priorities, static schedules, dynamic scheduling, best effort current best practice in scheduling (e.g. Rate Monotonic vs. static schedules), Real-world issues: blocking, unpredictability, interrupts, caching, Examples of OSs for embedded systems - RT Linux, VRTX, Mobile phones, RFID.

Reference Books:

1. Jack Ganssle, "The Art of Designing Embedded Systems", (Newnes), 1999.
2. David Simon, "An Embedded Software Primer", (Addison Wesley), 2000.
3. RTS: Real-Time Systems, by C.M. Krishna and Kang G. Shin, McGraw-Hill, 1997, ISBN 0-07-057043.
4. J. A. Stankovic and K. Ramamritham, Advances in Hard Real-Time Systems, IEEE Computer Society Press, Washington DC, September 1993, 777 pages.Selected papers and references
5. Introduction to Embedded Systems : Shibu K. V. (TMH)
6. Embedded System Design – A unified hardware and software introduction: Frank Vahid, Tony Givargis, (John Wiley)
7. Embedded Systems : Rajkamal (TMH)
8. Embedded Systems : L. B. Das (Pearson)
9. Embedded System design : S. Heath (Elsevier)
10. Embedded microcontroller and processor design: G. Osborn (Pearson)
11. ARM System-on-Chip Architecture, Steve Furber, (Pearson)

Course Name: TELECOMMUNICATION SYSTEMS (PROF ELECTIVE 1)					
Course Code : ECEN3234					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

Course Outcomes:
After completing the course the student will be able to:

1. Apply the previous knowledge of analog communication to appreciate the contents of this paper.
2. Understand basics of Telecommunications and its entities along with the evolution of different types of exchanges.
3. Identify concepts of Telecommunication like signaling techniques, setting up links etc effectively.
4. Describe working principles and practical applications of FAX, EPABX,ISDN etc effectively.
5. List salient features of EWSD, NGN, ADSL etc.
6. Evaluate performance of a telecom network using the concepts of Traffic Engineering and case studies based on the observation.

Module I: (10L)
Introduction to Telephone and Switching Systems
Evolution of Telecommunication, Components and Examples of Telecommunication Systems, Pulse and Tone Dialing, Telephone Instruments- Rotary Dial and Push Button Types, Electro-mechanical switching – Strowger and Crossbar, Circuit Switching and Packet Switching, Digital Switching Systems- Time Division Time Switch, Time Multiplexed Space Switch, Time Multiplexed Time Switch, Hybrid Switching, TS,ST,STS,TST systems, Architecture of 5ESS systems.

Module II: (8L)
Telecommunication Transmission Lines and Subscriber Loop Systems (8L)
Copper, co-axial and Fiber-Optic cables, Transmission Fridge- Hybrid Circuit for 2-wire to 4-wire conversion and vice versa. PCM Carriers, American and European standards of carrier channels.
BORSCHT Functions, Switching Hierarchy and Routing, Signaling Techniques- In channel and Common Channel Signaling, Signaling System 7 (SS7).
Introduction to Global Telecom Link through Satellite Networks

Module III: (10L)
Stored Program Control
Software architecture, Application Software, Electronic Exchanges, Introduction to Cordless Telephones and Digital PABX.
Introduction to Modems, FAX, Broadband Transmission- ISDN, DSL, ADSL, ISDN, B-ISDN, Introduction to IP Telephony.
INTRODUCTION TO NEW GENERATION OF ELECTRONIC EXCHANGES- EWSD (ELECTRONIC WORLDWIDE SWITCH DIGITAL), NGN (NEXT-GENERATION NETWORK)

Module IV: (8L)
Traffic Engineering
Blocking network, Blocking Probability, Grade of Service, Traffic Load, Erlang-B congestion formula- case studies

Text Books:

a) T. Viswanathan "Telecommunication Switching System and Networks", PHI
b) J.C Bellamy "Digital Telephony" – Wiley India

Reference Books:

a) O Hersent, D Gurle, J P Petit " IP Telephony" Pearson
b) J. E Flood " Telecommunication Switching, Traffic and Networks" Pearson
c) R L Freeman " Telecommunication System Engineering" Wiley-India
d) A Gokhale " Introdcution to Telecommunication" – Cengage Learning

Course Name: FIBER OPTIC COMMUNICATION (PROF ELECTIVE 2)					
Course Code : ECEN3241					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Course Outcomes:
After completing the course the student will be able to:

1. Apply the basic idea of electronics, physics and solid state devices and explain the operation of different components in an optical communication system.
2. Understand the properties of optical fiber and categorize the transmission characteristics of a wave through the optical fiber.
3. Analyze the structure of various optical sources and can classify them according to the performance, efficiency and application.
4. Explain the operation of optical detectors and can analyze the performance parameters of a detector.
5. Recognize the current optical technologies used for long distance communication and their application in optical networks.
6. Solve the problems related to optical fiber communication and can justify the physical significance of the solutions.

Module I [6L]:
Introduction to communication systems: Principles, components; Different forms of communications in brief, advantages of optical fiber communication, spectral characteristics. Optical Fiber wave guide: Planar & Cylindrical, Structure & fabrication of optical fiber, Single and Multimode operation; Attenuation, Material and wave guide dispersion. Fiber splices, Fiber optic connectors, OTDR.

Module II [10L]:
Optical Sources: Light Emitting Diode; principle, structures, power and efficiency, Surface Emitting LED and Edge emitting LED, Super luminescent diode (SLD), coupling of LEDs to fibers. Modulation response of an LED. Laser diodes; principle, double heterostructure, gain and index guiding, distributed lasers. Quantum Well Lasers; Modes and narrow linewidth lasers. Modulation; Bandwidth for modulation, Optical transmitters: components.

Module III [12L]:
Optical Detectors: Photo diodes, Photo conducting detectors, Photo Transistors, optical detection principles, efficiency, responsivity, bandwidth. Preamplifiers; noise sources, signal to noise ratio. Point-to-point link and Wavelength Division Multiplexing: Building blocks; Multiplexing; Intensity Modulation/Direct Detection system; Principle of Regeneration; WDM link, Optical amplifiers; EDFA, SOA, Raman amplifier, Fabry-Perot filters. Dispersion compensation and management, Link analysis and Bit-Error-Rate calculation.

Module IV [8L]:
Optical Network: [4] LAN, MAN, WAN; Topologies: bus, star, ring; Ethernet; FDDI; Telecom networking:SDH/SONET. Different forms of access networks: [4] Telephony; ISDN; Cable TV; Broadcast and Switched Networks; HFC networks.

Books:

1. Optical Networks – A practical perspective : Rajiv Ramaswami, K. N. Sivarajan, Galen H. Sasaki (Morgan-Kaufman)
2. Optical Fiber Communication : John M. Senior (Pearson)
3. Optical Fiber Communication : Gerd Kaiser (TMH) 4. Optical Communication Systems : John Gawar (PHI)
4. Fiber Optics and Optoelectronics, R. P. Khare, Oxford University Press

Course Name: POWER ELECTRONICS (PROF ELECTIVE 2)					
Course Code : ECEN3242					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Course Outcomes:
After completing the course the student will be able to:

1. Power control devices.
2. Rectifiers – types, PF, inversion etc.
3. DC line commutation, choppers, three phase circuits.
4. Inverters, SMPS etc.

Module I [10L]:
Power semiconductor devices Power diodes- general purpose diode, fast recovery diodes, Schottky diode, PNPN diodes, DIACS Thyristors, TRIACS, G.T.O. devices. Power Transistors, Power MOSFET, Rating, Losses and Cooling. Triggering circuits for SCR's, UJT, Blocking Oscillators, Schmitt trigger circuits – Power MOS gate drive circuits.

Module II [10L]:
Uncontrolled and controlled Rectifiers : Single phase and poly phase Bridge rectifiers. Transformer ratings. Inductive load, free wheeling diodes. Single phase & Three phase Converter operation: Overlap, power factor and its improvement, inversion, regulation, P-pulse converters, power factor control via PWM converters.

Module III [8L]:
D.C. line commutation : Series and parallel capacitor turn off, resonant turn off, impulse commutation. D.C. Choppers : Principles, classification, use. Frequency conversion : Cyclo-converter single and three phase circuits, blocked group operation, circulating current mode.

Module IV [8L]:
Single phase and three phase inverters, constant voltage source and constant current source inverters, HF inverters for heating. Application : D.C. and A.C. drives, S.M.P.S., Resonant converters, A.C. Line Filters, ratio, interference suppression. HDVC transmission. Speed control of AC/DC motors.

BOOKS :

1. Rammurthy M – An Introduction to Thysistors and their applications
2. Lauder C W - Power Electronics, 3rd Edn. MHI 1993
3. Sen P C – Power Electronics, TMH
4. Rashid M H – Power Electronics, PHI Pub.

5. Dubey S K – Thysistorised Power Controller; John Wiley & Sons

Course Name: ANTENNA DESIGN AND RADAR TECHNOLOGY (PROF ELECTIVE 2)					
Course Code : ECEN3243					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Course Outcomes:
After completing the course the student will be able to:

1. Apply their pre-requisite knowledge from electromagnetic field theory.

2. Develop the ability to analyze the radiation pattern of different dipole antenna configurations and identify respective areas of application.

3. Understand pattern synthesis and analysis in linear antenna array.

4. Identify different application areas of travelling wave and aperture antennas.

5. Comprehend fundamental aspects of Radar Technology.

6. Understand need of different Radar configurations, customized for specific application.

Module-I [10L]:

A. Review of Maxwell's Equation; Radiation of e.m waves and introducing Antenna; Vector Potential and Retarded Vector Potential; Radiation fields of a Hertzian dipole(electric); Duality Principle, Radiation fields due to short magnetic dipole.
B. Antenna Characteristics: Radiation Pattern, Beam Width; Radiation Resistance and efficiency; Directivity and Gain; Impedance, VSWR, Polarization; Effective height and Receive Aperture; Return Loss, Impedance Bandwidth.

Module- II [10L]:

A. Radiation fields and Characteristics of $\lambda/2$ dipole; discussion on $\lambda/4$ monopole antenna; Current distribution and Radiation patterns of center-fed dipoles of length λ, $3\lambda/2$ and 2λ. Horizontal and Vertical antennas over a plane ground.

B. Antenna Arrays: electric Field due to 2 element arrays, 3 element Arrays; Pattern Multiplication; Uniform Linear Array: End fire and Broad side; Phased array.

Module- III [10L]:

A. Characteristics and properties of :Travelling Wave Antenna, Helical Antenna, Folded Dipole, Yagi-Uda Array, Loop Antenna, Electrically Short Antennas, Broad Band Antenna (Log periodic Antenna), Rhombic Antenna, Microstrip Patch Antenna.
B. Radiation from an aperture: Sectoral and Pyramidal Horn Antennas, Design of Optimum Horn Antenna; Parabolic and Corner Reflectors and feed systems.
[Major stress on Characteristics features, applications (including frequency at which used), advantages and disadvantages, major design principles and equations (without long and detailed derivations]

Module-IV [10L]:
A. Historical background, radar terminology, radar band designations, Radar block diagram, Radar Range equation: detection of signals in noise and signal-to-noise ratio, Radar cross section, distributed targets, Transmitted power, pulse-repetition frequency, antenna parameters & system losses. Radar display, Radome, Different system losses in a radar system, Different scanning mechanism for radar antenna.

B. Pulse radars and CW radars, Advantages of coherent radar, Doppler radar and MTI: Doppler effect, delay-line cancellers, blind speed, Moving Target Detector, limitations of MTI. Mono pulse radar, Phased array radar.

Recommended (Text Books):

1. Antenna (for all application), John D. Kraus and Ronald J. Marhcfka; Tata- MacGraw Hill, 3 rd Edition
2. Antenna & Wave Propagation, K.D Prasad; Satya Prakashan, New Delhi, 3rd Edition
3. Antenna Theory: Analysis & Design, Constantine A. Balanis; Willey, 3rd Edition
4. Antenna and Wave Propagation, Sisir K. Das and A. Das: Mc Graw Hill Education, Reprint Edition (2013).
5. Introduction to Radar systems, M. I. Skolnik, Tata McGraw Hill Publishing Company

Reference Book :

1. Elements of Electromagnetics; Mathew N.O. Sadiku, Oxford University Press, 5th Edition (2010).
2. Electromagnetic Waves & Radiating Systems, EC Jordan & K.G. Balmain; Pearson Education, 2nd Edition (2009)
3. Microstrip Antenna Design Handbook- Ramesh Garg; Artech House (2001)

Course Name: OBJECT ORIENTED PROGRAMMING USING C++					
Course Code : CSEN3004					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

Students who complete the course will demonstrate the ability to do the following:

1. Learn object oriented concepts and various syntax and semantics using C++ and merits of object oriented approach over procedural approach.
2. Understand various properties of OOP for appropriate use in problem solving.
3. Analyze the real life problem to identify the related objects and abstract them to classes
4. Apply various object oriented properties and reusable components in solution building.
5. Evaluate for using standard patterns and for improving performance of solution using exception handling.
6. Develop the object oriented application using C++.

Module-I:

- **Overview of Object Oriented Concepts [2L]**
  - Difference between OOP and other conventional programming – advantages and disadvantages
  - Class, object, message passing, inheritance, encapsulation, polymorphism
- **Basic Programming with C++ [6L]**
  - Data Types, Operators
  - Control Statements and Loops
  - Functions and Parameters
  - Arrays, Pointers and References
  - String Manipulation

Module-II:

- **Classes and Objects [10L]**
  - Fundamentals of Class and Object
  - Abstraction, Encapsulation, Access Specifier
  - Static Member and Friend Function
  - Constructor and Destructor

Module-III:

- **Overloading and Inheritance [8L]**
  - Function Overloading
  - Operator Overloading
  - Inheritance
  - Derived Class
- **Polymorphism and Overriding [4L]**
  - Abstract Class
  - Runtime Polymorphism
  - Virtual Base Class
  - Overriding

Module-IV:

- **Exception Handling [2L]**
- **Namespace [2L]**
- **Templates [4L]**
  - Class Template
  - Function Template

Textbooks / References:

1. Bjarne Stroustrup – "The C++ Programming Language" – Pearson
2. E Balagurusamy – "Object Oriented Programming with C++" – 6th Edition – McGraw Hill
3. Robert Lafore – "Object-oriented Programming in C++" – SAMS Publishing
4. Steve Oualline – "Practical C++ Programming" – O'Reilly
5. James Rambaugh & Michael Blaha – "Object Oriented Modeling and Design" – Prentice Hall, India

Course Name: OOPs LABORATORY					
Course Code : CSEN3014					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

Assignments on: [based on Lectures]

1. Basic Programming
2. Class
3. Constructor
4. Overloading
5. Inheritance
6. Polymorphism
7. Overriding
8. Exception Handling
9. Templates

Note: use C++ for programming to carry out assignments based on lectures

Course Name: PRINCIPLES OF MANAGEMENT					
Course Code : HMTS3201					
Contact Hours per week	L	T	P	Total	Credit Points
	2	0	0	2	2

Module I:

Management: Definition, nature, purpose and scope of management, Skills and roles of a Manager, functions, principles; Evolution of Management Thought: Taylor Scientific Management, Behavioral Management, Administrative Management, Fayol's Principles of Management, Hawthorne Studies. **(4L)**

Module II:

a) **Planning:** Types of plans, planning process, Characteristics of planning, Traditional objective setting, Strategic Management, premising and forecasting.

b) **Organizing:** Organizational design and structure, Coordination, differentiation and integration.

c) **Staffing:** Human Resource Management and Selection, Performance appraisal and Career strategy, Managing Change.

d) **Decision-Making:** Process, Simon's model of decision making, creative problem solving, group decision-making.

e) **Coordinating:** Concepts, issues and techniques.

f) **Controlling:** Concept, planning-control relationship, process of control, Types of Control, Control Techniques (**8L)**

Module III:

Span of management, centralization and de-centralization Delegation, Authority & power - concept & distinction, Line and staff organizations. **(4L)**

Module IV:

Organization Behaviour: Motivation, Leadership, Communication, Teams and Team Work**. (6L)**

Module V:

Management by Objectives (MBO): Management by exception; Styles of management: (American, Japanese and Indian), McKinsey's 7-S Approach, Self Management. **(2L)**

Evaluation:

Max. Marks-100
Internal Test-30
Semester End Test-70

Suggested Readings:

1. Harold Koontz & Heinz Weihrich, Essentials of Management, TMH.
2. Stoner, Freeman, Gilbert Jr., Management, PHI.
3. Bhatt & Kumar, Principles of Management, OUP.

Course Name: ELECTRONICS CIRCUIT DESIGN LABORATORY					
Course Code : ECEN3221					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

COURSE OUTCOME:

After completing the following experiments, students will be able to:

1. Apply their previous theoretical knowledge of Analog and Digital circuits.
2. Design and test Audio amplifiers.
3. Design and test D.C power supply for their various parameters
4. Design digital circuits using ICs

1. Design of Audio Amplifier with given gain. Measurement of distortion.

2. Design of regulated DC power supply and measurement of ripple factor, efficiency etc.

3. Design of active filters of types i)LPF ii)HPF iii)BPF and plotting frequency Vs. output characteristics of the filters against given design parameters.

4. Design of digital sequencers and practical implementation of reduction techniques like Karnaugh Map.

5. Application circuits using timer ICs.

Course Name: PERSONALITY DEVELOPMENT					
Course Code : HMTS3221					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	0	1	1

Module I:
Self-Growth
i)Self Growth- Maslow's Hierarchy of Needs Theory

ii) Anger, Stress & Time Management- Theories and application

iii) SWOT Analysis

Module II:
Stepping Up
i)Growth & Environment

ii)Competitive Spirit
iii)Responsibility Factor

Module III:
Professional Communication
i) Impression Management- theory on social psychology
ii)Employability Quotient
iii)Cross-cultural communication

Module IV:
Leadership & Team Playing
i)Leadership & Team Playing: Theories, Styles, Stages
ii) Motivation, Negotiation Skills, Conflict Management
iii)Planning & Envisioning: Initiative and Innovation in the Work Environment- De Bono's Six Thinking Hats

Evaluation:
Max.Marks-100(sessional)
25 marks/ module
Methodology: Assignment and project

Suggested Reading:

1. Personality Development and Soft Skills by Barun K. Mitra, Oxford University, 2011

2. Soft Skills: An Integrated Approach to Maxmise Personality by Gajendra Singh Chauhan and Sangeeta Sharma, Wiley, 2016

3. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success by Gopalaswamy Ramesh and Mahadevan Ramesh, Pearson, 2010

ECE, B.Tech. Final year Syllabus, 1st. Semester

Course Name : RF & MICROWAVE ENGINEERING					
Course Code : ECEN 4101					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course outcomes:
After completing this course, the students will be able to:

1. Apply previous E.M. theory concepts to understand microwave engineering.
2. Identify high frequency electromagnetic wave propagation characteristics through guided media.
3. Analyze microwave passive components and circuits.
4. Students should be able to enhance their knowledge on semiconductor and vacuum tube devices operating at high frequency.
5. Design high frequency filters and amplifiers.
6. Implement the concepts in developing different prototype microwave systems.

Module	Topics	Hours
1	**Introduction** RF & Microwave Spectrum, Typical applications of RF and Microwave Engineering, Safety considerations	1
	Waveguides and Resonators Rectangular waveguides, TE & TM modes, TE_{10} mode analysis, cut-off frequency, propagation constant, intrinsic wave impedance, phase and group velocity, Power transmission, attenuation, waveguide excitation, wall current; Introduction of circular waveguide; Rectangular waveguide resonator- Design consideration, resonant frequency, Q-factor, excitation. Circular waveguides, TE_{11} mode analysis. Rectangular waveguide resonator- Design consideration, resonant frequency, Q-factor, excitation.	8
	Planar Transmission Lines Micro-strip lines, Coplanar waveguide, Slot line-design consideration, field patterns, propagation characteristics, Comparison for different characteristics of the above mentioned lines.	2
2	**Waveguide Passive Components and their S-matrix Representation** N-port networks-Properties of S matrix, Transmission matrix & their relationships; Microwave passive components and their S matrix representation: Attenuators, Phase shifter, Directional coupler, Bethe-hole coupler, Two hole coupler, Magic tee, hybrid ring, Circulators, Isolators	7
	Impedance Matching Networks Stub matching, Quarter wave matching, Introduction to theory of Small Reflections and tapered lines.	4

3	**Microwave Tubes** Electron beam & Field interaction for energy exchange in resonant (two cavity klystron, Reflex Klystron, Magnetron) and TWT microwave active devices: Typical characteristics &applications (only physical explanation is required, no mathematical derivation required).	5
	Semiconductor Microwave devices TED (Gunn diode) & Avalanche Transit Time (IMPATT) device, Schottky diode, PIN diode characteristics & applications; Microwave bipolar transistor, Microwave field effect transistor (MESFET)	4
4	**Microwave Filter Design** Design procedure of filter design using insertion loss method (maximally flat and equi-ripple), low pass prototype design, conversion to other filter prototypes.	5
	Microwave Amplifier Design Basic consideration in the design of RF amplifier- Transistor S-parameter, Stability, matching network, noise figure; Matching network design using lumped elements and L-Section. Brief introduction to NBA, LNA	6

Text books:

1. Microwave Engineering, 3rd edition David M. Pozar, Wiley & Sons Inc.
2. Microwave Engineering, Monojit Mitra, Dhanpat Rai & Co.
3. Microwave Engineering, A Das & S Das, TMH.
4. Microwave Devices & Circuits, SY Liao , Pearson Education /PHI
5. Microwave Engineering Fundamentals, Design and Applications, Subal Kar, University Press

References:

6. Microwave Engineering-Passive Circuits, PA Rizzi , Pearson Education.
7. Microwaves, K C Gupta, New Age Publishers.
8. Foundation of Microwave Engineering, 2ed edition, Robert E Collin, McGraw Hill, Inc.
9. Microwave Devices & Circuit Design , GP Srivastava & VL Gupta, PHI
10. Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design, M. Radmanesh, Authorhouse

Course Name : RF & MICROWAVE ENGINEERING LABORATORY					
Course Code : ECEN 4111					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

COURSE OUTCOME:

After completing the following experiments, students will be able to:

1. Understand electromagnetic wave propagation at high frequency.
2. Identify the difference between active and passive microwave devices.
3. Analyze and Characterize Microwave Devices.
4. Design measurement setup to perform analysis of microwave devices.

List of Experiments:

1. Determination of phase and group velocities in a waveguide carrying TE10 Wave from Dispersion diagram [ω-β Plot].
2. Measurement of unknown impedance using shift in minima technique using a waveguide test bench/ Measurement of the susceptance of an inductive and or a capacitive window using shift in minima technique using a waveguide test bench
3. Study of the characteristics of a Reflex Klystron oscillator
4. Study of Gunn Diode Characteristics using X-band waveguide test bench
5. Study of a Microwave Filters (LPF/BPF/HPF) using waveguide test bench.
6. Scattering matrix of a magic tee / E-plane tee / H-plane tee using waveguide test bench at X-band.
7. Measurement of Coupling factor, Directivity, Insertion loss and Isolation of a Directional coupler using X-band waveguide test bench set up.
8. Measurement of dielectric constant of a material using waveguide test bench at X-band.

Reference Books:

1. ML Sisodia & GS Raghuvanshi Basic Microwave Techniques and Laboratory Manual; Wiley Eastern Limited 1987
2. EL Gintzton Microwave Measurements, McGraw-Hill Book Co.
3. M Sucher and J Fox, Handbook of Microwave Measurements, Vol I, Wiley-Interscience Inc.

Course Name: CODING & INFORMATION THEORY					
Course Code: ECEN 4102					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:
After completing this course, the students will be able to:

1. Apply the concept of probability and estimate entropy, mutual information and channel capacity.
2. Design different source codes and measure efficiency and redundancy.
3. Use the concept of mathematics and Boolean algebra, to analyze different error detection and correction mechanism.
4. Formulate encoding and decoding technique of linear block code.
5. Construct cyclic code to detect and correct error efficiently.
6. List the concept of BCH code using linear algebra and construct the convolution code encoder and importance of Viterbi decoding.

1. Information theory, Source coding and channels [10L]
Uncertainty and information, measure of information, average, mutual information and entropy, information measures for continuous random variables, source coding theorem, Huffman codes, Shanon- Fano coding.
Channel models, channel capacity, channel coding, information capacity theorem, The Shannon limit.

2. Linear Block Codes [7L]
Matrix description of linear block codes, parity check matrix, decoding of a linear block code, Syndrome and Error detection, Minimum distance,Error detecting and Error-correcting capabilities, Standard Array , equivalent codes, perfect codes, Hamming codes.

3. Cyclic and Convolutional Codes [10L]
Code Polynomials, Generator Polynomials, Division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes,Decoding of cyclic codes.Golay codes, LFSR.
Tree codes, Trellis codes, Polynomial description of convolutional codes, Distance notions for convolutional codes, the generating function, decoding of convolutional codes, distance and performance bounds for convolutional codes, examples of convolutional codes, Turbo codes, Turbo decoding.

4. Linear Algebra and BCH code: [11L]
Introduction to Linear Algebra, Introduction to Galois Field, Primitive elements, generator polynomials in terms of minimal polynomials, Calculation of minimal polynomial.
Elementary concept of BCH Codes, Encoding and Decoding, Elementary concept of Reed Solomon Code

Books :

1. Information theory, coding and cryptography - Ranjan Bose; TMH.
2. Information and Coding - N Abramson; McGraw Hill.
3. Introduction to Information Theory - M Mansurpur; McGraw Hill.
4. Information Theory - R B Ash; Prentice Hall. 8. Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall.
5. Introduction to Error Control Codes – S Gravano; Oxford Press

Course Name : ADVANCED COMMUNICATION SYSTEMS					
Course Code : ECEN 4103					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcome:
After completing this course, the students will be able to:

1. The students will learn about the evolution of radio communication.
2. They will be able to appreciate the challenges of RF communication.
3. Different wireless networks and their operations will be clear to them.
4. The students will learn about the new technologies like SDR and Cognitive radios.
5. They will be able to understand the functioning of WI-FI networks.
6. Our students will be able to take up research work in communication domain.

MODULE – I:

Cellular Mobile Wireless Networks: Systems and Design Fundamentals:

Brief introduction to mobile wireless communication and systems, Description of cellular system, Cellular Structure, Frequency Reuse, Cell clustering, Capacity enhancement techniques for cellular networks, cell splitting, antenna sectoring, Co-channel and Adjacent channel interferences, Channel assignment schemes, mobility management, location management and handoff management. (6L)

Characteristics of wireless channel and propagation path loss models:
Fading, different types of fading, Inter symbol interference, fast fading model, Doppler effect due to velocity of mobiles, Rayleigh envelop, free space propagation model, two ray ground reflection model, log distance path loss model, log normal shadowing model, types of base stations and mobile station antennas. (4L)

MODULE – II:

Modern Mobile Wireless Communication Systems:

Evolution strategies – First Generation (1G) to Fourth Generation (4G), Introduction to SDR, Introduction to CR. (3L)

Multiple Access Technologies in cellular communication
Time division multiple access (TDMA), variants like narrowband and wideband TDMA, Frequency division multiple access (FDMA), Code Division Multiple Access (CDMA), Direct-sequence CDMA, spread spectrum technique, spectral efficiency of different wireless access technologies. (3L)
Cellular Communication Networks and Systems
Second generation (2G) Network: Global system for mobile communication (GSM): Architecture and Protocols, Air Interface, GSM spectrum, GSM Multiple Access Scheme, GSM Channel Organization, Traffic Channel multi-frame, Control (Signalling) Channel Multi-frame, Frames, Multi-frames, Super-frames and Hyper-frames, GSM Call Set up Procedure, Location Update Procedure, Routing of a call. (3L)
The concept of Packet data Services : 2.5G General Packet Radio Services GPRS network architecture, GPRS interfaces and reference points, GPRS Mobility management procedures,GPRS attachment and detachment procedures (3L)

Overview of CDMA systems: IS-95 Networks and 3G – Th e Universal Mobile Telecommunication System (UMTS) CDMA based IS-95 Systems, forward link and reverse link for IS-95, handoff process in CDMA based IS-95 network. UMTS Network Architecture –Release 99, UMTS Interfaces, UMTS Network Evolution, UMTS FDD and TDD, UMTS Channels, Logical Channels, UMTS Time Slots (3L)

Module III:

Wireless Local Area Networks (WLAN): IEEE 802.11 Standards and Protocols

IEEE 802.11 standards, WLAN family, WLAN transmission technology, WLAN system architecture, Collision Sense Multiple Access with Collision Detection (CSMA/CD) and CSMA collision avoidance (CSMA/CA), Frequency Hopping Spread Spectra, 802.11 PHY and MAC layers, IEEE 802.11 Distributed Coordination function (DCF) and Point coordination function (PCF), Back off algorithm. (4L)

Wireless Broadband Networks and Access:

Evolution of broadband wireless, IEEE 802.16 standards : **WiMAX** , Spectrum Allocation, IEEE 802.16 Standard Architecture, Overview of WiMAX PHY, IEEE 802.16 MAC Layer, IEEE 802.16, Orthogonal Frequency Division Multiple Access (OFDMA) (3L)

MODULE – IV:

Mobile Internet Protocol

Basic Mobile IP, Mobile IP Type-MIPV4 and MIPv6, Mobile IP: Concept, Four basic entities for MIPv4, Mobile IPv4 Operations, Registration, Tunneling, MIPv4 Reverse Tunneling, MIPv4 Triangular Routing, Configuring PDP Addresses on Mobile Station, Mobility Classification, Seamless Terminal Mobility Management, Limitations of current TCP/IP networks for mobility support, Mobility solution. (4L)

Text books:

1. Wireless Networks: Applications and Protocols, T.S. Rappaport, Pearson Education
2. Wireless Communication and Networks : 3G and Beyond, I.Saha Misra, TMH Education.
3. Wireless Communications : Principles and Practice, T.S.Rappaport, PHI Learning.
4. Wireless Communications, A. Goldsmith, Cambridge University Press.
5. Mobile Communication Engineering W.C.R Lee (TMH)

Reference books:

1. Wireless Digital Communications: Modulations and Spread Spectrum Applications, K. Feher, Prentice Hall.
2. Wireless Communications and Networking, J.W.Mark and W. Zhuang, PHI.

Course Name : ADVANCED COMMUNICATION SYSTEMS LABORATORY					
Course Code : ECEN 4113					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**2**	**2**

Course Outcomes:

After completing the following experiments, students will be able to:

1. Correlate different theories of wireless communication and fiber optics with practical experiments
2.Understand operations of repeater station, GPS and GSM cellular systems
3. Sort procedures for testing radio parameters
4.Learn working of fiber optic links

List of Experiments:

1. Study of working of Repeater stations with the help of Satellite communication system

2. Study of Global system for Mobile (GSM) system along with waveforms of different timing signals

3. Study of Global Positioning System (GPS) and plotting of active satellites with SNR etc.

4. Measurement of some important receiver parameters of a radio receiver like: i) SNR ; ii) Distortion with ISM band radio.

5. Measurement of some important transmitter parameters of a radio receiver like: VSWR for i) different antennae and ii) at different frequencies with ISM band radio.

6. Measurement of propagation loss, bending loss and connector loss in an optical fiber

7. Study of LASER characteristics

8. Measurement of wavelength of an optical fiber source

9. Study of a fiber optic analog link, study of PAM

10. Study of Frequency Division Multiplexing (FDM) and De multiplexing

11. Study of a fiber optic data link and study of TDM

12. Measurement of numerical aperture of an optical fiber

At least, 8 experiments are to be carried out in the semester.

Course Name: PROFESSIONAL DEVELOPMENT					
Course Code : HMTS4121					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	3	3	2

Module1: Professional Growth

- Goal Setting- Characteristic of goals, Short-term and long-term goals, Goal-achievement timeline
- Skill identification and Skill up gradation- Washington Accord and Skills for engineers (generic and specific), Local and global skills, Knowledge sources such as MOOC, NPTEL
- Career Planning- Vision and mission, Skill mapping to job profile, Basic and add-on qualifications, Career growth, Self-appraisal, Lifelong learning

Assessment - Activity (20 marks)

Module 2: Entrepreneurship

- The start-up ecosystem in India- Why entrepreneurship?, Indian tech start-up landscape, Stand-up India policies, funding agencies, market development, trends and best practices
- E-Commerce- India as a growing E-commerce market, Possibilities of growth, funding, niche retailers
- Make in India- New processes, Investments, Focus sectors, Makers of Make In India, Opportunities, Policies

Assessment-Project (30 marks)

Module 3: Industry specific opportunities

- Industry prospects in India and Beyond
- Industry-specific job opportunities
- Research & Development
- Other opportunities

Assessment---Presentation (30 marks)

Module 4: Working and living happily

- Managing crisis- Organizational and personal crisis, Analyzing crisis, Turnaround strategies, Learning from crisis as opportunity
- Work-life balance- Performance-expectation management, Personal and professional goal- mapping
- Understanding happiness- Components, Conflicts, Happiness Index

Assessment: Activity/case (20 marks)

Suggested Reading:

1) **Basic Managerial Skill for All by E. H. McGrath.SJ. Pub:PHI, New Delhi.**
2) **The Start-up Equation by Steven Fisher and Jae-Nae Duane. Pub: Mc Graw Hill Education (India) Pvt. Ltd. New Delhi.**
3) **Live Happily, Work Happily by Siddhartha Ganguli. Pub: Allied Publishers Pvt.Ltd. New Delhi.**
4) **Crisis Management: Planning for the Inevitable by Steven Fink. Pub: iUniverseInc.USA.**
5) **Influencer:The New Science of Leading Change by Joseph Grenny&Kerey Patterson. Pub:McGraw Hill Education , USA.**

FREE ELECTIVES (Offered by ECE department) IN THE FIRST SEMESTER:

Course Name: VLSI DESIGN AUTOMATION					
Course Code : ECEN 4181					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:
After completing this course, the students will be able to:

1. Relate to different MOS structures and functions in order to apply the knowledge in building CMOS circuits.
2. Determine logic and performance of CMOS combinational as well as sequential logic and apply the lambda based design rules.
3. Construct physical layout design and stick diagram of digital gates.
4. Classify between VLSI design cycle, style and methodology and also build various stages of miniaturization.
5. Make use of various synthesis flow and HDL modeling in ASIC semi custom design.
6. Build different logical synthesis algorithm and also differentiate between different physical design automation algorithms.

Module I: VLSI Circuits & Physical Layout: [12L]

Unit1: MOS Transistor Characteristics, MOS as Digital Switch, NMOS Logic Family, CMOS Logic Family, CMOS Inverter Characteristics (VTC), Inverter Delay & Noise, NAND and NOR gates, Complex Logic Circuits, Pass Transistor Logic & Transmission Gate, CMOS Sequential Circuits, CMOS D-Latch and D-Flip-Flop

Unit2: CMOS Cross Section, Layout and Mask layers, Inverter Layout, Lambda Rule vs Micron Rule, Std Cell Layout Topology, Stick Diagram, Euler Path Algorithm, Layout Legging.

Module II: VLSI Design Methodology: [8L]

Unit1: Moore's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI, GSI), Technology growth and process Node,

Unit2: Full Custom Design, Std Cell based Semi Custom Design, Gate Array Design, PLD, FPGA: CLB, LUT, MUX, VLSI Design Cycle, Y-Chart.

Module III: EDA Tools: High level Synthesis and HDL: [8L]

Unit1: High level Synthesis EDA Flow, Control and Data Flow Graph, Scheduling, Allocation, Binding, RTL

Unit2: Why HDL ? Frontend Design Flow using HDL (Behavioral, RTL and Gate Level), Verilog Modeling: Behavioral, Data-Flow, Structural and Mixed, Test Bench, FSM Example: Mealy Machine and Moore Machine. Pipeline Example.

Module IV: EDA Tools: Logical Synthesis and Physical Design Automation: [12L]

Unit1: Combinational Logic Optimization: BDD: Binary Decision Diagram, OBDD, ROBDD, and Technology Mapping: Pattern DAG, Subject DAG, Sequential Logic Optimization

Unit2: Physical Layout Automation EDA Flow, Partitioning: KL Algorithm, Floor-planning cost function, Placement, Detailed Routing: Channel Routing, Horizontal Constraint

Graph, Vertical Constraint Graph, Cyclic Constraint, Left-edge Algorithm, Global Routing: Steiner Tree, Maze Routing.

Text Book:

1. Principles of CMOS VLSI Design, A Systems Perspective, Author: Neil Weste, Kamran Eshraghian, Addison Wesley, 2nd Edition, 2000
2. Algorithms for VLSI Physical Design Automation, Author: N. Sherwani, KLUWER ACADEMIC PUBLISHERS (3rd edition)

Reference Book:

1. CMOS Digital Integrated Circuits, Analysis and Design, Author: Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill (3rd Edition), 2006
2. CMOS VLSI Design, A Circuits and Systems Perspective (3rd Edition) Author: Neil Weste, David Harris, Ayan Banerjee. Pearson, 2011
3. Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall
4. VLSI Design and EDA TOOLS, Author: Angsuman Sarkar, Swapnadip De, Chandan Kumar Sarkar, SCITECH PUBLICATIONS (India) Pvt. Ltd., 2011
5. Algorithms for VLSI Design Automation, Author: Gerez, Wiley, 2011

Course Name	: C O N T R O L S Y S T E M S				
Course Code : ECEN 4182					
	L	T	P	Total	Credit Points
Contact Hours per week	3	0	0	3	3

Course Outcomes:
After completing this course, the students will be able to:

1. Apply the previous knowledge gathered from Mathematics and Signals & Systems.
2. Understand the mathematical model of physical systems and study their nature, configuration and relevant mapping in equivalent models.
3. Evaluate stability related issues in time response, error analysis and stability analysis in advanced way for different types of control systems.
4. Evaluate the margin of stability with respect to the system's nature using frequency domain analysis tools.
5. Evaluate the system behavior with the help of models compatible to simulation.
6. Design controllers according to desired performance specifications which can be applied for system design in higher semesters.

MODULE – I:
INTRODUCTION

Concepts of Control Systems- Open Loop and Closed Loop Control Systems - their differences-Different examples of Control Systems - Classification of Control Systems, Feed-Back Characteristics, Effects of feedback.

Mathematical models – Differential equations, Impulse Response and Transfer Functions Translational and Rotational mechanical systems. [4L]

Transfer function representation:

LTI system- its advantage in analysis. Laplace transform- its use in transfer function analysis. Transfer Function of linear systems- presence or absence of initial condition. Block diagram representation of systems considering electrical systems as examples - Block diagram algebra – Representation by Signal Flow Graph - Transfer function using Mason's Gain Formula. [5L]

MODULE –II:
TIME DOMAIN ANALYSIS

Standard test signals - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants. [5L]

Stability analysis :

The concept of stability- Difference between absolute and relative stability. – Routh's stability criterion– its advantages and limitations. Root Locus Technique:

The Root Locus concept - construction of Root Loci-effects of adding poles and zeros to G(s)H(s) on the root loci. [5L]

MODULE – III:

Frequency domain analysis:

Introduction, Frequency domain specifications-Bode diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin & Gain margin-Stability Analysis from BodePlots. [6L]

Polar Plots, Nyquist Plots Stability Analysis. [4L]

MODULE –IV:

Classical control design techniques:

Compensation techniques – Lag, Lead,Lead-Lag Controllers design in frequency Domain, PID Controllers. [5L]

State space analysis of continuous time systems:

Concepts of state, state variables and state model, derivation of state models from block diagrams,

Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and its properties – Concepts of Controllability and Observability . [6L]

Text Books:

1. Automatic Control Systems– by B. C. Kuo, John Wiley and Sons.
2. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International (P) Ltd.
3. Modern Control Engineering – by Katsuhiko Ogata , Prentice Hall of India Pvt. Ltd.
4. Modern Control Systems- by R.C. Dorf & R.H. Bishop- Addison-Wesley Longman.

Reference Books:

1. Control Systems Engg. by Norman S. Nise , John Wiley.
2. Control System Engineering by Ananda Natarajan , P. Ramesh Babu, Scitech Pub.
3. Automatic Control Systems- Basic analysis and design- by A. Wolovich- Oxford University Press.

Course Name :PRINCIPLES OF COMMUNICATION SYSTEMS					
Course Code : ECEN4183					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:
After completing this course, the students will be able to:

1. Apply the previous knowledge of analog communication and telecommunication systems to appreciate the contents of this subject.
2. Understand concepts of BB transmission, various modulation schemes sampling theorem and multiplexing schemes.
3. Identify concepts of Digital Transmission like PCM, Quantization, NRZ/RZ , noise Immunity etc.
4. Describe bit rate and baud rate of different signals and evaluate merits and demerits of different digital modulation techniques.
5. List the features of FSK,FSK,PSK,DPSK etc.
6. Categorize the concepts of Information Theory and Coding in terms of Entropy, Mutual Information, Shanon-Fano algorithm , source Coding, Channel coding etc.

Module - 1:
Elements of Communication system, Analog Modulation & Demodulation, Analog-to-Digital Conversion. (Basic ideas in brief) [8L]
[Details: Introduction to Base Band transmission & Modulation (basic concept) **(1L);** Elements of Communication systems (mention of transmitter, receiver and channel);**;** Basic principles of Linear Modulation (Amplitude Modulation) **(2L);** Basic principles of Non-linear modulation (Angle Modulation - FM, PM) **(2L);** Sampling theorem, Sampling rate, Reconstruction from samples, Aliasing **(1L);** Analog Pulse Modulation - PAM,PWM, PPM **(2L);**Multiplexing - TDM, FDM **(1L);**]

Module - 2:
Digital Transmission: (8L)
[Details: Basic concept of Pulse Code Modulation, Block diagram of PCM **(1L),**Concept of Quantisation & Quantisation error, Uniform Quantiser **(2L);** Non-uniform Quantiser, companding (mention only) **(1L);** Line coding & properties, NRZ & RZ, AMI, Manchester coding**(2L);** ISI, Nyquist criterion for zero ISI, Eye pattern, **(2L);**

Module - 3:
Digital Carrier Modulation & Demodulation Techniques: [7]
[Details: Introduction to the different digital modulation techniques - ASK, FSK, PSK, DPSK, QPSK **(5L);** Introduction to QAM **(1L);** Spread Spectrum Modulation - concept only. **(1L)**.

Module - 4:
Information Theory & Coding: [8]
[Details: Introduction, News value & Information content **(1L);**, Entropy **(1L);**, Mutual information **(1L);**, Information rate **(1L);**, Shanon-Fano algorithm for encoding **(1L);**, Shannon's Theorem - Source Coding Theorem **(1L);**, Channel Coding Theorem, Information

Capacity Theorem (basic understanding only) **(1L);**; Error Control & Coding - basic principle only. **(1L);**

Text Books:

1. An Introduction to Analog and Digital Communications by Simon Haykin; Published by Wiley India.
2. Data Communication and Networking by Behrouz A. Forouzan, Published by Tata McGraw-Hill

References:

1. Communication Systems 4th Edition by Simon Haykin; Published by Wiley India (Student Edition)
2. Principles and Analog and Digital Communication by Jerry D Gibson, Published by MacMillan.
3. Communication Systems by A. B. Carlson, Published by McGraw-Hill.
4. Understanding Signals and Systems by Jack Golten, Published by McGraw Hill.

ECE, Final Year, B.Tech., 2nd. Semester Syllabus

Course Name : ORGANIZATIONAL BEHAVIOUR					
Course Code: HMTS-4201					
Contact hrs per week:	L	T	P	Total	Credit points
	2	0	0	2	2

Module I:
Introduction to Organizational Behaviour-Concept, Importance, Challenges and Opportunities (1L)
Personality-Meaning of Personality, Personality Determinants and Traits, Psychoanalytic Theory, Argyris Immaturity to Maturity Continuum Impact on organization.(2L)
Attitude-Concept, Components, Cognitive Dissonance Theory, Attitude Surveys. (2L)

Module II:
Perception- Concept, Nature and Importance, Process of Perception, Factors influencing perception, Perceptual Selectivity, Shortcuts to Judge Others: Halo Effect, Stereotyping, Projection and Contrast Effects, Impact on Organization. (2 L)
Motivation-Definition, Theories of Motivation-Maslow's Hierarchy of Needs Theory,McGregor's TheoryX&Y, Herzberg's Motivation-Hygiene Theory, Alderfer's ERG Theory, McClelland's Theory of Needs, Vroom's Expectancy Theory.(4L)

Module III:
Leadership-Concept, Leadership Styles, Theories-Behavioural Theory: Ohio Studies, Michigan Studies, Blake & Mouton Managerial Grid; Contingency Theory: Fielder Theory. (4L)
Group Behaviour: Definition, Characteristics of Group, Types of Groups: Formal & Informal; Stages of Group Development, Group Decision making, Group Decision MakingVs Individual Decision Making. (4L)

Module IV:
Organizational Design-Various organizational structures and their pros and cons.
Concepts of organizational climate and culture, Organizational Politics-Concept, Factors influencing degree of Politics (2L)
Conflict management- Concept,Sources of conflict, Stages of conflictprocess, Conflict resolution techniques,Tools-Johari Window to analyse and reduce interpersonal conflict, Impact on organization. (3L)

Evaluation:
Max. Marks-100
Internal Test-30
Semester End Test-70

Suggested Readings:
1) Organization Behaviour by Stephen Robbins
2) Organization Behaviour by Luthans
3) Organization Behaviour by L.M. Prasad
4) Organization Behaviour: Text, Cases &Games by AswathappaK.

Course Name: REMOTE SENSING USING SATELLITES					
Course Code: ECEN4241					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:
After completing this course, the students will be able to:

1. Apply previously gathered knowledge on Electromagnetic Theory and Microwave Engineering to correlate design aspects of sensors aboard remote sensing satellites.
2. Identify the basic principles of Satellite Communication and its various application areas in remote sensing.
3. Categorize various parameters associated with remote sensing using satellites through the use of mathematical and logical tools to gain insight into the concept.
4. Understand the basics of remote sensing principles and technologies to acquireknowledge about the important applications for satellite remote sensing in research and the public and private sectors.
5. Gain knowledge about the various remote sensing techniques for applications in improving social, economic and environmental conditions for agricultural, forestry and water body management.
6. Categorize the role of the Indian space program in contrast to other space agencies worldwide for remote sensing applications.

Module 1: Introduction
Definition of Remote sensing ,Microwave Remote Sensing , Electromagnetic Radiation, Radiometric terms and definitions, Radiation Laws, EM spectrum, Sources of EM, Interaction of EM Radiation with atmosphere, and target, Atmospheric Widows, imaging spectrometry, Spectral signature of various land cover features (4L)
Features of Satellite communication systems in relation to other terrestrial systems. Satellite orbits, earth segment and space segment components. Modulation techniques used in satellite Communication. Satellite orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination (4L)

Module 2: Basics of Remote Sensing

Principles and concepts of Remote Sensing, Sources of energy, Active, passive, ground based and space based remote sensing techniques. Indian Remote sensing satellite systems. Major application of remote sensing in India. Concept of thematic mapping with remote sensed data. (4L)

Module 3: Remote Sensing Technologies

Satellite mounted remote sensors, spatial, spatial, radiometric and temporal resolution , field of View (FOV).Radiation principles (Plank's Law, Stephen Boltzman law)
Data Acquisition Platforms: Various types of platforms, different types of aircraft, manned and Unmanned spacecrafts used for data acquisition - characteristics of different types of platforms LANDSAT, SPOT, IRS, ERS, INSAT. Image analysis and interpretation-thermal imaging-image processing, classification and interpretation. Satellite sensors, detectors and scanning techniques. Radio Occultation (12L)

Module 4: Remote sensing systems

Weather forecasting radars, IR Radiometer Airborne and space borne radar, Satellite TTR (Telemetry, Telecommand and Ranging Stations) , LIDAR (light detection and ranging), Acoustic sounding systems, SODAR(Sonic detection and ranging) TRMM (Tropical rainfall measuring mission), AURA MLS, Megha Tropiques, Altimeter, Scatterometer, Radiometer, sea surface temperature, wind speed, water vapour and trace gas measuring systems. Generic software used for Remote sensing. Future trends and research areas (12L)

Total: 36 lectures

Books:

1. Remote Sensing & GIS – Basudeb Bhatta (Oxford University press)
2. Remote sensing of the environment : an earth resource perspective –John R Jenson(Pearson)
3. Satellite Communication System Engineering W.Pritchrd (Pearson)
4. Satellite Communication- Manojit Mitra PHI learning Pvt Ltd

Reference :

1. An Introduction to Remote Sensing And Its Applications: S.Somvansh & M.Kumari (S.K Kataria)
2. NASA'S Remote Sensing Tutorial http://rst.gsfc.nasa.gov/start.html
3. Satellite Communication: Maini & Agrawal (Wiley)

Course Name: COMPUTER ORGANIZATION					
Course code: ECEN 4242					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:
After completing this course, the students will be able to:

1. Apply the previous knowledge gathered from the course on Computer Architecture.
2. Solve combinatorial and sequential logic design problems.
3. Understand Princeton & Harvard Computer architecture.
4. Design a machine code program using capabilities of stack, program counter and status register.
5. Evaluate a parallel computer system using the knowledge of pipeline and vector computing.
6. Construct the instruction set and associated microinstructions of a computer.

Module I[12L]: Computer Organization & Architecture Refresh: Design of ALU{Discuss component units } Design of Design of control unit - hardwired and micro programmed control, {Sequencer }], Pipelining, Hazards [Data, Control, Resource], Flynn's classification, Array, Vector Processors, SuperScalar, SuperPipelined Computers, [Pentium 4, ARM 8]

Module II[12L]: Parallel Processing: Front end-Instruction fetching and Branch Prediction, Back end-Instruction Scheduling and Memory Access, Multiple Processors, Symmetric Processors, Cache Coherence and MESI Protocol [Improve L1 access], Message passing and IPC, Multithreading and Chip Multi-Processor, Clusters, NonUniformMemoryAccess Computer, Vector Computers, IA 64 Architecture.

Module III[8L]:
Multicore Computer organizations: Multicore CPU Organization Fundamentals, Example Compare Intel X86 Multicore Vs ARM 11 MPCore organization, Discuss Hardware and Software Performance Issues.

Module IV [6L]:
Design of a Computer Organization in VHDL/Verilog: Design a single RISC based machine starting from its instruction format, instruction set, addressing mode, Memory Unit, ALU, Control Unit, and proper I/O interface with required BUS system. The implementation of the design is in VHDL/Verilog

Text Books for ECEN 4232

1. Computer Organization & Architecture Designing for performance, 8th Edition, William Stallings, Pearson (free download)

2. Microprocessor Architecture From simple pipelines to Chip Multiprocessors , Jean Loup Bear, Cambridge University Press.

3. Computer Architecture and Organization, 3rd Ed, John P Hayes

4. Computer Organization, 5th Edition, Carl Hamacher, Zvonko Vranesic, Safwat Zaky, MGH

5. Computer System Architecture, 3rd Edition, Morris M. Mano, Pearson

6. Computer Organization, Hennessey and Patterson.

Reference Books:

1. Computer Organization and Design: The Hardware/Software interface, David A. Patterson and John L. Hennessy, 3rd Edition, Elsevier, 2005.

2. High-Performance Computer Architecture, Harold S. Stone

3. Advanced Computer Architecture and parallel Processing – Hesham El-Rewini and Mostafa Abd-El-Brar. A John Wiley & Sons, Inc. Publication

4. Computer Architecture by Morgan Kauffmann

Course Name: ALTERNATIVE ENERGY SOURCES					
Course Code: ECEN4243					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcome:
After completing this course, the students will be able to:

1. Apply the previous knowledge gathered from the course on Environmental Studies and solid state devices.
2. Analyze and categorize the different environment friendly Renewable energy.
3. Evaluate and calculate the solar radiation and designing of solar thermal collectors.
4. Analyze and design of different type of solar cells.
5. Categorize the different optical materials suitable to solar cells.
6. Understand and identify the different fabrication techniques pertaining to solar cell fabrication.

Module- I: Overview of different alternative energy sources: [12]
Classification of different Energy Sources and Impact on Environment, Electricity Generation from alternative Energy Sources: Solar Energy, Wind Energy, characteristics of different types of wind generators. Hydel Energy: Electricity generation from micro hydel plants, Fuel Cell. Bio Energy: bio gas conversion, Bio Diesel Principle of Tidal Energy; Principle of Wave Energy Principle of Geo thermal Energy Principle of Fly wheel Energy

Module- II: Solar Energy: [10]
Spectrum of electromagnetic radiation, solar radiation data requirements, sun structure and characteristics, solar constant, spectral distribution, sun earth geometric relationship, solar angles, sun's trajectories in different seasons, zenith solar time, air mass, beam, diffuse and total solar radiation, irradiance, solar radiation on different surfaces at different angles, extraterrestrial radiation. Attenuation of solar radiation by the atmosphere, beam and diffuse components of hourly and daily radiation, clearness index Earth sun energy flux diagram, solar thermal collectors, solar heat pumps & refrigeration, concentrating collectors, overview of solar thermal power systems, photovoltaic energy conversion.

Module- III: Physics of Solar Cell: [8]
Introduction to physics of semiconductor devices; Photovoltaic Effect, basics of solar cells, Semiconductor Materials and its properties suitable to solar cells, sources of losses and prevention, III-V & II-VI compound materials suitable for solar cells. Perovskite materials and its application to the solar cell; Carbon nano tube and its application to solar cell.

Module- IV: Different type of solar cell & basic concept of fabrication technology:[10]
Crystalline and amorphous Silicon Solar cell; PIN Solar Cell, Tandem Solar cell, HIT Solar Cell, Dye Sensitised solar cell.
Basic concepts of few important fabrication techniques pertain to solar cell- Sputtering, physical vapour deposition (PVD), Chemical Vapour deposition (CVD), Plasma enhanced Chemical Vapour Deposition (PECVD).

Text Books:
1. Renewable Energy Engineering and Technology – A Knowledge Compendium, ed. VVN Kishore (TERI Press)

2. VLSI Fabrication Principles Silicon and Gallium Arsenide – Sorab K.Gandhi. (John Willey & Sons, Inc.)
3. CS Solanki: **Solar Photovotaics – Fundamentals, Technologies and Applications**, (PHI Learning)
4. Renewable energy resources – 2nd Edition- John Twidell and Tony Weir (Taylor & Francis)

Reference Books:

1. DYE-SENSITIZED SOLAR CELLS - K. Kalyanasundaram, (EPFL Press A Swiss academic publisher distributed by CRC Press)
2. Carbon nanotubes and related structures: New material for twenty-first century, P.J.F. Harris, Cambridge University Press, 1999

FREE ELECTIVES (Offered by ECE department) IN THE SECOND SEMESTER:

Course Name: CELLULAR & SATELLITE COMMUNICATION					
Course Code : ECEN 4281					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcome:
After completing this course, the students will be able to:

1. Apply the previous knowledge of analog and digital communication to appreciate the contents of this paper.
2. Understand elements of cellular network and its various parameters like freq. planning, cell structure etc.
3. Identify GSM and CDMA Cellular architecture and its various parameters.
4. Categorize different multiple access techniques used for Satellite Communication.
5. Understand various orbits, orbital parameters, satellite launch vehicles etc.
6. Design uplink and downlink for satellite networks.

Module I: [8L]

Brief introduction to mobile wireless communication and systems, Description of cellular system, Cellular Structure, Frequency Reuse, Cell clustering, Capacity enhancement techniques for cellular networks, cell splitting, antenna sectoring, Co-channel and Adjacent channel interferences, Channel assignment schemes – Fixed channel, Dynamic channel and Hybrid channel, mobility management – location management and handoff management, handoff process, different types of handoff.

Module II: [10L]

Evolution strategies – First Generation (1G) to Fourth Generation (4G), Personal Area Networks :PAN, Low Tier Wireless System: Cordless Telephone, Second Generation (CT2), Digital European Cordless Telecommunications (DECT), Public wide-area Wireless Networks: 1 G to 3G cellular networks (4L)

Second generation (2G) Network: Global system for mobile communication (GSM):Architecture and Protocols Air Interface, GSM spectrum, GSM Multiple Access Scheme, GSM Channel Organization (4L)

Overview of CDMA systems: IS-95 Networks and 3G – The Universal Mobile Telecommunication System (UMTS) CDMA based IS-95 Systems, forward link and reverse link for IS-95, handoff process in CDMA based IS 95 network (2L)

Module III: [8L]

Historical background, Basic concepts, Frequency allocation for satellite services, orbital & spacecraft problems, comparison of networks and services, modulation techniques used for satellite communication. Indian satellite Scenario. (4L)

Orbits- Orbital elements, orbital mechanics, geostationary orbit, change in longitude, orbital maneuvers, orbital transfer, orbital perturbations. Launch Vehicles- principles of Rocket propulsion, powered flight, Launch vehicles for communication satellite (4L)

Module IV:

RF link- noise, the basic RF link, satellite links (up and down) , optimization RF link, inter satellite link, noise temperature, Antenna temperature, overall system temperature, propagation factors, rain attenuation model. Tropospheric and Ionospheric EFFECT. (5L)

Multiple access- FDMA, TDMA, CDMA techniques, comparison of multiple access techniques, error correcting codes. Satellite subsystems and satellite link design- AOC S, TT&C, power system, spacecraft antenna, transponder, Friis Transmission equation, G/T Ratio of Earth stations.(4L)

Books:

1. Wireless Networks: Applications and Protocols, T. S. Rappaport, Pearson Education
2. Wireless Communication and Networks : 3G and Beyond, I. Saha Misra, TMH Education.
3. Satellite communication – D. Roddy (TMH)
4. Satellite Communication: Maini & Agarwal (Wiley)

Course Name: VLSI DESIGN					
Course Code : ECEN 4282					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcome:
After completing this course, the students will be able to:

1. Understand different MOS structures and functions in order to apply the knowledge in building CMOS circuits.
2. Classify VLSI Design Cycle, Style and Methodology.
3. Identify logic and performance of CMOS combinational and sequential logic.
4. Construct physical layout design and stick diagram of digital gates.
5. Use various synthesis flow and HDL modeling in ASIC Semi custom design.
6. Interpret Si testing and debug related algorithms and fault modelling.

Module I: VLSI Circuits & Physical Layout: [12L]

Unit1: MOS Transistor Characteristics, MOS as Digital Switch, NMOS Logic Family, CMOS Logic Family, CMOS Inverter Characteristics (VTC), Inverter Delay & Noise, NAND and NOR gates, Complex Logic Circuits, Pass Transistor Logic & Transmission Gate, CMOS Sequential Circuits, CMOS D-Latch and D-Flip-Flop

Unit2: CMOS Cross Section, Layout and Mask layers, Inverter Layout, Lambda Rule vs Micron Rule, Std Cell Layout Topology, Stick Diagram, Euler Path Algorithm

Module II: VLSI Design and Test Methodology: [10L]

Unit1: VLSI Design Cycle, Y-Chart, Full Custom Design, Std Cell based Semi Custom Design, Gate Array Design, PLD, FPGA: CLB, LUT, MUX,

Unit2: Si Testing: Why Testing, Challenge of Si-Testing, Manufacturing Defects, Die (Inter and Intra) Variation, Yield, DPM, Logical Fault Modelling: Stuck at Faults (D-Algorithm), Bridging Fault, Transistor Stuck open/Stuck Short, ATPG, DFT, Scan Design

Module III: Front-end Design: HDL: [8L]

Why HDL ? Frontend Design Flow using HDL (Behavioral, RTL and Gate Level), Verilog Coding, Verilog Modeling: Behavioral, Data-Flow, Structural and Mixed, FSM Example: Mealy Machine and Moore Machine.

Module IV: Backend Design: VLSI Memory Circuit: [10L]

Types of Memory, Memory Organization, Memory Folding Criteria, DRAM 4T, 3T, 1T Cell Design Method, SRAM 8T, 6T Cell Design Method, Sense Amplifier Operation: Differential Amplifier based and Latch Based, Multiport Register File Design Challenges, Mask ROM, ROM Programming Techniques, Flash ROM

Text Book:

1. Principles of CMOS VLSI Design, A Systems Perspective, Author: Neil Weste, Kamran Eshraghian, Addison Wesley, 2nd Edition, 2000
2. CMOS VLSI Design, A Circuits and Systems Perspective (3rd Edition) Author: Neil Weste, David Harris, Ayan Banerjee. Pearson, 2011

Reference Book:

1.CMOS Digital Integrated Circuits, Analysis and Design, Author: Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill (3rd Edition), 2006
2.Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall
3.VLSI Design and EDA TOOLS, Author: Angsuman Sarkar, Swapnadip De, Chandan Kumar Sarkar, SCITECH PUBLICATIONS (India) Pvt. Ltd., 2011

Course Name: VLSI TESTING AND VERIFICATION					
Course Code : ECEN 4283					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcome:
After completing this course, the students will be able to:

1. Apply the previous knowledge gathered from the courses on Semiconductor Physics and Digital Computer.
2. Construct Y Chart representing the VLSI Design Cycle.
3. Design complex logic circuits with either nMOS or CMOS transistors.
4. Solve combinatorial and sequential logic design problems.
5. Evaluate the correct logic of a digital circuit with test vectors.
6. Analyze the timing characteristics of a digital logic circuit.Understand D and ATPG algorithm for VLSI testing.

Module I: VLSI Design Methodology: [6L]

Unit1: Moore's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI, GSI), Technology growth and process Node,

Unit2: Full Custom Design, Std Cell based Semi Custom Design, Gate Array Design, PLD, FPGA: CLB, LUT, MUX, VLSI Design Cycle, Y-Chart.

Module II: VLSI Circuits & Physical Layout: [10L]

Unit1: MOS Transistor Characteristics, MOS as Digital Switch, NMOS Logic Family, CMOS Logic Family, CMOS Inverter Characteristics (VTC), Inverter Delay & Noise, NAND and NOR gates, Complex Logic Circuits, Pass Transistor Logic & Transmission Gate, CMOS Sequential Circuits, CMOS D-Latch and D-Flip-Flop

Unit2: CMOS Cross Section, Layout and Mask layers, Inverter Layout, Lambda Rule vs Micron Rule, Std Cell Layout Topology, Stick Diagram, Euler Path Algorithm, Layout Legging.

Module III: VLSI Verification Flows and Static Timing Analysis: [12L]

Unit1: Logic Verification, Circuit Verification, Layout Verification (DRC, LVS), pre-layout simulation, parasitic Extraction and Back-annotation, post layout verification,

Unit2: Timing checks (set-up, hold), process variation study with PVT analysis, Library Cell characterization, Static Timing Analysis: Types of Path for Timing Analysis, Launch path, Capture Path, Longest Path, Shortest Path, Critical Path, Clock Skew

Module IV: Si-Testing: [12L]

Unit1: Why Testing, Challenge of Si-Testing, Manufacturing Defects, Die (Inter and Intra) Variation, Yield, DPM, Combinational Circuit Testing: Logical Fault Modelling: Stuck at Faults (D-Algorithm), Bridging Fault, Transistor Stuck open/Stuck Short, ATPG, Path Delay Fault,

Unit2: Sequential Circuit Testing: DFT, Scan Design, SFF, LSSD-SSF, BIST

Text Books:

1. Principles of CMOS VLSI Design, A Systems Perspective, Author: Neil Weste, Kamran Eshraghian, Addison Wesley, 2nd Edition, 2000
2. VLSI Test Principles and Architectures, Design for Testability, Author: Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen, The Morgan Kaufmann series in Systems on Silicon. 2006 Elsevier

Reference Books:

3. CMOS VLSI Design, A Circuits and Systems Perspective (3rd Edition) Author: Neil Weste, David Harris, Ayan Banerjee. Pearson, 2011
4. Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall