Aliah University

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IIA/27, New Town, Rajarhat, Kolkata- 700 160

Date : 28.06.2019

Board of studies (BOS) approved curriculum and syllabi for B Tech in Electronics and Communication Engineering.

(Academic Session 2018-19 & onwards)

Board of studies (BOS) members present on 28.6.2019 at 2.00 pm at HoD room, Electronics and Communication Engineering department.

1.	Dr. SK. Moinul Haque, HoD, ECE Dept., Aliah University	Chairperson
2.	Mr. Md. Abdul Alim Sheikh, Asst. Prof., ECE Dept., Aliah University	Member
3.	Dr. Md. Asraful Sekh, Asst. Prof., ECE Dept., Aliah University	Member
4.	Mr. Somsubhra Talapatra, Asst. Prof., ECE Dept., Aliah University	Member
5.	Mr. Anisur Rahaman, Asst. Prof., ECE Dept., Aliah University	Member
6.	Mr. Sabir Ali Mondal, Asst. Prof., ECE Dept., Aliah University	Member
7.	Mr. A.H.M Toufique Ahmed, ECE Dept., Aliah University	Member
8.	Mr. Md. Aftab Alam, Asst. Prof., EE Dept., Aliah University	Member
9.	Dr. Ayatullah Faruk Mollah, Asst. Prof., CSE Dept., Aliah University	Member

ALIAH UNIVERSITY

Curriculum and syllabi of B.Tech

Programme

In

ELECTRONICS AND COMMUNICATION ENGINEERING

(Academic Session 2018-19 & onwards)

General, Course structure & Theme

Course code and definition:

Course code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional core courses
PEC	Professional Elective courses
OEC	Open Elective courses
LC	Laboratory course
MC	Mandatory courses
PROJ	Project

Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credits
2 Hours Practical (Lab)/week	1 credit

Range of credits –

A range of credits from 150 to 160 for a student to be eligible to get Under Graduate degree in Engineering. A student will be eligible to get Under Graduate degree with Honours or additional Minor Engineering, if he/she completes an additional 20 credits. These could be acquired through MOOCs.

Structure of Undergraduate Engineering program:

Category Index	Category name	Ideal credit set by AICTE	Actual credit proposed
HSMC	Humanities and social science including management	12	10
BSC	Basic Science course	25	23
ESC	Engineering Science course	24	22.5
PCC	Professional core courses	48	60.5
PEC	Professional elective courses	18	21
OEC	Open elective course	18	12
PROJ	Project, seminar, internship in industry	15	16
MC	Mandatory courses	Non-credit	0
TOTAL		**160***	**165**

*Minor variation is allowed as per need of the respective disciplines.

Semester-wise structure of curriculum

[L= Lecture, T = Tutorials, P = Practicals & C = Credits]

Semester I (First year)

Sl no	Category Index	Paper code	Name of the paper	Periods per week				Credit
				L	T	P	Total	C
1	ESC	ME 101	Engineering Mechanics	3	1	0	4	4
2	ESC	EE 101	Basic Electrical Engineering	3	0	0	3	3
3	BSC	MA 133	Engineering Mathematics I	4	0	0	4	4
4	BSC	PH 151	Engineering Physics	3	0	0	3	3
5	ESC	CE 191	Engineering Graphics & Design	0	1	3	4	2.5
6	ESC	EE 191	Basic Electrical Engineering Lab	0	0	3	3	1.5
7	BSC	PH 161	Engineering Physics Lab	0	0	3	3	1.5
8	MC	AI 131	Elementary Arabic & Islamic Studies	4	0	0	4	0
TOTAL PERIOD PER WEEK								**28**
TOTAL CREDIT								**19.5****

**** Students will undergo an induction program of 3 weeks duration during the First Semester**

Semester II (First year)

Sl no	Category Index	Paper code	Name of the paper	Periods per week				Credit
				L	T	P	Total	
1	ESC	CSE 102	Programming for Problem Solving	3	0	0	3	3
2	*ESC*	ECE 102	Basic Electronics Engineering	3	0	0	3	3
3	BSC	MA 134	Engineering Mathematics II	4	0	0	4	4
4	BSC	CH 152	Engineering Chemistry	3	0	0	3	3
5	HSMC	EN 132	Communicative English	3	0	0	3	3
6	ESC	CSE 192	Programming for Problem Solving Lab	0	0	4	4	2
7	ESC	ECE 192	Basic Electronics Engineering Lab	0	0	3	3	1.5
8	ESC	ME 192	Workshop Practice	0	1	2	3	2
9	BSC	CH 162	Engineering Chemistry Lab	0	0	3	3	1.5
10	HSMC	EN 192	Language Lab	0	0	2	2	1
TOTAL PERIOD PER WEEK								**31**
TOTAL CREDIT								**24**

Semester III (Second year)

Sl no	Category Index	Paper code	Name of the paper	Periods per week				Credit
				L	T	P	Total	
1	PCC	ECE201	Analog Electronics	3	0	0	3	3
2	PCC	EE201	Signals and Networks	3	0	0	3	3
3	PCC	ECE203	Physics of Semiconductor Devices	3	0	0	3	3
4	OEC		OEC I	3	0	0	3	3
5	BSC	MA233	Engineering Mathematics III	4	0	0	4	4
6	MC	IC231	Indian Constitution	2	0	0	2	0
7	*PCC*	ECE291	Analog Electronics Lab	0	0	3	3	1.5
8	PCC	CSE291	Data Structures Lab	0	0	3	3	1.5
TOTAL PERIOD PER WEEK								**24**
TOTAL CREDIT								**19**

Semester IV (Second year)

Sl no	Category Index	Paper code	Name of the paper	Periods per week				Credit
				L	T	P	Total	
1	*PCC*	ECE202	Digital Electronics and Logic Design	3	0	0	3	3
2	*PCC*	ECE204	Electromagnetic Engineering	3	0	0	3	3
3	*PCC*	ECE208	Electronic and Electrical Measurement	3	0	0	3	3
4	OEC		OEC II	3	0	0	3	3
5	BSC	BIO252	Biology for Engineers	2	0	0	2	2
6	*MC*	ES232	Environmental Science	2	0	0	2	0
7	PCC	ECE292	Digital Electronics & Logic Design Lab	0	0	3	3	1.5
8	PCC	ECE294	Transmission Line and Antenna Lab	0	0	3	3	1.5
TOTAL PERIOD PER WEEK								**22**
TOTAL CREDIT								**17**

Semester V (Third year)

Sl no	Category Index	Paper code	Name of the paper	Periods per week				Credit
				L	T	P	Total	
1	PCC	ECE301	Microprocessor and Microcontroller	3	0	0	3	3
2	*PCC*	ECE 307	Communication System	3	0	0	3	3
3	*PCC*	ECE 309	Micro and Nano Fabrication Process	3	0	0	3	3
4	PCC	EE331	Power Electronics Devices & Converters	3	0	0	3	3
5	PCC	EE303	Control System	3	0	0	3	3
6	OEC		OEC III	3	0	0	3	3
7	PCC	ECE391	Microprocessor and Microcontroller Lab	0	0	3	3	1.5
8	PCC	ECE 397	Communication Systems Lab	0	0	3	3	1.5
9	PCC	EE393	Control Systems Lab	0	0	3	3	1.5
TOTAL PERIOD PER WEEK								**27**
TOTAL CREDIT								**22.5**

Semester VI (Third year)

Sl no	Category Index	Paper code	Name of the paper	Periods per week				Credit
				L	T	P	Total	
1	PCC	ECE302	Digital Signal Processing	3	0	0	3	3
2	PCC	ECE304	Photonics Devices and Optical Communication	3	0	0	3	3
3	PCC	ECE306	VLSI Circuit Design	3	0	0	3	3
4	OEC		OEC IV	3	0	0	3	3
5	PCC	ECE392	Digital Signal Processing Lab	0	0	3	3	1.5
6	PCC	ECE394	Photonics Devices and Optical Communication Lab	0	0	3	3	1.5
7	PCC	ECE396	VLSI Circuit Design lab	0	0	3	3	1.5
8	PROJ	ECE 382	Seminar	0	0	2	2	1
9	PROJ	ECE 398	Electronic Design Workshop	0	0	2	2	1
TOTAL PERIOD PER WEEK								**24**
TOTAL CREDIT								**18.5**

***** A student must undergo summer internship of 2-4 week duration during the break after 6th semester (before commencement of 7th semester). The same will be evaluated during 7th semester.**

Semester VII (Fourth year)

Sl no	Category Index	Paper code	Name of the paper	Periods per week				Credit
				L	T	P	Total	C
1	PEC		PEC I	3	0	0	3	3
2	PEC		PEC II	3	0	0	3	3
3	PEC		PEC III	3	0	0	3	3
4	PEC		PEC IV	3	0	0	3	3
5	HSMC	MS431	Engineering Economics & Management	4	0	0	4	4
6	PEC	ECE493	PEC VII (RF and Microwave Lab)	0	0	3	3	1.5
7	PCC	ECE 495	Electronic Design automation Lab	0	0	3	3	1.5
8	PROJ	ECE481	Summer Internship	-	-	-	-	2
9	PROJ	ECE471	Project I	0	0	8	8	4
TOTAL PERIOD PER WEEK								**30**
TOTAL CREDIT								**25**

Semester VIII (Fourth year)

Sl no	Category Index	Paper code	Name of the paper	Periods per week				Credit
				L	T	P	Total	C
1	PEC		PEC V	3	0	0	3	3
2	PEC		PEC VI	3	0	0	3	3
3	HSMC	MS432	Professional Values & Ethics	2	0	0	2	2
4	PEC	ECE492	PEC VII (Wireless and Mobile Communication lab)	0	0	2	2	1.5
5	PROJ	ECE472	Project II	0	0	16	16	8
6	PCC	ECE482	Grand Viva	-	-	-	-	2
TOTAL PERIOD PER WEEK								**26**
TOTAL CREDIT								**19.5**

List of Elective papers

Professional Elective Course (PEC)-I:		
SL. No	Code	Subjects
1	ECE401	Information Theory and Coding
2	ECE413	Micro Electro Mechanical System
3	ECE425	Nanotechnology
Professional Elective Course (PEC)-II:		
SL. No	Code	Subjects
1	ECE415	Satellite Communication
2	ECE407	Remote Sensing
3	ECE409	Advanced Optical Communication
Professional Elective Course (PEC)-III		
SL. No	Code	Subjects
1	ECE417	Image Processing and Computer Vision
2	ECE419	Medical Signal Processing
3	ECE421	Adaptive System and Signal Processing
Professional Elective Course (PEC)-IV		
SL. No	Code	Subjects
1	ECE403	RF and Microwave Engineering
2	ECE411	Radar System
3	ECE405	EMI/EMC Techniques
Professional Elective Course (PEC)-V		
SL. No	Code	Subjects
1	ECE402	Wireless and Mobile Communication

2	ECE404	Adhoc & Sensor Network
3	**ECE406**	Renewable Energy
Professional Elective Course (PEC)--VI		
SL. No	Code	Subjects
1	**ECE412**	Soft Computing
2	**ECE410**	Robotics and Intelligent System
3	**ECE414**	Optical & Advanced Control
Professional Elective Course (PEC)--VII		
SL. No	Code	Subjects
1	ECE493	RF and Microwave Engineering Lab
2	ECE492	Wireless and Mobile Communication Lab

List of Open Elective Courses

Semester	**Code**	**Subject**	Offering department
3rd	OCE 201	Building Materials	CEN
	OCS 201	Data Structures & Algorithms Analysis	CSE
	OEE 201	Circuit Theory & Networks	EEN
	OEC 201	Electronic Devices & Circuits	ECE
	OME 201	Materials Engineering	MEN
4th	OCE 202	Engineering Geology	CEN
	OCS 202	Computer Organization	CSE
	OEE 202	Electrical Measurement	EEN
	OEC 202/ OEC 204	Principal of Communication System/ Digital Elecctronics	ECE
	OME 202	Thermodynamics	MEN
5th	OCE 301	Transportation Engineering	CEN
	OCS 301	Object Oriented Programming	CSE
	OEE 301	Introduction to Electrical Machines	EEN
	OEC 301	Microprocessor & its Application	ECE
	OME 301	Strength of Material	MEN
6th	OCE 302	Environmental Engineering	CEN
	OCS 302	Data Communication & Computer	CSE
	OEE 302	Control System	EEN
	OEC 302	Microelectronics	ECE
	OME 302	Mechatronics	MEN
7th	OCE 401	Hydraulics Engineering	CEN
	OCS 401	Digital Image Processing	CSE

	OEE 401	Generation Transmission Distribution of Electric Power	EEN
	OEC 401	Radar System	ECE
	OME 401	Non-conventional Energy Utilization	MEN
8th	OCE 402	Construction Management	CEN
	OCS 402	Data Science	CSE
	OEE 402	Renewable Energy Resources	EEN
	OEC 402/ OEC 404	Laser Technology/ Neural Network	ECE
	OME 402	Finite Element Method	MEN
5th sem onwards	*	Entrepreneurship Development	MBA

Semester wise Credit Segregation

Semester	HSMC	BSC	ESC	PCC	PEC	OEC	PROJ	MC	TOTAL
1st	-	8.5	11	-	-	-	-	√	**19.5**
2nd	4	8.5	11.5	-	-	-	-	x	**24**
3rd	-	4	-	12		3	-	√	**19**
4th	-	2	-	12	-	3	-	√	**17**
5th	-	-	-	19.5	-	3	-	x	**22.5**
6th	-	-	-	13.5		3	2	x	**18.5**
7th	4	-	-	1.5	13.5	-	6	x	**25**
8th	2	-	-	2	7.5	-	8	x	**19.5**
TOTAL	**10**	**23**	**22.5**	**60.5**	**21**	**12**	**16**	**0**	**165**

Note: Subject code indicated by CSE/EE, the concerned departments (CSE/EE) will have to organize the course. The detailed courses in such cases have to be recommended by the concerned departments.

Semester I (First year)

ESC	ME101	Engineering Mechanics	3L-1T-0P	4 Credits

Upon completion of this course, students will able to grasp the following concepts –

- Use scalar and vector analytical techniques for analyzing forces in statically determinate structures.
- Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.
- Understand basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts);
- Understand basic dynamics concepts – force, momentum, work and energy;
- Understand and be able to apply Newton's laws of motion;
- Understand and be able to apply other basic dynamics concepts – the Work-Energy principle, Impulse – Momentum principle and the coefficient of restitution;
- Learn to solve dynamics problems choosing an appropriate solution strategy;
- Attain an introduction to basic machine parts such as pulleys and mass-spring systems etc.

Module	Content	Lecture
Module 1	Importance of Mechanics in engineering. Introduction to Statics; Concept of Particle and Rigid Body; Types of forces: collinear, concurrent, parallel, concentrated, distributed; Vector and scalar quantities; Force as a vector; Transmissibility of a force.	**3**
	Introduction to Vector Algebra; Parallelogram law; Lami's theorem; Co-ordinate representation of vector; Cross product and Dot product and their applications.	**3**
	Two dimensional force system; Resolution of forces; Moment; Varignon's theorem; Couple; Resolution of a coplanar force by its equivalent force-couple system; Resultant of forces	**4**
Module 2	Concept and Equilibrium of forces; Free body concept and diagram; Equations of equilibrium, plane frames and trusses.	**4**
	Concept of Friction; Coulomb friction; Angle of Repose; Coefficient of friction	**4**
Module 3	Distributed Force: Centroid and Centre of Gravity; Centroids, circular sector, quadrilateral, composite areas consisting of different figures.	**4**
	Moments of inertia: Parallel axis theorem; Perpendicular axis theorem; Mass moment of inertia of symmetrical bodies e.g. cylinder, sphere, cone etc.	**4**
	Concept of virtual work and energy; Concept of simple stresses and strains; Torsion; Concept of fluid statics	**4**
Module 4	Introduction to Dynamics: Kinematics and Kinetics; Newton's laws of motion; Law of gravitation & acceleration due to gravity; Rectilinear motion of particles; determination of position, velocity and acceleration under uniform and non-uniformly accelerated rectilinear motion; construction of x-t, v-t and a-t graphs.	**4**

	Plane curvilinear motion of particles: Rectangular components (Projectile motion); Normal and tangential components (circular motion). Relative motion.	**4**
Module 5	Kinetics of particles: Newton's second law; Equation of motion; D'Alembert's principle and free body diagram; Principle of work and energy; Principle of conservation of energy; Power and efficiency; Impulse and Momentum.	**6**
Module 6	Steady flow; Vibration	**2**

Books Recommended:

1. Engineering Mechanics [Vol I & II] by Meriam & Kraige – Wiley India
2. Engineering Mechanics: Statics & Dynamics by R.C. Hibbeler – Pearson
3. Vector Mechanics for Engineers [Vol I & II] by F. P. Beer and E. R. Johnston, TMH
4. Engineering Mechanics by Timoshenko, Young and Rao – TMH

ESC	**ECE101**	**Basic Electronics Engineering** **(for CEN,MEN & CSE)**	**3L-0T-0P**	**3 Credits**

Module	Content	Lecture
Module 1	**Semiconductor Basics:** Energy band theory, Fermi levels, Conductors, Semiconductors and Insulators: electrical properties, Semiconductors: intrinsic and extrinsic, P-type and N-type semiconductors; electrical conduction phenomenon, drift and diffusion carriers, mass action law.	**7**
Module 2	**Rectifying Devices:** Formation of P-N junction, formation of depletion zone, Junction capacitance-I characteristics, Zener breakdown, Avalanche breakdown. Linear piecewise model; rectifiers: half wave, full wave, ripple factor, efficiency, Clipper and Clamper circuits	**6**
Module 3	**Transistors:** Formation of PNP / NPN junctions, principle of operation, configurations, transistor characteristics. Biasing and Bias stability: small signal low frequency operation of transistors; equivalent circuits h parameters, Transistors as amplifier: voltage gain, current gain, input impedance and output impedance, Decibel power.	**7**
Module 4	**Field Effect Transistor:** Construction and characteristics of JFET and MOSFET characteristics; depletion and enhancement type, FET small signal model.	**4**
Module 5	**Feed Back Amplifier:** Block diagram, properties, positive and negative feedback, loop gain, topologies of feedback amplifier; effect of feedback on gain, output impedance, input impedance, sensitivities(qualitative),bandwidth stability	**4**

Module 6	**Operational Amplifier:** Introduction to integrated circuits, operational amplifier and its terminal properties; concept of virtual earth, Gain-frequency and Slew rate; inverting and non-inverting mode of operation, voltage summing, difference, voltage follower, integrator, and differentiator.	**4**
Module 7	**Electronic Instruments:** Principle of operation of CRO; Electron ballistics and electron beam deflection; Concept of time base; Measurement of voltage, and frequency.	**4**

Text Books:

1. Rakshit & Chattopadhyay, Foundation of Electronics, New Age
2. Cathey, Electronic Devices and Circuits, Shaum series, TMH
3. Boylestead & Nashlesky, Electronic Devices and Circuits, Pearson
4. Millman and Halkias, Integrated Electronics, TMH

ESC	**EE1 01**	**Basic Electrical Engineering** **(for ECE & EEN)**	**3L-0T-0P**	**3 Credits**

Module	Content	Lecture
Module 1	**Introduction:** Basic concepts of Electrostatics and Electromagnetic.	**4**
Module 2	**DC Circuit**: Introduction of Electric Circuit & Elements, Loop Analysis, Node analysis, Star (Y) - Delta (Δ) & Delta (Δ)-Star (Y) Transformations.	**6**
Module 3	**DC Network Theorem**: Superposition Theorem, Thevenin's theorem, Norton's theorems, Maximum Power Transfer Theorem, Reciprocity Theorem, Time-domain analysis of first-order RL and RC circuits.	**8**
Module 4	**Single-phase AC Circuits** Generation of Sinusoidal Voltage Waveform (AC) and Some Fundamental Concepts, Representation of Sinusoidal Signal by a Phasor, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.	**8**
Module 5	**Transformer:** Definition, working principle & construction, EMF equation, Equivalent circuit, Open circuit & Short circuit tests, Efficiency & Regulation.	**4**
Module 6	**DC Machines**: Constructional Features of D.C Machines , Principle of Operation of D.C Machines, EMF & Torque Equation , D.C Generators, D.C Motors, Losses, Efficiency, 3-point Starter and speed control of DC shunt Motor.	**4**

Module 7	**Three-phase Induction Motor**: Introduction to 3-phase induction motor	**1**
Module 8	**Introduction to Power System:** Basic concepts of Power System	**1**

Text Books:

1. D.P. Kothari & I.J. Nagrath, "Basic Electrical Engineering", TMH.
2. Hughes, "Electrical and Electronics Technology", Pearson Education.
3. V.N Mittle & Arvind Mittal, "Basic Electrical Engineering", , TMH, Second Edition.
4. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India,
5. C L Wadhwa, "Basic Electrical Engineering", New Age International Publishers.

BSC	**MA133**	**Engineering Mathematics I**	**4L-0T-0P**	**4 Credits**

Module	Content	Lecture
Module 1	Basics of sequence and series ; Power series, Limit, Continuity.	**14**
Module 2	Differentiation, Mean value theorems and its application; Taylor's theorem, Maclaurin's infinite series; Maxima and minima; L Hospital's rule.	**12**
Module 3	Reduction formulae, Beta and Gama functions.	**2**
Module 4	Lines and planes, Polar coordinates, Quadric surfaces, Volume, Area, length.	**10**
Module 5	Continuity, Differentiability of vector functions, Arc length; Curvature, Torsion, Serret-Frenet formulas, Double, triple integrals, Jacobian .	**10**
Module 6	Green theorem, Gauss theorem and Stokes Theorems and its application.	**6**

References:

1. Advanced Engineering Mathematics : Erwin Kreyszig
2. Advanced Engineering Mathematics : R.K. Jain & S. R. K lyengar
3. Advanced Engineering Mathematics : C. R. Wylle & L. C. Barrett
4. Differential & Integral Calculus : N. Plskunov

BSC	**PH151**	**Engineering Physics**	**3L-0T-0P**	**3 Credits**

Module	Content	Lecture
Module 1	**Mechanics** **Classical mechanics:** scalars and vectors, vector multiplication, central force, mechanics of system of particles, elastic properties, rotational motion, fluid dynamics: viscocity, Stoke's law, streamline flow, equation of continuity, Reynold's number, Bernoulli's theorem **Quantum mechanics:** Photoelectric effect, de-Broglie's hypothesis, matter wave, Hysenberg's uncertainty principle, wave function, Schrodinger equation and simple problems **Statistical mechanics:** Necessity of statistical mechanics, Maxwell-Boltzman, Bose-Einstein and Fermi-Dirac distribution formula	**12**
Module 2	**Optics** Huygen's principle, Interference of light, Young's double-slit experiment, Newton's ring; Diffraction: Fresnel and Fraunhofer class, Fresnel's half-period zones, zone plate, Fraunhofer diffraction due to single slit and plane transmission grating (elementary theory); Polarization: plane, circular and elliptically polarized light, Brewster's law, Polaroid, optical activity. Coherence length and time; Einstein's A and B coefficients; spontaneous and induced emissions, condition for laser action, population inversion, He-Ne laser Optical Fiber, core and cladding; total internal reflection; optical fiber and waveguide; communication through optical fiber, energy loss, attenuation and dispersion	**6**
Module 3	**Electrostatics & Electricity** Coulomb's law, intensity and potential of point charge, Gauss's theorem and simple applications, electric-dipole, Electric displacement, capacitor, parallel plates and cylindrical, Thermoelectricity, Magnetic effects of currents, Self-inductance, Mutual inductance, Transformer Electric circuit elements and AC, DC circuit analysis.	**6**
Module 4	**Solid State Physics** Crystalline nature of solid, diffraction of X-ray, Bragg's law, Mosley's law, explanation from Bohr's theory, Origin of the energy gap, band theory; metal, semiconductor and insulators; intrinsic and extrinsic semiconductors, dia, para and ferro magnetic materials, superconductivity	**6**

Module 5	**Nuclear Physics** Binding energy of nucleus, Binding energy curve and stability, Radioactivity, successive disintegration, radioactive equilibrium, radioactive dating, radioisotope and their uses, Nuclear transmutation, fission & fusion, nuclear reactor	**6**

TEXT BOOKS NOT MENTIONED

ESC	**CE191**	**Engineering Graphics & Design**	**0L-1T-3P**	**2.5 Credits**

Module	Content	Lecture
Module 1	**Introduction to Engineering Graphics:** Drawing instruments and accessories, BIS – SP 46. Use of plane scales, Diagonal Scales and Representative Fraction. **Engineering Curves:** Classification and application of Engineering Curves, Construction of Conics, Cycloid Curves, Involutes and Spirals along with normal and tangent to each curve.	**30**
Module 2	**Projections of Points and Lines:** Introduction to principal planes of projections, Projections of the points located in same quadrant and different quadrants, Projections of line with its inclination to one reference plane and with two reference planes. True length and inclination with the reference planes. **Projections of Planes:** Projections of planes (polygons, circle and ellipse) with its inclination to one reference plane and with two reference planes, Concept of auxiliary plane method for projections of the plane	**30**
Module 3	**Projections of Solids and Section of Solids:** Classification of solids. Projections of solids (Cylinder, Cone, Pyramid and Prism) along with frustum with its inclination to one reference plane and with two reference planes. Section of such solids and the true shape of the section	**20**
Module 4	**Drawing practice:** Drawing practise using software like AUTO CAD	**20**

Reference Books:

1. A Text Book of Engineering Graphics by P.J.Shah S.Chand & Company Ltd., New Delhi.
2. Elementary Engineering Drawing by N.D.Bhatt Charotar Publishing House, Anand.
3. A text book of Engineering Drawing by R.K.Dhawan, S.Chand & Company Ltd., New Delhi.

ESC	**ECE191**	**Basic Electronics Engineering Lab (for CEN,MEN & CSE)**	**0L-0T-3P**	**1.5 Credits**

Module	Content	Lecture
Module 1	Familiarization of Electrical and Electronics Components	**3**
Module 2	Familiarization of Various Instruments like Power Supply, Digital Multimeter, Function	**3**
Module 3	Generator, CRO etc.	**3**
Module 4	Study of Junction Diode Characteristics	**3**
Module 5	Study of Zener Diode Characteristics	**3**
Module 6	Study of Clipping Circuits	**3**
Module 7	Study of Clamping Circuits	**3**
Module 8	Study of Rectifier Circuits	**3**
Module 9	Study of BJT Characteristics	**3**
Module 10	Study of FET Characteristics	**3**
Module 11	Study of fundamental characteristics of OP-AMP	**3**
Module 12	Determination of Slew rate and bandwidth of an OP-AMP.	**3**

ESC	**EE191**	**Basic Electrical Engineering Lab (ECE & EEN)**	**0L-0T-3P**	**1.5 Credits**

Module	Content	Lecture
Module 1	Verification of Thevenin's Theorem	**3**
Module 2	Verification of Norton's Theorem	**3**
Module 3	Verification of Superposition Theorem	**3**
Module 4	Power Measurement of Fluorescent Lamp	**3**
Module 5	V-I characteristics of Incandescent Lamp	**3**

Module 6	Speed Control of DC motor Using Field and Armature Control Method	**3**
Module 7	Starting and reversing of DC motor	**3**
Module 8	Open circuit and Short circuit test of Single Phase Transformer	**3**
Module 9	Calibration of Voltmeter and Ammeter	**3**
Module 10	Characteristics of Series R-L-C Circuit	**3**
Module 11	Characteristics of Parallel R-L-C Circuit	**3**
Module 12	Resistance measurement and continuity test of DC motor using Megger	**3**

BSC	**PH161**	**Engineering Physics Lab**	**0L-0T-3P**	**1.5 Credits**

Module	Content	Lecture
Module 1	Measurements of length (or diameter) using vernier scale, slide caliper, screw gauge and travelling microscope.	**3**
Module 2	Determination of the radius of curvature of a spherical surface by using spherometer.	**3**
Module 3	Determination of moment of inertia of (a) a cylinder and (b) a rectangular solid bar.	**3**
Module 4	To determine the focal length of a concave lens by combination method and hence to determine the refractive index of the material of the lens by measuring the radii of curvature of both lenses	**3**
Module 5	Determination of the average resistance per unit length of the meter bridge wire by Carey-Foster's method and hence to determine an unknown resistance	**3**
Module 6	Determination of the horizontal component of the earth's magnetic field and the magnetic moment of a magnet by employing magnetometers	**3**
Module 7	Determination of Young's Modulus of elasticity of a material of a bar by the method of flexure.	**3**
Module 8	Determination of rigidity modulus of a material of a wire by static method.	**3**
Module 9	Determination of rigidity modulus of a material of a wire by dynamic method.	**3**
Module 10	Determination of unknown frequency of a tuning fork by using a sonometer.	**3**

MC	**AI131**	**Elementary Arabic & Islamic Studies**	**4L-0T-0P**	**0 Credits**

SYLLABUS

TEXT BOOKS NOT MENTIONED

Semester II (First year)

ESC	CSE102	Programming for Problem Solving	3L-0T-0P	3 Credits

Module	Content	Lecture
Module 1	**Introduction to computing:** block architecture of a computer, bit, bytes, memory, and representation of numbers in memory.	**1**
Module 2	**Introduction to problem solving:** Basic concepts of an algorithm, program design methods, flowcharts.	**1**
Module 3	**Introduction to C programming:** A Brief History of C, C is middle-level Language, is a Structured Language, Complier Vs Interpreters, The Form of a C Program, Library & Linking, Compilation & Execution process of C Program . [2]	**2**
Module 4	**Variables, Data Types, Operator & Expression:** Character Set, Token, Identifier & Keyword, Constant, Integer, Floating Point, Character, String, Enumeration, Data Types in C, Data Declaration & Definition Operator & Expression, Arithmetic, Relational, Logical, Increment & Decrement, Bit wise, Assignment, Conditional, Precedence & Associability of Operators.	**3**
Module 5	**Console I/O:** ntroduction, Character input & Output, String Input & Output, Formatted Input/Output (scanf/printf), sprintf & sscanf.	**2**
Module 6	**Control Statement:** Introduction, Selection Statements, Nested if, if-else-if, The "?" Alternative, The Conditional Expression, switch, Nested switch, Iteration Statements, for loop, while loop, do-while loop, Jump Statements, Goto & label, break & continue, exit() function.	**4**
Module 7	**Array & String:** Single Dimension Arrays, Accessing array elements, Initializing an array, Multidimensional Arrays, Initializing the arrays, Memory Representation, Accessing array elements, String Manipulation Functions, searching, sorting an array.	**6**
Module 8	**Function:** Introduction, advantages of modular design, prototype declaration, Arguments & local variables, Returning Function Results by reference & Call by value, passing arrays to a function, Recursion.	**4**
Module 9	**Storage Class & Scope:** Meaning of Terms, Scope - Block scope & file scope, Storage Classes Automatic Storage, Extern Storage, Static, Storage, Register Storage.	**2**
Module 10	**Pointers:** Introduction, Memory Organization, The basics of Pointer, The Pointer operator Application of Pointer, Pointer Expression, Declaration of Pointer, Initializing Pointer, De-referencing Pointer,Void Pointer,	**4**

	Pointer Arithmetic, Precedence of &, * operators Pointer to Pointer, Constant Pointer, Dynamic memory allocation, passing pointer to a function, array of pointers, accessing arrays using pointers, handling strings using pointers.	
Module 11	**Structure, Union, Enumeration & typedef:** Structures, Declaration and Initializing Structure, Accessing Structure members, Structure, Assignments, Arrays of Structure, Passing, Structure to function, Structure Pointer, Unions.	**2**
Module 12	**C Preprocessor:** Introduction, Preprocessor Directive, Macro Substitution, File Inclusion directive, Conditional Compilation.	**2**
Module 13	**File handling:** Introduction, File Pointer, Defining & Opening a File, Closing a File, Input/Output Operations on Files, Operations on Text mode files and binary mode files, Error Handling During I/O Operation, Random Access To Files, Command Line Arguments	**3**

Suggested Books:

1. B.S. Gottfried: Programming in C; TMH.
2. B.W. Kernighan and D.M. Ritchie: The C Programming Language; PHI.
3. H. Schildt: C++: The Complete Reference; TMH, 4e.
4. B. Stroustrup: The C++ Programming Language; Addison-Wesley.
5. E. Balagurusamy: Programming in ANSI C; TMH.
6. Yashwant Kanetkar: Let Us C; BPB Publications.
7. K. N. King: C Programming: A Modern Approach, W. W. Norton and Company.

Pradip Dey and Manas Ghosh: Programming in C, Oxford University Press

ESC	**ECE102**	**Basic Electronics Engineering (for ECE & EEN)**	**3L-0T-0P**	**3 Credits**

Module	Content	Lecture
Module 1	**Semiconductor Basics:** Energy band theory, Fermi levels, Conductors, Semiconductors and Insulators: electrical properties, Semiconductors: intrinsic and extrinsic, P-type and N-type semiconductors; electrical conduction phenomenon, drift and diffusion carriers, mass action law.	**7**
Module 2	**Rectifying Devices:** Formation of P-N junction, formation of depletion zone, Junction capacitance-I characteristics, Zener breakdown, Avalanche breakdown. Linear piecewise model; rectifiers: half wave, full wave, ripple factor, efficiency, Clipper and Clamper circuits	**6**

Module 3	**Transistors:** Formation of PNP / NPN junctions, principle of operation, configurations, transistor characteristics. Biasing and Bias stability: small signal low frequency operation of transistors; equivalent circuits h parameters, Transistors as amplifier: voltage gain, current gain, input impedance and output impedance, Decibel power.	**7**
Module 4	**Field Effect Transistor:** Construction and characteristics of JFET and MOSFET characteristics; depletion and enhancement type, FET small signal model.	**4**
Module 5	**Feed Back Amplifier:** Block diagram, properties, positive and negative feedback, loop gain, topologies of feedback amplifier; effect of feedback on gain, output impedance, input impedance, sensitivities(qualitative),bandwidth stability	**4**
Module 6	**Operational Amplifier:** Introduction to integrated circuits, operational amplifier and its terminal properties; concept of virtual earth, Gain-frequency and Slew rate; inverting and non-inverting mode of operation, voltage summing, difference, voltage follower, integrator, and differentiator.	**4**
Module 7	**Electronic Instruments:** Principle of operation of CRO; Electron ballistics and electron beam deflection; Concept of time base; Measurement of voltage, and frequency.	**4**

Text Books:

1. Rakshit & Chattopadhyay, Foundation of Electronics, New Age
2. Cathey, Electronic Devices and Circuits, Shaum series, TMH
3. Boylestead & Nashlesky, Electronic Devices and Circuits, Pearson
4. Millman and Halkias, Integrated Electronics, TMH

ESC	**EE102**	**Basic Electrical Engineering (CSE,CEN & MEN)**	**3L-0T-0P**	**3 Credits**

Module	Content	Lecture
Module 1	**Introduction:** Basic concepts of Electrostatics and Electromagnetic.	**4**
Module 2	**DC Circuit**: Introduction of Electric Circuit & Elements, Loop Analysis, Node analysis, Star (Y) - Delta (Δ) & Delta (Δ)-Star (Y) Transformations.	**6**
Module 3	**DC Network Theorem**: Superposition Theorem, Thevenin's theorem, Norton's theorems, Maximum Power Transfer Theorem, Reciprocity Theorem, Time-domain analysis of first-order RL and RC circuits.	**8**

Module 4	**Single-phase AC Circuits** Generation of Sinusoidal Voltage Waveform (AC) and Some Fundamental Concepts, Representation of Sinusoidal Signal by a Phasor, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.	**8**
Module 5	**Transformer:** Definition, working principle & construction, EMF equation, Equivalent circuit, Open circuit & Short circuit tests, Efficiency & Regulation.	**4**
Module 6	**DC Machines**: Constructional Features of D.C Machines , Principle of Operation of D.C Machines, EMF & Torque Equation , D.C Generators, D.C Motors, Losses, Efficiency, 3-point Starter and speed control of DC shunt Motor.	**4**
Module 7	**Three-phase Induction Motor**: Introduction to 3-phase induction motor	**1**
Module 8	**Introduction to Power System:** Basic concepts of Power System	**1**

BSC	**MA134**	**Engineering Mathematics II**	**4L-0T-0P**	**4 Credits**

Module	**Content**	**Lecture**
Module 1	Matrices: Matrix operations (Addition, Multiplication, Transpose), invertible matrix.	**4**
Module 2	Determinant and their properties.	**2**
Module 3	Row reduced echelon form; Rank of a matrix. Solution of the matrix equation Ax = b; Cramer's rule. Eigenvalues and eigenvectors, characteristic polynomial of a matrix, Cayley–Hamilton theorem and its application. Linear dependence and independence of vectors, basis and dimension. Complex numbers and Complex integrals. Inequalities, Theory of equations.	**32**
Module 4	Complex numbers and Complex integrals. Inequalities, Theory of equations.	**18**
Module 5	Differential equation of first order and first degree: Exact, separable and homogeneous differential equations, Bernoulli's equation, ODEs of first order but not of first degree; Clairaut's equation.	**7**
Module 6	Higher order linear equation with constant coefficients: Complementary function, Particular integral, Symbolic Operator D.	**4**

Module 7	Method of undetermined coefficients, Euler's homogeneous equation and deduction to an equation of constant coefficients.	**4**
Module 8	Second order linear equation with variable coefficients: exact equation: reduction of order; variation of parameters; reduction to normal form; change of independent variables. Simple eigenvalue problems.	**4**
Module 9	System of linear differential equations with constant coefficients.	**2**

References:

1. Advanced Engineering Mathematics : Erwin Kreyszig
2. Advanced Engineering Mathematics : R.K. Jain & S. R. K lyengar
3. Advanced Engineering Mathematics : C. R. Wylle & L. C. Barrett
4. Differential & Integral Calculus : N. Plskunov

BSC	**CH152**	**Engineering Chemistry**	**3L-0T-0P**	**3Credits**

Module	Content	Lecture
Module 1	**Thermodynamics :** Importance and scope, definitions of system and surroundings; type of systems; Extensive and intensive properties; Steady state and equilibrium; Zeroth law of thermodynamics; First law of thermodynamics, internal energy and Enthalpy as a state function; Second law of thermodynamics; Kelvin, Planck and Clausius statements; Carnot cycle and refrigerator; Carnot's theorem; Physical concept of entropy.	
Module 2	**Water and its treatment :** Sources of water, Impurities in water, Hardness of water, Determination of hardness of water, Water quality parameter, Treatment of water for domestic purpose, Waste water.	
Module 3	**Polymers :** Terminology, Classification of polymers, Polymerization techniques, Molecular weight of polymers, Plastics, Rubbers, Fibers, Conducting and semiconducting polymers, Natural polymers.	
Module 4	**Green Chemistry :** Definition and concept of green chemistry, Emergence of green chemistry, Alternative solvents, Design of safer chemicals, Microwave radiation of green synthesis, Green laboratory Technology.	

Books referred

1. K. S. Maheswaramma and M. Chugh, Engineering Chemsitry, Pearson, 2016.
2. Wiley Engineering Chemistry, Wiley, 2nd Edn., 2014.

HSMC	**EN132**	**Communicative English**	**3L-0T-0P**	**3Credits**

Objectives of the Course: To impart basic Communication skills to the first year UG students in the English language through rigorous practice and use of various categories of common words and their application in sentences; to enable them to achieve effective language proficiency for their social, professional & inter personal communication both in speaking & writing.

Module	Content	Lecture
Module 1	**Fundamentals of Communication:** Communication: Meaning, Nature, Process, Importance and Function of Communication; Levels of Communication: Intra-personal, Interpersonal, Organizational, Mass Communications; The Flow of Communication: Downward, Upward, Lateral or Horizontal, Diagonal, Grapevine Communication; Network in an Organization; Principles for Effective Communication; Verbal and Non-Verbal Communication; Barriers to Communication, Gateways to Communication.	
Module 2	**Listening and Speaking Skills:** The Process of Listening; Barriers to Listening; Types of Listening: Active and Passive Listening; Methods for improving listening skills, Benefits of Effective Listening. Presentation Strategies: Defining Purpose; Organizing Contents; Preparing Outline; Audio-visual Aids; Nuances of Delivery; Body Language; Dimensions of Speech – Accent, Pitch, Rhythm, Intonation, Strong and Weak Forms, Connected Speech- Assimilation and Elision, Paralinguistic Features of Voice; Articulation of Speech Sounds- Vowels and Consonants; Spelling and Pronunciation; Problems of Indian speakers of English and their remedial measures.	
Module 3	**Reading and Writing Skills :** **Reading Skills:** Purpose, Process, Methodologies, and Strategies; Special Reading Situations – Skimming and Scanning, Intensive and Extensive Reading, Critical Reading, Drawing Inferences, Reading Technical Reports, etc. **Writing Skills:** Words and Phrases: Word Formation, Synonyms and Antonyms, Homophones, One Word Substitutes, Words Often Confused, Word Choice - Right Words, Appropriate Words, Idioms and Phrases; Correct Usage: Parts of Speech, Modals, Concord, Articles, Infinitives, Requisites of Sentence Construction. Elements of Effective Writing, Main Forms of Written	

	Communication: Paragraph - Techniques and Methods (Inductive, Deductive, Linear, Spatial, Chronological etc.), The Art of Condensation- various types (Précis, Summary and Abstract, etc.), Description, Agenda, Minutes, Notices, Circulars, Memo, Advertisements, Drafting an E-mail, Press Release.	
Module 4	**Business Communication:** Business Letters: Principles; Sales & Credit letters; Claim and Adjustment Letters; Job application and Résumés. Reports: Types; Significance; Structure, Style & Writing of Reports. Technical Proposal; Parts; Types; Writing of Proposal. Negotiation & Business Presentation skills.	

Suggested Readings:.

1. Sethi, J & et al. *A Practice Course in English Pronunciation*, Prentice Hall of India, New Delhi.
2. Berry Cicely: *Your Voice and How to Use it Successfully*, George Harp & Co. Ltd, London
3. Bansal, R.K. and J.B. Harrison. *Spoken English*, Orient Longman.
4. Hornby's, A.S. *Oxford Advanced Learners Dictionary of Current English*, 7th Edition.
5. Pillai, Sabina & Agna Fernandez: *Soft Skills & Employability Skills.* Cambridge Univ. Press.
6. Sudharshana, N.P. & C. Savitha: *English for Technical Communication*, Cambridge Univ. Press.
7. Raman, Meenakshi & Sangeeta Sharma: *Technical Communication: Principles and Practice.* Oxford Univ. Press.
8. Prasad, P. *The Functional Aspects of Communication Skills*, Delhi.
9. McCarthy, Michael. *English Vocabulary in Use*, Cambridge University Press, Cambridge.
10. Leech, G & Svartvik, J. *A Communicative Grammar of English*. Pearson Education. New Delhi.
11. Narayanaswamy V.R. *Strengthen your Writing*. Orient Longman, London.
12. Dean, Michael. *Write it*, Cambridge University Press, Cambridge.
13. Sen, Leena. *Communication Skills*, Prentice Hall of India, New Delhi.

Bown, G. *Listening and Spoken English* , Longman, London

ESC	**CSE192**	**Programming for Problem Solving Lab**	**0L-0T-4P**	**2 Credits**

Module	Content	Lecture
Module 1	Primary goal of this course is to make acquaint the students to know the programming language and also to know how 'C' can be used to write serious program to solve the problems. Programs will be based on the theoretical paper and to cover the concept of basic arithmetic operations, control statements, functions, recursions, arrays, strings, pointers, structures, unions, file handling etc.	

Suggested Books:

1. B.S. Gottfried: Programming in C; TMH.
2. B.W. Kernighan and D.M. Ritchie: The C Programming Language; PHI.
3. H. Schildt: C++: The Complete Reference; TMH, 4e.
4. B. Stroustrup: The C++ Programming Language; Addison-Wesley.
5. E. Balagurusamy: Programming in ANSI C; TMH.
6. Yashwant Kanetkar: Let Us C; BPB Publications.
7. K. N. King: C Programming: A Modern Approach, W. W. Norton and Company.
8. Pradip Dey and Manas Ghosh: Programming in C, Oxford University Press

ESC	**ECE193**	**Basic Electronics Engineering Lab (for ECE & EEN)**	**0L-0T-3P**	**1.5 Credits**

Module	Content	Lecture
Module 1	Familiarization of Electrical and Electronics Components.	**3**
Module 2	Familiarization of Various Instruments like Power Supply, Digital Multimeter, Function.	**3**
Module 3	Generator, CRO etc.	**3**
Module 4	Study of Junction Diode Characteristics.	**3**
Module 5	Study of Zener Diode Characteristics.	**3**
Module 6	Study of Clipping Circuits.	**3**
Module 7	Study of Clamping Circuits.	**3**
Module 8	Study of Rectifier Circuits.	**3**
Module 9	Study of BJT Characteristics.	**3**
Module 10	Study of FET Characteristics.	**3**
Module 11	Study of fundamental characteristics of OP-AMP.	**3**
Module 12	Determination of Slew rate and bandwidth of an OP-AMP.	**3**

ESC	**EE192**	**Basic Electrical Engineering Lab (CSE,CEN & MEN)**	**0L-0T-3P**	**1.5 Credits**

Module	Content	Lecture
Module 1	Verification of Thevenin's Theorem	**3**
Module 2	Verification of Norton's Theorem	**3**
Module 3	Verification of Superposition Theorem	**3**
Module 4	Power Measurement of Fluorescent Lamp	**3**
Module 5	V-I characteristics of Incandescent Lamp	**3**
Module 6	Speed Control of DC motor Using Field and Armature Control Method	**3**
Module 7	Starting and reversing of DC motor	**3**
Module 8	Open circuit and Short circuit test of Single Phase Transformer	**3**
Module 9	Calibration of Voltmeter and Ammeter	**3**
Module 10	Characteristics of Series R-L-C Circuit	**3**
Module 11	Characteristics of Parallel R-L-C Circuit	**3**
Module 12	Resistance measurement and continuity test of DC motor using Megger	**3**

ESC	**ME192**	**Workshop Practice**	**0L-1T-2P**	**2 Credits**

Module	Content	Lecture
Module 1	Introduction to various hand tools e.g. allen keys, spanners, punch, files, hacksaw, hammers, chisels, vices, marking block, angle plates, etc.	
Module 2	Introduction to basic instruments: Vernier Caliper, Micrometer, Tri-square, Surface Plate, Height Gauge, Vernier Bevel Protractor, Screw Pitch Gauge, Radius Gauge, etc.	
Module 3	Demonstration on different machines and Equipments: Lathe, Milling, Drilling, Shaping, Radial Drilling, Grinding, Welding, Power Saw, Power Press, Planer Machine, Microscope, Profile Projector, etc.	
Module 4	Practical Exercises: Exercises involving the following operations: measuring and marking, sawing, chipping, filing, maintaining of perpendicularity of all surfaces by filing, making of taper surface by filing, making of curved surface by filing, plain turning, step turning and drilling.	

Reference books

1. Hazra Choudhury & Hazra Choudhury – Elements of Workshop Technology, Vol. I & II – Media Promoters and Publishers Pvt. Ltd.
2. Rajender Singh - Introduction to Basic Manufacturing Process and Workshop Technology, New Age International.

BSC	**CH162**	**Engineering Chemistry Lab**	**0L-0T-3P**	**1.5 Credits**

Module	Content	Lecture
Module 1	Acidimetric estimation of Sodium Carbonate and Sodium bi-Carbonate in their mixture.	**3**
Module 2	Estimation of Total Hardness of water by Complexometric method	**3**
Module 3	Estimation of Fe^{II} in Mohr's Salt by Permanganometric Titration.	**3**
Module 4	Qualitative analysis of single solid organic compounds.	**3**

HSMC	**EN192**	**Language Lab**	**0L-0T-2P**	**1 Credits**

Objectives of the Course: To impart basic Communication skills to the first year UG students in the English language through rigorous practice and use of various categories of common words and their application in sentences; to enable them to achieve effective language proficiency for their social, professional & inter personal communication both in speaking & writing; to improve their English pronunciation.

Module	Content	Lecture
Module 1	Group Discussion: Practical based on Accurate and Correct Grammatical Patterns.	
Module 2	Conversational Skills under suitable Professional Communication Lab conditions with emphasis on Kinesics: Interview, Greeting and Introducing, Leave taking, Asking Questions and Giving Replies, Inviting Friends and Colleagues, Negotiating, Persuading, Taking Initiatives, Praising and Complementing People, Expressing Sympathy, Seeking and Giving Permission, Complaining and Apologizing, Official/Public Speaking, Telephoning etc.	
Module 3	Communication Skills for Seminars/Conferences/Workshops with emphasis on Paralinguistic/ Kinesics.	

Module 4	Presentation Skills for Technical Paper/Research Paper/Project Reports/ Professional Reports based on proper Stress and Intonation Mechanics	
Module 5	Extempore, Argumentative Skills, Role Play Presentation with Stress and Intonation.	
Module 6	Comprehension Skills based on Reading and Listening Practical on a model Audio-Visual Usage.	

Reference Books

1. Bansal R.K. & Harrison: *Phonetics in English*, Orient Longman, New Delhi.
2. Sethi & Dhamija: *A Course in Phonetics and Spoken English*, Prentice Hall, New Delhi.
3. Pandey, L.U.B. & R.P.Singh: *A Manual of Practical Communication*, A.I.T.B.S. Pub. India Ltd. Krishan Nagar, Delhi.
4. Joans, Daniel, *Cambridge English Pronouncing Dictionary*, Cambridge Univ. Press.
5. Sudharshana, N.P. & C. Savitha: *English for Technical Communication*, Cambridge Univ. Press.

Semester III (Second year)

PCC	**ECE201**	**Analog Electronics**	**3L-0T-0P**	**3 Credits**

Course Outcomes:

1. At the end of this course students will demonstrate the ability to
2. Understand the characteristics of diodes and transistors
3. Design and analyze various rectifier and amplifier circuits
4. Design sinusoidal and non-sinusoidal oscillators
5. Understand the functioning of OP-AMP and design OP-AMP based circuits

Module	Content	Lecture
Module 1	Diode Circuits, Rectifiers, And Clipper, Clamper Amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc.,design procedure for particular specifications, low frequency analysis of multistage amplifiers.	**8**
Module 2	Large signal models, BJT as an amplifier and as a switch; high frequency models and frequency response.; Bode plot; Rise Time bandwidth relation, Miller Effects, Typical configurations: R-C coupled, Transfer coupled, Classes of operation, Cascade connection, Cascade connection, Darlington amplifier, Tuned Amplifiers; Current Mirror circuits, Constant current source. Feedback amplifiers; Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., and Differential amplifiers.	**8**
Module 3	Principle of sinusoidal oscillators and Barkhausen criterion; starting voltage in oscillator, Beat frequency, Wien Bridge; Twin-T, R-C Phase-Shift audio Oscillator; Tuned Circuit oscillators: Hartley, Colpitts, Armstrong, Clapp-oscillators, Crystal controlled RF Oscillators; Multivibrators – Astable, Monostable and Bistable circuits; Generation of square, triangular waveforms; Timer, Voltage controlled oscillator, Phase Locked loops.	**8**
Module 4	OP-AMP applications: review of inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications. Active filters: Low pass, high pass, band pass and band stop, design guidelines.	**6**

Module 5	Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc. Analog-to digital converters (ADC): Single slope, dual slope, successive approximation, flash etc. Switched capacitor circuits: Basic concept, practical configurations, application in amplifier, integrator, ADC etc.	6
Module 6	Voltage feedback regulation, Current Limiting, three terminal regulators Fixed and Variable voltage regulators, Switched Voltage regulators	6

Text/Reference Books:

1. Boylestead & Nashlesky, Electronic Devices and Circuits, Pearson
2. Millman and Halkias, Integrated Electronics, TMH

3. S M Sze, Physics of Semiconductor Devices, John Willy
4. R A Gayakwad, Op-Amps and Linear Integrated Circuits, PHI
5. Malvino, Electronic Principles, TMH

PCC	**EE201**	**Signals and Networks**	**3L-0T-0P**	**3 Credits**

Module	Content	Lecture
Module 1	Signals and systems as seen in everyday life, and in various branches of engineering and science. Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additive and homogeneity, shift-invariance, causality, stability, realizability.	**6**
Module 2	Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input output behaviour with aperiodic convergent inputs. Characterization of causality and stability of linear shift-invariant systems. System representation through differential equations and difference equations. Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response, Fourier series representation, the Fourier Transform, Convolution/multiplication and their effect in the frequency domain, magnitude and phase Response, Fourier domain duality.	**8**
Module 3	The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. The idea of signal space and orthogonal bases, The Laplace Transform, notion of Eigen functions of LSI systems, a basis of Eigen functions, region of convergence, poles and zeros of system, Laplace domain analysis, solution to differential equations and system behaviour.	**6**

Module 4	The z-Transform for discrete time signals and systems- Eigen functions, region of convergence, z-domain analysis.	**2**
Module 5	State-space analysis and multi-input, multi-output representation. The state-transition matrix and its role.	**2**
Module 6	The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems.	**4**
Module 7	Node and Mesh Analysis, matrix approach of network containing voltage and current sources, and reactance, source transformation and duality. Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation and Tallegen's theorem as applied to AC. circuits.	**4**
Module 8	Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation.	**4**
Module 9	Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions.	**4**
Module 10	Transient behaviour, concept of complex frequency, Driving points and transfer functions poles and zeros of admittance function, their properties, sinusoidal response from pole-zero locations, convolution theorem and Two four port network and interconnections, Behaviours of series and parallel resonant circuits, Introduction to band pass, low pass, high pass and band reject filters.	**5**

Text/Reference books:

1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
3. Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.
4. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
5. Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition: c1999.
6. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, c1998.
7. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.
8. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", TMH, 2003.
9. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.

10. Ashok Ambardar,"Analog and Digital Signal Processing", 2nd Edition, Brooks/ Cole Publishing Company (An international Thomson Publishing Company), 1999.
11. Van, Valkenburg.; "Network analysis" ; Prentice hall of India, 2000
12. Sudhakar, A., Shyammohan, S. P.; "Circuits and Network"; Tata McGraw-Hill New Delhi, 1994
13.A William Hayt, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill Education.

PCC	**ECE203**	**Physics of Semiconductor Devices**	**3L-0T-0P**	**3Credits**

COURSE OBJECTIVES:

1. To learn the fundamentals of structure of solids and physical processes in semiconductor materials.
2. To learn the device engineering and optimizations of most used semiconductor devices and few others.
3. Visualization of physics of semiconductors and devices through simulations.

COURSE OUTCOME:

1. Understanding of the physical processes in a semiconductor.
2. Understanding and developing the ability to engineer semiconductor junctions and transport through them.
3. Understanding and developing the ability to engineer bipolar junction transistors and properties.
4. Understanding and developing the ability to engineer MOSFETs and properties.

Module	Content	Lecture
Module 1 **Physics of Semiconductors:**	**Crystal and Band Theory:** Introduction to quantum mechanics, Schrodinger Equation with examples, types of solids, lattice structures (including vectors) and symmetries and defects, Miller indices, Diamond lattice, Band formation of 1-D lattice, Bloch's theorem, E-k diagram, metal vs semiconductor vs insulator, direct and indirect band gap semiconductor, effective mass tensor, concept of hole, light and heavy carries, Gunn effect, III-V semiconductors, effect of stress and temperature on bandwidth. **Equilibrium System**: Density of states, Fermi-Dirac distribution statistics, equilibrium electron and hole concentration, intrinsic/extrinsic semiconductors, impurity doping, non-degenerate semiconductor, scattering basics and Matthiessen's rule, temperature dependence of scattering, phonons – acoustic and optical, effect of momentum scattering in direct/indirect semiconductors and photon emission, high field effect and velocity saturation.	**18**

	Non-equilibrium & Carrier Transport Phenomena: Excess carrier and finite lifetime from Heisenberg uncertainty, SRH recombination and life time, quasi Fermi level, Mobility and conductivity, drift and diffusion, nonuniform doping and inbuilt electric field, Drude's model.	
Module 2 **Properties of Junctions and Devices:**	**Junction Devices:** p-n homo/hetero-junctions and carrier injections, ideal and nonideal currents, short diode, avalanche and Zenner breakdown, tunneling, Schottky effect, Ohomic metal-semiconductor junctions, Schottky barrier diode and transport mechanisms. Graded junction and varacter diode, p-i-n diode, solar cells. **Negative Resistance devices**: Tunnel, Gunn & Impatt diode -- their energy band diagrams & negative resistance property.	**8**
Module 3 **Properties of Bipolar Junction Transistor:**	**Bipolar Junction Transistors**: Device cross-section of BJT, Operating modes, injection and transport mechanisms and optimization in HBT, non-ideal effects, physical origin of terminal impedances, switching, capacitances, small signal equivalent circuits in FB and RB, Cutt-off frequency, Ebers- Moll model, instability.	**10**
Module 4 **Properties of MOSFET:**	**Metal-Oxide-Semiconductor (MOS):** Contact potential, MOS device cross-section and band-diagrams, concept and types of inversions, threshold voltage, enhancement and depletion mode devices, operating modes, MOSFET device cross-section, identification of junctions, gradual channel approximation and C. T. Sah equation, channel length modulation, short channel effects, small signal equivalent model, capacitances, f_T and f_{MAX}, qualitative introduction to SOI, SON, GAA MOSFET, FinFET, TFET.	**10**

Text/Reference Books:

1) D. Neamen , D. Biswas "Semiconductor Physics and Devices," 4th edition, McGraw-Hill Education, 2017.
2) G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson, 2014.
3) S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley &Sons, 2006.
4) Y. Taur, and T. H. Ning," Fundamentals of Modern VLSI Devices,"2nd editions, Cambridge University Press, 2013.
4) Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ.Press, 2011.
5) C.T. Sah, "Fundamentals of solid state electronics," World Scientific Publishing Co. Inc, 1991.

OEC	**OCE201** **OCS201** **OEE201** **OEC201** **OME201**	**OEC I**	**3L-0T-0P**	**3Credits**

SULLABUS

PCC	**MA 233**	**Engineering Mathematics III**	**4L-0T-0P**	**4Credits**

Module	Content	Lecture
Module 1	Partial Differential Equations: first order partial differential equation, geometrical interpretation, second order partial differential equations with constant coefficients and their classification into elliptical, parabolic and hyperbolic type, solution of one dimensional wave and diffusion equations and Laplace equation of dimension two by the method of separation of variables.	**12**
Module 2	Fourier Series: periodic functions, trigonometric series of sines and cosines, Euler formulae, Fourier series in the interval $(-\pi, \pi)$, Dirichlet's conditions, even and odd functions, half range sine and cosine series, Fourier series in the intervals $(0, 2\pi)$, $(-\pi,\pi)$, $(0,\pi)$ etc. Laplace & Fourier Transform: Definition and properties, inverse transform, convolution, application to solution of linear differential equations with constant coefficients.	**16**
Module 3	Analytic Geometry of two dimensions: Transformation of axes: Translation and Rotation; Invariants; Application to general equation of second degree; Pair of straight lines: Canonical Form: Conics, General equation of second degree and its reduction to canonical form; Classification of conics: central and non-central conics; Tangent & Normal: Intersection of a straight line and a conic; Tangent, Pair of tangents; Chords in terms of middle point; Normal; Pole and polar of a conic. Polar equation: Polar equations of a line, circle and a conic. Equations of Tangent, normal, chord of contact and pair of tangents.	**20**
Module 4	Analytic Geometry of three dimensions: Distance of a point from a plane; Angle between two planes; Straight lines: Equations of straight lines in different forms; Distance of a line from a point; Parallel lines; Shortest distance between two lines; Sphere; Cone; Cylinder	**6**

References:

1. Advanced Engineering Mathematics : Erwin Kreyszig
2. Advanced Engineering Mathematics : R.K. Jain & S. R. K lyengar
3. Advanced Engineering Mathematics : C. R. Wylle & L. C. Barrett

MC	**IC231**	**Indian Constitution**	**2L-0T-0P**	**0Credits**

[L= Lecture, T = Tutorials, P = Practicals & C = Credits]

Basic features and fundamental principles

The Constitution of India is the supreme law of India. Parliament of India can not make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of m"Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and

particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America. The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the

Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Module	Content	Lecture
Module 1	Meaning of the constitution law and constitutionalism	
Module 2	Historical perspective of the Constitution of India	
Module 3	Salient features and characteristics of the Constitution of India	
Module 4	Scheme of the fundamental rights	
Module 5	The scheme of the Fundamental Duties and its legal status	
Module 6	The Directive Principles of State Policy – Its importance and implementation	

Module 7	. Federal structure and distribution of legislative and financial powers between the Union and the States	
Module 8	Parliamentary Form of Government in India – The constitution powers and status of the President of India	
Module 9	Amendment of the Constitutional Powers and Procedure	
Module 10	The historical perspectives of the constitutional amendments in India	
Module 11	Emergency Provisions : National Emergency, President Rule, Financial Emergency	
Module 12	Local Self Government – Constitutional Scheme in India	
Module 13	Scheme of the Fundamental Right to Equality	
Module 14	. Scheme of the Fundamental Right to certain Freedom under Article 19	
Module 15	Scope of the Right to Life and Personal Liberty under Article 21	

PCC	**ECE291**	**Analog Electronics Lab**	**0L-0T-3P**	**1.5Credits**

[L= Lecture, T = Tutorials, P = Practicals & C = Credits]

Module	Content	Lecture
Module 1	Study of line and load regulation using Zener Diode.	**3**
Module 2	Study of Voltage Regulator using BJTs and Regulator ICs	**3**
Module 3	Study of Emitter-Follower Circuit.	**3**
Module 4	Study of Single Stage R-C Coupled Amplifier.	**3**
Module 5	Study of Single Stage FET Amplifier.	**3**
Module 6	Study of Adder and Subtractor Circuit using OP-AMP 741	**3**

Module 7	Study of Integrator and Differentiator Circuits using OP-AMP 741	**3**
Module 8	Study of Phase Shift Oscillator using OP-AMP.	**3**
Module 9	Study of Wien Bridge Oscillator using standard OP-AMP.	**3**
Module 10	Study of Active filter using OP-AMP.	**3**
Module 11	Study of Timer Circuit using NE 555 and its Configuration for Monostable and Astable Multivibrators	**3**

PCC	**CSE291**	**Data Structures Lab**	**0L-0T-3P**	**1.5Credits**

Module	Content	Lecture
Module 1	Implementation of various sorting algorithms such as Bubble sort, Insertion sort, Selection sort, Merge sort, Quick sort, Shell sort, Heap sort, Radix sort, Bucket sorting.	**3**
Module 2	Implementation of Linear and Binary Search.	**3**
Module 3	Implementation of stacks and queues using arrays	**3**
Module 4	Implementation of stacks and queues using linked lists.	**3**
Module 5	Applications of linked lists: polynomial arithmetic, set operations, etc.	**3**
Module 6	Sparse Matrices: Multiplication, addition.	**3**
Module 7	Implementation of Binary Trees, Binary Search Trees, B-Trees, B+-Trees.	**3**
Module 8	Implementation of Hash tables.	**3**

Semester IV (Second year)

PCC	**ECE202**	**Digital Electronics and Logic Design**	**3L-0T-0P**	**3Credits**

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Design and analyze combinational logic circuits
2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder
3. Design & analyze synchronous sequential logic circuits
4. Use HDL & appropriate EDA tools for digital logic design and simulation

Module	Content	Lecture
Module 1	Review of Number System, Signed and Unsigned Number. Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh's map, Binary codes, Code Conversion. MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU.	10
Module 2	Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Asynchronous and synchronous counter design. Ring and Johnson (twisted ring) counters, Different types of registers. Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation.	10
Module 3	D/A conversion- R-2R ladder type, weighted resistor type, A/D conversion-counter type, flash type. Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.	10
Module 4	VLSI Design flow: Design entry: Schematic, FSM & HDL, different modelling styles in VHDL, Data Types and objects, Dataflow, Behavioural and Structural Modelling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits**.**	10

Text/Reference Books:

1. R.P. Jain,"Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Digital design by M. Mano (Pearson)
3. Fundamental of digital circuits by A. Anand Kumar (PHI)
4. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
5. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition ,2006.
6. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989
7. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.

PCC	**ECE204**	**Electromagnetic Engineering**	**3L-0T-0P**	**3 Credits**

Course Objectives: Understanding fundamental concepts of electromagnetic theory of fields and waves, transmission line, antenna and wave propagation.

Course outcomes

Students will be able to

- gain knowledge on fundamentals concepts and laws of electromagnetic theory, transmission line and antenna.
- solve numerical problems on design issues of the above topics.

Module	Content	Lecture
Module 1	**Vector Laws and Electrostatics:** Vector laws, Co-ordinate systems, Del operator, Gradient, Divergence, Curl – their physical interpretations, Laplacian operator, Coulomb's law, electric field intensity, charge distribution; Gauss' law, flux density and electric field intensity. Divergence theorem .	**10**
Module 2-	**Magnetostatics and Electromagnetic Induction:** Biot-Savart law, Ampere's law, Current Densities, Boundary Conditions between media interface, Faradays laws, limitation of Amperes law and its correction by Maxwell, Maxwell's equations .	**6**

Module 3	**Electromagnetic waves and waveguides:** Waves in general, Uniform Plane wave, Wave Propagation in Lossy Dielectric, Loss-less Dielectric, Free space. Poynting Theorem, Power flow. Wave reflection & transmission at normal incidence, standing wave formation, modes in planar and rectangular waveguides .	**10**
Module 4	**Trans mission Lines:** Concept of Lump parameters and Distributed parameters, Line Parameters, Transmission line equations and solutions, Propagation constant, Characteristic Impedance; Wavelength; Velocity of Propagation; Distortion-less Line, Reflection and Transmission coefficients; Standing Waves, , Smith Chart – Applications; Load Matching Techniques.	**10**
Module 5	**Antenna Fundamentals:** Primary function of antenna and antenna fundamentals, some definitions of Radiation Pattern, Beam Area, Beam width, Band width, Directivity, Gain, Antenna Aperture, effective aperture, Radiation Resistance, antenna efficiency. Concept of retarded Potential, Field solutions; Radiations from Hertzian and Half wave Dipole, Near-Field and Far-Field Concept	**6**
Module 6	**Wave Propagation:** Different modes of Radio Wave Propagation: Ground Wave Propagation, Sky Wave Propagation, Skip Distance, Critical Frequency, Virtual Height. Space Wave Propagation, Troposphere Propagation.	**6**

Reference Books:

1. Mathew N O Sadiku, *'Elements of Electromagnetics'*, Oxford Univ. Press
2. E C Jordon and K G Balmain, '*Electromagnetic Waves and Radiating Systems'*, PHI
3. G.S.N.Raju., *'Electromagnetic Field Theory and Transmission Lines',* Pearson Education,
4. Hayt and Buck, *'Engineering Electromagnetics'*, TMH
5. Roger F Harrington, '*Time Harmonic Electromagnetic Fields'*, Willey Interscience

PCC	**ECE208**	**Electronic and Electrical Measurement**	**3L-0T-0P**	**3Credits**

Module	Content	Lecture
Module 1	**Fundamentals of Measurement** Systems and Standards; Types of errors: Gross errors, systematic errors and random errors; probability of errors-normal distribution of errors probable errors; limiting errors.	**4**
Module 2	**Galvanometers** Construction, Performance, Steady state and Dynamic Behaviors of d'Arsonval, Vibration, and Ballistic Galvanometers.	**4**
Module 3	**Electromechanical Indicating Instruments:** *Ammeters and Voltmeters:* PMMC, Moving-Iron, and Electrodynamic type; *Ohmmeters:* Series-type and Shunt-type Ohmmeters; Thermo-instruments, Watt-hour Meters, Power-Factor Meters and Instrument Transformers;	**8**
Module 4	**Potentiometers** DC and AC; BRIDGES: *D.C. Bridges:* Wheatstone bridge, and Kelvin bridge. *A.C. Bridges and their Applications:* Maxwell Bridge, Hay Bridge, Schering Bridge, and Wein bridge, Measurement of high resistance by Megger;	**8**
Module 5	**Electronic Instruments for Measuring Basic Parameters** Amplified DC Meter, AC Voltmeter Using Rectifiers, True RMS– Responding Voltmeter, Electronic Multimeter, *Digital Voltmeters:* Ramp-type, Integrating type, and Successive-Approximation type; Component Measuring Instruments: Q-meter, Vector Impedance Meter, Vector Voltmeter, RF Power and Voltage Measurements.	**4**
Module 6	**Cathode Ray Oscilloscopes** Cathode Ray Tube, Deflection Amplifiers, Oscilloscope Time Base, Dual-Trace Oscilloscopes, Oscilloscope Controls, Oscilloscope Probes, Delayed time base oscilloscope, Digital Storage Oscilloscope.	**4**
Module 7	**Digital Instruments** Basic Digital Displays – LEDs and LCD panels. Display Drivers and Latches, Time Base generation with Crystal Oscillators. Digital Frequency: Meter, Errors Time and Ratio measurement.	**4**

Module 8	**Transducers** Resistance type, potentiometer & strain gauges, Inductive type, LVDT, Capacitive type, Piezoelectric transducer; Measurements : Dimensional change, Motion, Force, Torque, Pressure, Sound; Sensing Elements : Temperature sensing elements: RTD, Thermistor, Thermocouple, Semiconductor sensor; Pressure sensing elements: Manometer, Bourdon tube, Diaphragm, Bellow; Measurement methods : Measurement of vacuum pressure using Mcleod gauge & Pirani gauge, Flow sensing elements: Orifice, Venturi Flow-nozzle, Rotameter, Electromagnetic flowmeter, Coriolis flowmeter. Ultrasonic transducer. Measurement of non electrical quantities such as Strain, Temperature, pressure, force, speed, flow, humidity, sound, etc. Optical sources and sensors. Application of transducers in measurement and control	**9**

Text Books:

1. Sawhney A K, "A course in Electrical & Electronic Measurements & Instruments", Dhanpat Rai.
2. Golding E.W. & Wides F.C., "Electrical Measuring Instruments & Measurements", Wheeler.
3. Ernest O. Doebelin, "Measurement Systems Application and Design", McGraw Hill.

Reference books:

1. Heltrick A.D. & Copoper W.D., "Modern Electronic Instrumentation & Measuring Instruments", Wheeler.
2. Singh, "Industrial Instrumentation &control", 2/e Tata Mcgraw-Hill.
3. Bolton W, "Instrumentation & Process Measurement", Universities Press
4. Heltrick A.D. & Copoper W.D., "Modern Electronic Instrumentation & Measuring Instruments", Wheeler.
5. Singh, "Industrial Instrumentation &control", 2/e Tata Mcgraw-Hill.
6. Bolton W, "Instrumentation & Process Measurement", Universities Press.

OEC	**OCE202** **OCS202** **OEE202** **OEC202/OEC204** **OME202**	**OEC II**	**2L-0T-0P**	**2 Credits**

SEE SYLLABUS FOR RESPECTIVE COURCES

BSC	**BIO 252**	**Biology for Engineers**	**2L-0T-0P**	**2 Credits**

Module	Content	Lecture
Module 1	Diversity of Life-prokaryotes and eukaryotes, non chordates and chordates; Origin of life and Darwinian Evolution, Synthetic theory of evolution	**5**
Module 2	Cell and Cell theory, Cellular structure and function, central dogma of molecular Biology, Concept of Gene and Allele, Genetic disorder, Genetic code, Understanding inheritance patterns through pedigree	**5**
Module 3	Organismal physiology, Bioenergetics, Exothermic and endothermic vs. Exergonic and endergonic reaction (include Glycolysis, Krebs cycle and photosynthesis)	**4**
Module 4	Biomolecules, monomers and polymers, Nucleotides and DNA/RNA, Amino acids and proteins, carbohydrates and lipids, hierarchy of protein structure, structure function correlation , enzymes and their mode of action	**5**
Module 5	Immunology- Self vs. Non Self, pathogens, human immune system , antigen-antibody reactions, Vaccines, Nervous system- impulse transmission	**4**
Module 6	Biosafety, bioresources, Drug design principle	**2**
Module 7	Engineering designs inspired by examples in biology (compare eye and camera, bird flight and aircraft	**3**
Module 8	Engineering aspects of some Nobel Prizes in physiology and Medicine	**2**

MC	**ES 232**	**Environmental Science**	**2L-0T-0P**	**0 Credits**

Module	Content	Lecture
Module 1	**Environmental Ecosystem** Definition, concept, structure and function, Flow of energy, Food chain and food web, Biogeochemical cycles, Carbon cycle, Nitrogen cycle, Phosphorous cycle, Sulphur cycle, Ecological pyramids, Ecological Succession	8
Module 2	**Biodiversity** Ecosystem Biodiversity, Species and Genetic Diversity, The value of biodiversity, Categories of threatened species, Reasons of biodiversity loss, Biodiversity conservation (In-situ and Ex-situ conservation),	6

	Biodiversity Hot spot, Biosphere reserve	
Module 3	**Environmental Pollution** Definition, Sources, effects and control measures of air, water and noise pollution	4
Module 4	**Global Environmental Problems** Greenhouse effect, Global warming and Climate change, Ozone depletion, Acid rain	3
Module 5	**Sustainable Development** Concept of sustainable development, Objectives of sustainable development, Need for sustainable development, Renewable and Non-renewable sources of energy	3

PCC	**ECE292**	**Digital Electronics & Logic Design Lab**	**0L-0T-3P-3T**	**1.5Credits**

Module	Content	Lecture
Module 1	Verification of truth table of the basic gates.	**3**
Module 2	Study of half adder and full adder circuit.	**3**
Module 3	Study of half subtractor and full subtractor circuit.	**3**
Module 4	Study of encoder and decoder circuit.	**3**
Module 5	Study of MUX and DEMUX circuit.	**3**
Module 6	Study of SR, JK, D, T Flip flop.	**3**
Module 7	Study of shift registrar.	**3**
Module 8	Study of counter circuit.	**3**

PCC	**ECE294**	**Transmission Line and Antenna Lab**	**0L-0T-3P-3T**	**1.5Credits**

Module	Content	Lecture
Module 1	Study of Simple Dipole λ/2 Antenna and Folded Dipole l/2 Antenna	**3**
Module 2	Measuring Antenna Beam width	**3**
Module 3	Study of Antenna Band width	**3**
Module 4	Study of Antenna Radiation with distance	**3**
Module 5	Study of Voice Communication using Antenna	**3**
Module 6	Measuring the characteristics parameters of a transmission line	**3**
Module 7	Measuring the attenuation of a transmission line	**3**
Module 8	Measuring the Input Impedance of a transmission line	**3**
Module 9	Frequency characteristic of the transmission line	**3**
Module 10	Study of Stationary Waves in a transmission line	**3**

Semester V (Third year)

PCC	**ECE301**	**Microprocessor and Microcontroller**	**3L-0T-0P**	**3Credits**

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Do assembly language programming

2. Do interfacing design of peripherals like, I/O, A/D, D/A, timer etc.

3. Develop systems using different microcontrollers

4. Understand RSIC processors and design ARM microcontroller based systems

Module	Content	Lecture
Module 1	Microprocessors 8085 and 8086- Pin description, software and hardware model, memory, data structure/ access. Overview of microcomputer systems and their building blocks, memory interfacing, concepts of interrupts and Direct Memory Access (DMA), Addressing Modes Instruction sets of microprocessors (with examples of 8085 and 8086).	**10**
Module 2	Interfacing with peripherals - timer, serial I/O, parallel I/O, A/D and D/A converters, RAM, ROM,I/O, DMA controller , Keyboard and displays using 8255, interfacing technique. Arithmetic Coprocessors; System level interfacing design.	**8**
Module 3	Concepts of virtual memory, Cache memory, advanced coprocessor Architectures- 286, 486, Pentium; Architecture of Microcontrollers 8051, Memory and I/O interface.	**6**
Module 4	Introduction to RISC processors; ARM microcontrollers interface designs.	**6**

Text Books/References:

1. Microprocessor architecture, programming and applicationwith the 8085-Gaonkar
2. 8086/8088 family (Design, programming & inteface)-Uffenbeck
3. 8088 & 8086 microprocessors (Programming, interfacing, software,hardware and application)-Triebel & Singh
4. D. V. Hall, "Microprocessor and Interfacing Programming & Hardware" TMH

PCC	**ECE307**	**Communication Systems**	**3L-0T-0P**	**3Credits**

Module	Content	Lecture
Module 1	**Introduction:** Block diagram of Electrical communication system, Radio communication: Types of communications, Analog, pulse and digital Types of signals, Noise – Types of noise, sources of noise, noise figure.	**4**
Module 2	**Amplitude Modulation:** Need for modulation, Types of Amplitude modulation, AM, DSB SC, SSB SC, Power and BW requirements, generation of AM, DSB SC, SSB SC, Demodulation of AM: Diode detector, Product demodulation for DSB SC & SSB SC. Angle Modulation: Frequency & Phase modulations and demodulation, advantages of FM over AM, Bandwidth consideration, Narrow band and Wide band FM, Comparison of FM & PM.	**16**
Module 3	**Pulse Modulations:** Sampling, Nyquist rate of sampling, Sampling theorem for Band limited signals, PAM, regeneration of base band signal, PWM and PPM, Time Divison Multiplexing, Frequency Division Multiplexing.	**8**
Module 4	**Digital Communication:** Advantages, Block diagram of PCM, Quantization, effect of quantization, quantization error, Base band digital signal, DM, ADM, ADPCM and comparison. Digital Modulation: ASK, FSK, PSK, DPSK, QPSK modulation and demodulation, coherent and incoherent reception, Line coding: Polar/Unipolar/Bipolar NRZ and RZ; Manchester, differential encoding and their spectral characteristic.	**16**
Module 5	**Information Theory:** Concept of information, rate of information and entropy, Source coding for optimum rate of information, Coding efficiency, Shanon-Fano and Huffman coding, Error control coding: Introduction, Error detection and correction codes, block codes, convolution codes.	**8**

TEXT BOOKS:

- Principles of Communications – H. Taub and D. Schilling, TMH
- Communication System- Simon Haykin, John Wiley & Sons
- B.P. Lathi, Modern Digital and Analog Communication System, Oxford University Press

REFERENCE BOOKS:

- Electronic Communication Systems – Kennedy and Davis

Communication Systems Engineering – John. G. Proakis and Masoud Salehi, PHI

PCC	**ECE309**	**Micro and Nano Fabrication Process**	**3L-0T-0P**	**3Credits**

[L= Lecture, T = Tutorials, P = Practical & C = Credits]

Module	Content	Lecture
Module 1	**Material properties** SiGe and Group III-V compound semiconductors; band gap and lattice structures; gap narrowing; Heterostructures: Drift and diffusion equations: bipolar transistors: Heterostructure technologies for SiGe-HBT, AlGaAs/GaAs HBT; Heterostructure field effect devices; Double heterstructures; Strained layer superlattices; III-V compound heterostructure; Quantum well and Quantum well devices;	**4**
Module 2	**Semiconductor substrate** Crystal growth-defects; Wafer preparation;	**16**
Module 3	**Unit processes and equipments** Diffusion and thermal oxidation, Ion implantation; Rapid thermal processing.	**8**
Module 4	**Pattern transfer** Optical Lithography: Photoresists: etching: plasma : reactive ion eching;	**16**
Module 5	**Thin films** Deposition; dielectric and poly silicon film deposition; evaporation and sputtering; chemical vapour deposition; epitaxial growth;	**8**
Module 6	**Process integration** Device isolation, contacts and metallization**:** bipolar and MOS processing: GaAs technologies Molecular Building Blocks for Nanostructures – Nano-scale 1D to 3D Structures – Electrical, Mechanical and Optical Properties – Nanoelectronic Devices – Quantum Dots and Wells – Nano-scale Functional Materials – Carbon Nanotubes and Fullerenes – Nano-scale Fabrications processes: Characterization: electron microscope; atomic force microscope	

Text/Reference Books:

1. Donald A. Neamen, Semiconductor Physics and Devices (Basic principle), Mc Graw Hill
2. Robert F. Pierret, Semiconductor Device Fundamentals, Pearson
3. Behzard Razavi, Fundamentals of Microelectronics, John Willey
4. D Nag Choudhury, Principles of Microelectronics Technology, Wheeler(India)
5. Sedra & Smith, Microelectronic Circuits, Oxford

PCC	**EE331**	**Power Electronics Devices & Converters**	**3L-0T-0P-3T**	**3Credits**

Module	Content	Lecture
Module 1	**Introduction:** Concept of Power Electronic System, Scope & Applications, Classification of Power Processors & Converters	**2**
Module 2	**Power Semiconductor Devices:** **Power Diodes:** Structure, I-V and Reverse Recovery Characteristics, Diode Equation, Types of Power Diode. **Power Transistors& Power MOSFETs:** Structure, Steady State and Switching Characteristics. **IGBTs:** Basic Structure, Equivalent Circuit, Output, Transfer & Switching Characteristics, Latch-ups in IGBTs. **Thyristors:** Construction & Operation, I-V Characteristic & Operating Modes, Two-Transistor Model, Turn-On Methods, Thyristor Turn-Off. Introduction to GTO, UJT, DIAC & TRIAC	**8**
Module 3	**AC – DC Converters (Rectifiers):** **Diode Rectifiers:** Introduction, Single-phase Half Wave Rectifier with R & R-L Loads, Effect of Freewheeling Diode, Single-phase Full Wave Rectifier with R & R-L Loads, Performance Parameters. **Controlled Rectifiers:** Single-phase Half Wave & Full Wave Controlled Rectifiers with R & R-L Loads, Freewheeling Diode, Single-phase Semi Converter, Single-phase Dual Converter	**9**

Module 4	**DC – DC Converters (Choppers):** Introduction, Basic Chopper Classification, Principle of Chopper Operation (Step-Down Chopper), Step-Up Chopper, Step-Up/Down Chopper, Control Strategies.	**5**
Module 5	**DC – AC Converters (Inverters):** Introduction & Classification, Single-phase Half Bridge and Full Bridge Inverters with R & R-L Loads, Shoot-Through Fault, Performance Parameters. 120^0 and 180^0 Three-phase Inverters. Voltage Control of Single-phase Inverters, External Control, Internal Control (PWM), Single-Pulse Modulation, Multiple-Pulse Modulation, Sinusoidal Pulse Modulation (SPWM).	**9**
Module 6	**AC – AC Converters:** **AC Voltage Controllers:** Introduction, Principle of Phase Control, Principle of Integral Cycle Control, Single-phase Voltage Controllers with R & R-L Loads	**3**

Text Books:

1. M. H. Rashid, "Power Electronics: Devices, Circuits, and Applications", Pearson Education
2. P. S. Bimbhra, "Power electronics", Khanna Publishers

Reference Books:

1. Ned Mohan, Tore M. Undeland& William P. Robbins, "Power Electronics: Converters, Applications and Design", John Wiley & Sons
2. M. D. Singh &K. B. Khanchandani, "Power electronics", Tata McGraw-Hill
3. Bimal K. Bose, "Modern Power Electronics & Ac Drives", Prentice-Hall of India
4.

9. Industrial Electronics by James A. Rehg, Glenn J. Sartori, Prentice Hall, 2005

PCC	**EE303**	**Control System**	**3L-0T-0P-3T**	**3Credits**

Module	Content	Lecture
Module 1	**Concepts of Control Systems:** Open loop & Closed-loop control systems, Automatic control system, Linear & Non-linear control system, Continuous-time & Discrete-time control systems.	**2**
Module 2	**Mathematical Modelling of Physical Systems:** Transfer function; Concepts of poles and zeros; Block diagram representation of control systems, Signal flow graph and Mason's gain formula. Electrical analogy of mechanical system**.**	**5**
Module 3	**Control System Components:** Error sensing devices, potentiometer, synchros, D.C. and A.C. tachometers, D.C. and A.C. servomotors.	**3**
Module 4	**Time Response of Closed-loop Systems:** Transient & steady state response (first and second order system), time-domain specifications and error coefficients, higher order systems.	**4**
Module 5	**Stability Analysis:** Concept and definition, R-H criteria, internal stability of closed-loop system.	**3**
Module 6	**Root Locus Technique:** Construction of Root Loci, effects of the movement of poles and zeros.	**4**
Module 7	**Frequency Response Analysis:** Bode plot, Nyquist plot, Polar plot, Nichols' chart, measures of relative stability.	**7**
Module 8	**Concept of** P, PI, PD &PID controllers and applications.	**2**

Module 9	**Concept of** Lag, Lead, Lag-Lead compensators and applications.	**2**
Module 10	**Introduction to State Variable Analysis:** Concepts of state variables, state space model, solution of state equation, eigenvalues and stability analysis, concept of controllability and observability.	**2**
Module 11	**Introduction to Digital Control System:** Introduction, signal conversion, sample-hold device, Z-transform and inverse Z-transform, Sampling theorem.	**2**

Text Books:

3. Ogata K, "Modern Control Engg.", PHI/ Pearson Education
4. Nagrath I J & Gopal M, "Control Systems Engineering", New Age International.
5. B.C. Kuo, "Automatic Control System", PHI.
6. P. Ramesh Babu, "Control System Engineering", Scitech.

Reference books:

1. Stefani, Design of feedback Control System, OUP.
2. B. C. Nakra, "Theory & Applications of Automatic Control", New Age International.
3. M. Gopal, "Modern Control System Theory", New Age International.
4. M. Gopal, "Digital Control Engineering", New Age.

OEC	**OCE301** **OCS301** **OEE301** **OEC301** **OME301**	**OEC III**	**3L-0T-0P-3T**	**3Credits**

SEE SYLLABUS FOR RESPECTIVE COURCES

PCC	**ECE397**	**Communication Systems Lab**	**0-0-3L-3T**	**1.5Credits**

Module	Content	Lecture
Module 1	Study of AM system.	**3**
Module 2	Study of DSB-SC system.	**3**
Module 3	Study of SSB-SC system.	**3**
Module 4	Study of FM.	**3**
Module 5	Study of sampling theorem	**3**
Module 6	Study of PAM, PPM, PWM.	**3**
Module 7	Study of FDM system.	**3**
Module 8	Study of TDM system.	**3**
Module 9	Study of Delta modulator and demodulator.	**3**
Module 10	Study of PCM system.	**3**
Module 11	Study of ASK system.	**3**
Module 12	Study of PSK.	**3**
Module 13	Study of FSK.	**3**
Module 14	Study of pseudo noise generator.	**3**
Module 15	Study of spread spectrum systems DSSS, FHSS.	**3**
Module 16	Study of MSK system.	**3**

PCC	**ECE391**	**Microprocessor and Microcontroller Lab**	**0-0-3L-3T**	**1.5Credits**

Module	Content	Lecture
Module 1	Study of prewritten programs on trainer kit using the basic instruction set (data transfer, Load/Store, Arithmetic, Logical) Assignments based on above.	**3**
Module 2	Familiarization with 8085 simulator on PC. Study of prewritten programs using basic instruction set (data transfer, Load/Store, Arithmetic, Logical) on the simulator. Assignments based on above.	**3**
Module 3	Programming using kit and simulator for: i. Table look up ii. Copying a block of memory iii. Shifting a block of memory iv. Packing and unpacking of BCD numbers v. Addition of BCD numbers vi. Binary to ASCII conversion vii. String Matching Multiplication using Booth's Algorithm	**3**
Module 4	Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer kit e.g. subroutine for delay, reading switch state and glowing LEDs accordingly.	**3**
Module 5	Study of timing diagram of an instruction on oscilloscope.	**3**
Module 6	Interfacing of 8255: Keyboard and Multi-digit Display with multiplexing using 8255	**3**
Module 7	Study of 8051 Micro controller kit and writing programs for Interfacing of Keyboard, DAC and ADC using the kit.	**3**
Module 8	Serial communication between two trainer kits .	**3**

PCC	**EE393**	**Control Systems Lab**	**0-0-3L-3T**	**1.5Credits**

SEE SYLLABUS FOR RESPECTIVE COURCES

Semester VI (Third year)

PCC	**ECE302**	**Digital Signal Processing**	**3L-0T-0P**	**3Credits**

Course Objectives:

In this course, we will mainly study the following topics:

- Identify the signals and systems
- Apply the principles of discrete-time signal analysis to perform various signal operations
- Signal representation in time domain, Fourier transform analysis to describe the frequency characteristics of discrete-time signals and systems, sampling theorem, linear time-invariant system, discrete convolution, z-transform, discrete Fourier transform, and discrete filter design.
- Use computer programming tools to process and visualize signals.

Course Outcome

- Ability to apply current knowledge and applications of mathematics, science, engineering and technology.
- After this lecture, the students should be able to understand how to analyze a given signal or system using tools such as Fourier transform and z-transform; what kind of characteristics should we analyze to know the property of a signal or system;
- How to process signals to make them more useful; and how to design a signal processor (digital filter) for a given problem. Ability to identify, formulate, analyze and solve technical and engineering problems
- Ability to use the techniques, skills and modern technical tools necessary for technical or engineering practice

  Ability to creatively design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

Module	Content	Lecture
Module 1	**Discrete-time signals** Discrete-time sequences, their frequency domain behaviour, comparison with analog signals, convolution of two sequences, sampling theorem, Reconstruction of continuous-time signals. Unit-sample response of a system, Time-invariant systems, Superposition principle for linear systems, Stability criterion for discrete-time systems, Causality	**12**

	criterion for discrete-time systems, Linear constant-coefficient difference equations.	
Module 2	**Discrete-time Fourier transform** FT of special sequences, the inverse FT; Computation of the DFT from the discrete-time sequence, linear and circular convolution; computations for evaluating the DFT: increasing the computational speed of the DFT.	**10**
Module 3	**3Z-transform** Definition and properties of the z-transform, the inverse z-transform; relationship between the Fourier transform and the z-transform.	**5**
Module 4	**Digital filter** filter categories: IIR and FIR, recursive and non-recursive. Digital Filter Structures: The direct form I and II structures, Cascade combination of second-order sections, parallel combination of second-order sections, Linear-phase FIR filter structures, Polyphase decomposition; Frequency-sampling structure for the FIR filter. Uniform DFT filter banks.	**15**
Module 5	**Digital Signal Processor** **A**rchitecture of TMS320C 6416/6713 Processor (any one; programs in Assembly Language.)	**5**

Text Books:

1. Digital Signal Processing – Principles, Algorithms and Applications - J.G.Proakis & D.G. Manolakis, Pearson Education/ PHI.
2. Digital Signal Processing- Alan V. Oppenheim, Ronald W. Schafer
3. Digital Signal Processing by Sanjit Mitra, 4th edition, 2011, McGraw-Hill, New York, NY.
4. Digital Signal Processors Architectures, Implementations and Applications – S.M.Kuo & W. Gan, Pearson Education

Reference Books:

1. Digital Signal Processing – A Computer Based Approach – S.K.Mitra, TMH Publishing Co,
2. Digital Signal Processing – P. Rameshbabu, Scitech Publications (India)
3. Digital Signal Processing – S. Sharma, S. K. Kataria & Sons

PCC	**ECE304**	**Photonics Devices and Optical Communication**	**3L-0T-0P**	**3Credits**

Course Objectives: Understanding fundamental concepts of operation of photonic devices and their applications in communications

Course outcomes

Students will be able to

- know how light propagates through optical fiber and what are the parameters affecting transmission characteristics
- understand and describe principle of operation and applications of photonic devices
- do numerical problems on optical sources, detectors, optical fiber and link design

Module	Content	Lecture
Module 1	**Overview of Optical Fiber Communication** Introduction and different generations of optical fiber communication.	**2**
Module 2	**Optical Fiber** Materials, Fabrication Process, Types of fibers, Wave guiding fundamentals: NAs, Acceptance angle, Wave equation for step index fiber, modal equation, concept of Modes, V number, Number of modes, cut off wavelength, LP modes	**10**
Module 3	**Transmission characteristics** Attenuation and Dispersion mechanisms and their effects. Special type Fibers-PMF, PCF & DCF	**6**
Module 4	**Optical Sources and optical transmitter** LEDs and ILDs, Principles of operation, structures and characteristics, transmitter circuits; power launching and coupling mechanism, optical modulators	**8**
Module 5	**Photodetectors and optical receiver** Optical detection principle, p-n, p-i-n and APD, Photo transistor, detector response time and speed of response. Receiver Noise and SNR calculation, Receiver Structure,	**8**

Module 6	**Inter-Connecting Devices** Couplers, Isolators, Polarizers, Circulators, Filters, Add/Drop Mux/Demux, Fiber Optic Repeaters, Optical Amplifiers, Optical MEMS	**6**
Module 7	**Communication System** System design issues, Link analysis, Intensity modulation/ direct detection system, coherent communication, Digital systems: coding and multiplexing mechanism, OTDM and WDM system	**10**

Reference Books:

1. John M Senior, *'Optical Fiber Communications: Principles and Practice'*, PHI
2. Ghatak and Thyagaragan, *'Introduction to Fibre Optics'*, Cambridge
3. G Keiser, *'Optical Fiber Communications'*, McGraw Hill Education, India
4. D K Mynbaev and L L Scheiner, *'Fiber Optic Communication Technology'*, Pearson
5. John Gowar, *'Optical Communication Systems'*, PHI
6. Jasprit Singh 'Optoelectronics- An Introduction to Materials and Devices', McGraw Hill Education India
7. J. Wilson and J F B Hawkes *'Optoelectronics- An Introduction'*, 3rd Edition, Pearson Education Taiwan

Reference Books:

8. John M Senior, *'Optical Fiber Communications: Principles and Practice'*, PHI
9. Ghatak and Thyagaragan, *'Introduction to Fibre Optics'*, Cambridge
10. G Keiser, *'Optical Fiber Communications'*, McGraw Hill Education, India
11. D K Mynbaev and L L Scheiner, *'Fiber Optic Communication Technology'*, Pearson
12. John Gowar, *'Optical Communication Systems'*, PHI
13. Jasprit Singh 'Optoelectronics- An Introduction to Materials and Devices', McGraw Hill Education India
14. J. Wilson and J F B Hawkes *'Optoelectronics- An Introduction'*, 3rd Edition, Pearson Education Taiwan

PCC	**ECE306**	**VLSI Circuit Design**	**3L-0T-0P**	**3Credits**

Course objectives:

1. To understand need for integration, basic IC fabrication steps, layout techniques and advanced MOSFET structures.
2. To understand the design issues and techniques of small combinational and sequential circuits.

3. To learn the various architectures of few often-used subsystems in digital VLSI circuits.
4. To learn the important CMOS analog subcircuits , OpAmp, Data conversion circuits.
5. To understand the physical design issues and techniques of an ASIC chip.

Course outcome:

5. Understanding various aspects of integration, IC fabrication steps, layout techniques and advanced MOSFET structures.
6. Understanding of the design issues techniques of small combinational and sequential circuits, and also system level issues.
7. Knowledge of the various architectures of few often-used subsystems in digital VLSI circuits.
8. Knowledge of the important CMOS analog subcircuits, OpAmp, Data conversion circuits.
9. Understanding of the physical design issues and techniques of an ASIC chip.

Module	Content	Lecture
Module 1 Introduction	**ASIC Design**: Advantages, disadvantages, limitations; Scale of Integration – SSI , MSI, LSI, VLSI, ULSI, GSI; Moor's Law; Meaning of 'X' nm technology node; International Technology Roadmap for Semiconductors overview; Hierarchy, Regularity, Modularity & Locality; Chip Design Options: Gate Array, Field Programmable Gate Array, PLA, PLD, Standard Cell. **Fabrication & Layout of CMOS**: MOS device cross-section, Capacitances, Low-frequency model, BSIM; Fabrication Process Flow; CMOS n-Well Process: Layout & Design Rules; CMOS inverter Layout Design; Stick diagram and layout planning; Short channel effect, SOI process – FD & PD, SON process, GAA MOSFET, FinFET; Multi-Vt MOSFET.	**14**
Module 2 Digital VLSI Circuits	**CMOS Logic Circuits**: Properties of digital circuit, comparison with analog circuit; Resistive load inverter; Ratioed/ratioless circuits; n-MOS, pseudo n-MOS, CMOS, DCVSL logic topologies; Advantages/disadvantages of CMOS topology; Logic circuit synthesis using Graph, CMOS EXOR2/3/4, Full adder circuit; Small geometry effect and circuit/path optimization techniques; Shannon's expansion rule, BDD; PTL, CMOS TG; Static/dynamic logic; Dynamic CMOS Logic- issues and solutions, advantages/disadvantages; Sequential CMOS logic circuits: Bi-stable elements; SR Latch Circuit; Problem with JK flipflop in VLSI, CMOS D-latch and edge triggered Flip-flop, Asynchronous set/reset, All timing parameters for characterization.	**16**

Module 3 **Few Digital Subsystems**	**Subsystem Design**: Adders: Carry ahead adder, carry save adder, Manchester carry chain, Tree adders; Multipliers: Booth Multiplier, Array multiplier; Baugh-Wooley signed multiplier, (3,2)- and (4,2)- compressors, Walsh tree, High Density Memory: ROM, Static RAM, Dynamic RAM, Flash Memory.	**8**
Module 4 **Analog VLSI Circuits**	**Analog VLSI Circuits :** Analog CMOS subcircuits: Basic single stage amplifies, Small Signal Analysis techniques, Current source/sink, Current mirrors, Voltage level shifter; CMOS Current Sources and sinks; CMOS Differential Amplifier; CMOS Operational Amplifier; Comparator; CMOS Voltage and Current references; Gyrator; Data conversion circuits, SAR & Sigma-delta ADC; Resistor emulation using switched capacitor, Switched Capacitor Filters.	**16**
Module 5 **Physical Design**	**Physical Design**: Basic chip organization in Standard Cell flow, Physical Design processes, issues and solutions; RTL2GDS2 flow steps and tools; STA and SSTA (if time permits), DVFS overview; Routing algorithms.	**4**

Text/Reference Books:

1. S M Sze, VLSI Technology, M Hill
2. Philips E. Allen & Douglas R. Holberg, " CMOS Analog Circuit Design" , Oxford University Press
3. J. M. Rabaey, A. Chandrakasan, B. Nikolic , "Digital Integrated Circuits"
4. W Wolf, Modern VLSI Design Systems on Silicon, Pearson
5. S Gandhi, VLSI Fabrication Principles, John Willey
6. S A Campbell, The Science and Engineering of Microelectronic Fabrication, Oxford
7. D A Pucknell and Eshraghian, Basic VLSI Design, PHI

OEC	**OCE302** **OCS302** **OEE302** **OEC302** **OME302**	**OEC IV**	**3-0-0-3**	**3Credits**

SEE SYLLABUS FOR RESPECTIVE COURCES

PCC	**ECE392**	**Digital Signal Processing Lab**	**0L-0T-3P**	**1.5Credits**

Simulation Laboratory using Standard Simulator:

Module	Content	Lecture
Module 1	Simulation of sampled Sinusoidal signal, various sequences and different arithmetic operations.	**3**
Module 2	Write a program for linear convolution of two sequences.	**3**
Module 3	Simulation of z-transform of various sequences - verification of the properties of z-transform.	**3**
Module 4	Simulation of Twiddle factors – verification of the properties.	**3**
Module 5	Write a program to perform N-point DFT. Also perform the IDFT on the result obtained to verify the result.	**3**
Module 6	Write a program for circular convolution	**3**
Module 7	Write a program to perform linear convolution using (a) overlap save method (b) overlap add method.	**3**
Module 8	Write a program to perform FFT on a sequence using the following methods. (a) Decimation in time (b) Decimation in frequency	**3**
Module 9	Write a program to design an FIR filter using windowing technique.	**3**
Module 10	Write a program to design an IIR filter using (a) impulse invariant method (b) bilinear transformation method.	**3**

Hardware Laboratory using either DSP6416 or 6713 Processor:

Practising of writing & execution of small programs related to arithmetic operations & convolution using Assembly Language of TMSC205416/6713 Processor, Study of MAC instruction.

PCC	**ECE394**	**Photonics Devices and Optical Communication Lab**	**0L-0T-3P**	**1.5Credits**

Module	Content	Lecture
Module 1	Study of Components/Instruments used in Optical fiber communication.	**3**
Module 2	Determination of NA of Optical Fiber.	**3**
Module 3	Determination of Fiber attenuations.	**3**
Module 4	Comparison of EMI effects on fiber and copper medium.	**3**
Module 5	Study of point to point fiber optic analog link.	**3**
Module 6	Study of digital fiber optic communication schemes.	**3**

Module 7	Study of different modulation/demodulation techniques in optical fiber communication.	**3**
Module 8	Experiment on Eye diagram and BER measurement.	**3**
Module 9	Study on EDFA operation	**3**
Module 10	Study on WDM system	**3**

PCC	**ECE396**	**VLSI Circuit Design lab**	**0-0-3L-3T**	**1.5Credits**

Module	**Content**	**Lecture**
Module 1	Study of Different Analog and Digital Circuit using P-Spice/Tanner-Spice.	**3**
Module 2	Study of different Analysis (transient, ac , Fourier) for Analog/hybrid circuit using P-Spice/T-Spice.	**3**
Module 3	Simulation study of Op-amp based circuits. (Adder, Waveform generator, Oscillator, Filter)	**3**
Module 4	Familiarization with EDA tools like Model Sim or Tanner EDA	**3**
Module 5	Study of CMOS Digital circuits using P-Spice/TCAD	**3**
Module 6	Study of CMOS Analog circuits using P-Spice/TCAD	**3**
Module 7	Study of Sequential Circuits using P-spice\TCAD	**3**
Module 8	Study of Ring Oscillator	**3**

PROJ	**ECE382**	**Seminar**	**0-0-2-2**	**1Credits**

Supervised Learning

Objective: To impart the essential knowledge of electronic and communication engineering, to enhance hands on experience on report preparation and presentation skills. Finally to encourage innovativeness.

PROJ	**ECE398**	**Electronic Design Workshop**	**0-0-2-2**	**1Credits**

Supervised Learning

Objective: To impart the essential knowledge of electronic circuit design and fault analysis, to enhance hands on experience and to encourage innovativeness.

Guidelines: The teacher will prepare an exact design problem with specified parameters and assign to the student. As such the teacher can further elaborate or specialize the problem creating enough room for the student to learn and innovate.

If same job is assigned to more than one student/group, it must be with different parameter values.

The students will find their own design solutions with minimum input from the teacher. Of course there can be more than one solution but the student should ultimately know their comparative merits/demerits.

The hardware assembly and testing has to be done only during assigned class hours under general supervision of a teacher. The student must always make a comparative study between the theoretical and measured performance parameters and analyze their causes.

At the end of each job, the student will prepare a report including detail technical specification of his design, circuit diagram, design calculations, theoretical & measured values, graphs, references etc.

Semester VII (Fourth year)

PEC	ECE401, ECE413, ECE425	PEC I	3L-0T-0P-3T	3Credits

SEE SYLLABUS FOR RESPECTIVE COURCES

PEC	ECE415 ECE407 ECE409	PEC II	3L-0T-0P-3T	3Credits

SEE SYLLABUS FOR RESPECTIVE COURCES

PEC	ECE417, ECE419 ECE421	PEC III	3L-0T-0P-3T	3Credits

SEE SYLLABUS FOR RESPECTIVE COURCES

PEC	ECE403 ECE411 ECE405	PEC IV	3L-0T-0P-3T	3Credits

SEE SYLLABUS FOR RESPECTIVE COURCES

HSMC	**MS431**	**Engineering Economics & Management**	**4L-0T-0P-4T**	**4Credits**

Module	Content	Lecture
Module 1	**Economics:** Introduction and Basic Economics Terms: Nature and Significance of Economics, Role of Economics in Engineering and Technology, Basic Economic: Utility, Saving, Investment, Equilibrium, Micro and Macro Economics, Liberalization, Privatization, Globalisation. Demand Analysis, Elasticity of Demand, Demand Forecasting, Factors of Production.	**10**

	Money Banking and Trade: Functions of money, supply & demand for money, money price level & inflation, black money, meaning, magnitude & consequences. Banking system in India, Functions of Commercial banks, Function of RBI, Sources of public revenue, principles of taxation, direct and indirect taxes, balance of trade and payment.	
Module 2	**Organizational Behavior:** Basic concepts of management, objectives, classification and hierarchy, Different Schools of Management Thought, Motivation: Concept, Different Theories (Maslow, ERG, Herzberg) Communication: Purpose, process, Barriers to effective communication, Guidelines to make communication effective. Perception: Process, Importance, Factors influencing perception, Shortcuts for judging people- Halo effect, Stereotyping, Projection.	**5**
Module 3	**Human Resource Management:** Recruitment and selection, Training, Performance appraisal, Industrial Relations, Trade Union, Collective Bargaining	**5**
Module 4	**Quality Management**: Concept, Dimensions for goods and services, Cost of Quality, Statistical Quality Control, Control Charts, Acceptance Sampling (single). Quality circle. Total Quality Management: Concept, benefits, Criticism. New Quality Tools: Kaizen, Six Sigma, Quality Circles.	**5**
Module 5	**Productions Management:** Concept, Difference from Operations Management, Types of Production (Mass, Batch, Project), Functions of Production Management. Productivity: Concept, Different Inputs and Productivity Measures, Efficiency and Effectiveness, Measures to increase Productivity.	**6**
Module 6	**Marketing Management:** Basic Concepts of Marketing, Difference between Selling and Marketing, Elements of Marketing Mix- the 4 P's., STP. Marketing Research: Definition, Process, Importance, SWOT Analysis, BCG Matrix, GE Matrix.	**6**
Module 7	**Financial Management:** Use of management science for the efficient administration of economic units, cost benefit analysis, present work and breakeven analysis, budgetary control.	**6**
Module 8	**Materials Management:** Concept, Functions, EOQ Models, Selective Inventory Control—ABC, VED, FSN analysis	**5**

Books:

1. A Text Book of Industrial Engineering (Vol.1) , L. C. Jhamb , Publisher: Everest Publishing House
2. Management: Principles, Processes and Practices , Anil Bhat & Arya Kumar, Publisher: OUP
3. Industrial & Business Management , Martand T. Telsang, Publisher: S. Chand.

4. Rajan Misra, (2009). Engineering Economics, University Science Press, An imprint of Laxmi Publiactions Pvt. Ltd., New Delhi

PEC	**ECE493**	**RF and Microwave Engineering Lab (PEC-VII)**	**0-0-3-3**	**1.5Credits**

Module	Content	Lecture
Module 1	To study V-I characteristics of Gunn Diode.	**3**
Module 2	To study the following characteristic of Gunn Diode **a.** Output power and frequency as a function of voltage. **b.** Square wave modulation through PIN diode.	**3**
Module 3	To determine the frequency & wavelength in a rectangular waveguide working on TE10 mode.	**3**
Module 4	To determine the Standing Wave-Ratio and Reflection Coefficient.	**3**
Module 5	Study of the characteristics of Klystron Tube and to determine its electronic tuning range.	**3**
Module 6	To measure the polar pattern and the gain of a wave-guide horn Antenna.	**3**
Module 7	Study of Magic Tee	**3**
Module 8	Study of Attenuator (Fixed and Variable type).	**3**
Module 9	Study the voice communication by using microwave test bench.	**3**
Module 10	Phase shift measurement	**3**

PCC	**ECE495**	**Electronic Design automation Lab**	**0-0-3-3**	**1.5Credits**

Sl. No.	Name of the Experiments/Assignments	Lecture
Module 1	Introduction to coding styles for synthesis.	**3**
Module 2	Introduction to Xilinx ISE 14.5 and Spartan 3E Starter Kit.	**3**

Module 3	VHDL modelling and implementation of combinational logic equations.	**3**
Module 4	VHDL modelling of a clock divider, simulation and implementation on Spartan 3E starter kit.	**3**
Module 5	Design and implementation of a timer peripheral block.	**3**
Module 6	Fixed point addition, subtraction and multiplication in Qn, n being a generic.	**3**
Module 7	Design of a generic barrel shifter for a micro processor.	**3**
Module 8	Design of an interface buffer for data transfer using circular queue.	**3**
Module 9	Emulation of a stack memory for a RISC processor.	**3**
Module 10	Modelling of a 3:8 decoder and 1:8 demultiplexer.	**3**
Module 11	Design of a priority encoder.	**3**
Module 12	State machine implementation.	**3**
Module 13	Design of a register bank (8x16 bits) with support for post-increment-register-indirect addressing mode for a pipelined processor.	**3**

PROJ	**ECE481**	**Summer Internship**	**- - - -**	**2Credits**

Students will undertake a training/internship at a company or any training institute.

PROJ	**ECE471**	**Project I**	**0-0-8P-8T**	**4 Credits**

Supervised Learning

PEC-I

PEC	**ECE401**	**Information theory and Coding**	**3L-0T-0P**	**3Credits**

COURSE OBJECTIVES:

- To understand mathematical models of information and its application in estimation of source coding scheme.
- To understand the concept of channel, and analysis of propagation of information through channel in presence of noise.
- To understand the mathematical basis of representation of linear block codes.
- To understand BCH-class of codes including the widely used RS code.
- To understand the convolutional codes, its advantages and applications.
- To understand the concatenated codes, its advantages and applications.

COURSE OUTCOME:

- Understanding of mathematical model of information, its analysis and encoding of a source.
- Understanding the concept of channel, effect of noise and its abstraction, and its information capacity.
- Gaining knowledge of Field, arithmetic over it and associated algorithms for efficient computation.
- Understanding BCH-class of codes including the widely used RS code.
- Understanding the the concept of convolutional codes, its purpose and application, analysis, its decoding methods.
- Understanding method of code concatenation, effective large minimum distance, advantages in presence of burst noise, limitations, soft decoding and turbo code.

Module	Content	Lecture
Module 1 Information Theory	**Information Theory**- Uncertainty and information, Self, mutual and conditional mutual information and entropies, Information measures for continuous and discrete random variables; Source coding theorem, FLC and VLC, Gibb's theorem and Kraft's theorem,. Examples of source coding, Source with memory, Markov model and entropy, Quantization and distortion, Lloyd-Max quantizer. **Channel Model**: Channel Capacity and Coding, Channel transmission matrix, Memoryless channel models, BSC,	**12**

	Asymmetric channel model, Composite channels, Information capacity theorem.	
Module 2 Basics of Vector Space	**Vector Space:** Field, Irreducible polynomial, Minimal polynomial, Finite field's extension, Galois field, Arithmetic operations over finite field and algorithms, Basis set, Vector space and null space, Generator matrix and properties. **Coding for reliable digital transmission**: Error Control Strategies, BER and coding gain. **Linear block codes**: Syndrome and Error detection, Minimum distance, Error detecting and Error-correcting capabilities, Standard Array and Syndrome decoding, Hamming code, **Cyclic codes**: Generator & parity-check matrices of cyclic codes, Encoding of cyclic codes, Syndrome computation and error detection, Decoding, Cyclic Hamming Codes, Shortened cyclic codes.	**12**
Module 3 Bose–Chaudhuri–Hocquenghem	**BCH codes**: Description, Decoding BCH codes, Implementation of error correction, Non binary BCH codes and Reed-Solomon codes, Weight distribution and Error detection of Binary BCH codes, Introduction to LDPC.	**8**
Module 4 Convolution Codes	**Convolution codes:** Encoding, Structural properties, Distance properties, Maximum likelihood decoding of convolution codes, Viterbi algorithm, Performance bound for convolution codes, Application of Viterbi decoding, RSC code.	**6**
Module 5 Concatenated Code	**Concatenated Codes**: Concept and advantages of concatenated codes, Interleaves – Block and Convolutional, Burst error correction, soft decoding, LLR algebra, Turbo Code, example of product code.	**4**

Text/Reference Books:

1. Information Theory, Coding and Cryptography, Ranjan Bose, TMH.
2. Error Control Coding, Shu Lin & D I Costello Jr., Prentice Hall.
3. Information and Coding Theory, Jones, Springer.
4. Introduction to Information Theory, M. Mansurpur, MGH.

PEC	**ECE413**	**Micro Electro Mechanical System (MEMS)**	**3L-0T-0P**	**3Credits**

Course Outcomes:

At the end of the course the students will be able to

1. Appreciate the underlying working principles of MEMS and NEMS devices.

Module	**Content**	**Lecture**

Module 1	Introduction and Historical Background, Scaling Effects. Micro/Nano Sensors, Actuators and Systems overview: Case studies.	10
Module 2	Review of Basic MEMS fabrication modules: Oxidation, Deposition Techniques, Lithography (LIGA), and Etching. Micromachining: Surface Micromachining, sacrificial layer processes, Stiction; Bulk Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding.	10
Module 3	Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending; Energy methods, Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.	12
Module 4	Microwave MEMS applications: MEM switch design considerations.. MEMS-based microwave circuit and system. Optical MEMS and MOEMS.	10

Text/Reference Book:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.

2. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering (Vol. 8). CRC press, (2005).

3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.

4. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.

5. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.

6. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

PEC	**ECE425**	**Nanotechnology**	**3L-0T-0P**	**3Credits**

Module	**Content**	**Lecture**
Module 1	Matrices, functions of several variables, ordinary differential equations, geometrical applications of differential calculus, three-dimensional analytical geometry	8
Module 2	Basics and scale of nanotechnology, different classes of nano materials, synthesis of nano materials, fabrication and characterization of nanostructures, applications	8
Module 3	Nano biomaterials and biocompatibility, structural & functional principles of bionanotechnology, protein and dna based nanostructures, nanobio-analytics, nanotechnology in food, medicine and health science	12

Module 4	Basics for nano photonics, quantum confined materials and photonic crystals, plasmonics and near field optics, nano photonic fabrication, nanobiophotonics	10
Module 5	Evolution of nanoelectronics, tunnel junctions and applications of tunneling, ballistic and spin transport, molecular electronics, nanoelectronics simulation	10

Reference books

1.Cutting Edge Nanotechnology **by** Dragica Vasileska

2. Carbon nanotube by Jose Mauricio Marulanda

3. Introduction to Nanoscience and Nanotechnology **by** M. Kuno

PEC-II

PEC	**ECE415**	**Satellite Communication**	**3L-0T-0P**	**3Credits**

Course Objectives: overview of satellite communication principle, concepts and operation.

Course outcomes

Students will be able to

- understand orbital aspect of satellite operation and applications of satellite communication
- do numerical calculation on satellite link analysis
- evaluate the various channel access schemes

Module	Content	Lecture
Module 1	**Introduction:** Need of Satellite Communications, History, Current State, Overview of Satellite System Engineering;	**4**
Module 2	**Orbital Aspects of Satellite Communication:** Orbital mechanism, look angle determination, orbit determination, orbit effects on Communication, System performance;	**10**

Module 3	**Satellite Link Budget:** Basic transmission theory, system noise and G/T ratio, down link design, satellite system using small earth station, up-link design;	**12**
Module 4	**Modulation Multiplexing Techniques:** Analog telephone transmission, Television transmission, Digital transmission, Digital TV and bandwidth Compression, time division multiplexing;	**8**
Module 5	**Multiple Access Techniques:** Frequency division multiple access, time division multiple access, code division multiple access, practical demand access systems, random access, multiple access with on-board processing;	**8**
Module 6	**Satellite Earth Solution Techniques:** Earth solution design, tracking, small earth station antennas, Equipment for the Earth station.	**6**

Reference Books:

1. Dennis Roddy, *'Satellite Communications'*, McGraw-Hill Publication.

2. Timothy Pratt, Charles Bostian & Jeremy Allmuti, *'Satellite Communications'*, John Willy & Sons

3. Wilbur L. Pritchars Henri ,G.Suyder, Hond Robert, A.Nelson, *'Satellite Communication Systems Engineering'*, Pearson.

4. M.Richharia, *'Satellite Communication Systems Design Principles'*, McGraw Hill

PEC	**ECE407**	**Remote Sensing**	**3L-0T-0P**	**3Credits**

Module	Content	Lecture
Module 1	**Concept of Remote Sensing** Distance Remote Sensing, Remote Sensing Process, Sources of Energy, Interaction with atmosphere, Ideal remote sensing.	**4**

Module 2	**Global Positional System** Functions and advantages of GIS, Process of GIS, Planning, Implementation Management of GIS, Data models of GIS.	**6**
Module 3	**Photogrammetry** Development and Classification, Stereo model, Stereoscopic 3D viewing, Measurement and extraction.	**6**
Module 4	**Orthorectification** Low and High resolution DEM, Multiimage fusion, spatial domain fusion, spectral domain fusion, Scale -space fusion.	**6**
Module 5	**Image Processing** Visual image interpretation, Data integration: Analysis and presentation, Thermatic maps, Thermal image interpretation.	**6**
Module 6	**Noise and Correction** Noise reduction, Global noise, Sigma filter, Local noise, Periodic noise, Radiometric calibration, Distorsion correction.	**6**
Module 7	**Sensors** Introduction, Photographic Sensors, Multispectral remote sensing system, Thermal remote sensing system, Microwave remote sensing system, Atmospheric sensors-Radar, LIDAR, SONAR.	**8**
Module 8	**Modern trends in GIS** Local and global concepts , Increase in dimension of GIS , Linear and Non linear techniques in GIS , 3D GIS , Mobile GIS , CGIS.	**6**

Text/Reference Books:

1. Remote Sensing and Geographical Information Systems by Anji Reddy, BS Pub, 2001
2. Remote Sensing Applications by M G Srinivas (Edited)
3. Remote Sensing Method and Applications by Michael Hord, John Willey & Sons, 1986
4. Remote Sensing and image Interpretation by T M Lillesand and R W Keifer, John Willey & Sons, 1987

PEC	**ECE409**	**Advanced Optical Communication**	**3L-0T-0P**	**3Credits**

Course Objectives: Fundamental aspects of components, devices and systems of high speed optical communications and networks

Course outcomes

Students will be able to

- understand components and devices and their principle of operation for optical communication
- know about importance and application of Soliton systems
- gain knowledge about optical networks

Module	Content	Lecture
Module 1	**Overview of Optical Communication:** Motivation and Evaluation of light wave communication systems	**2**
Module 2	**Optical Fiber and Nonlinear effects:** Fiber Modes, dispersion in single mode fiber, dispersion induced limitations, fiber dispersion management, non linear optical effects	**8**
Module 3	**Optical Amplifiers, Filters and Integrated Circuits:** Optical Amplifiers, Optical Filters, FBG, OEICs and applications	**8**
Module 4	**Optical Modulators:** Basic principle, Birefringence, Optical Activity, Electro-Optic, Acusto-Optic and Magneto-Optic Effects and modulators	**6**
Module 5	**Multichannel Systems:** WDM lightwave systems, WDM Components, System performance, Time division and code division multiplexing	**8**
Module 6	**Soliton Systems:** Non linear Schrodinger Equation, Bright and Dark Solitons, Soliton based communication	**8**
Module 7	**Optical networks:** Network Concepts, Network Topologies, SONET/SDH, High speed lightwave links, Optical switching, WDM network example, PON, IP over DWDM, Optical Ethernet	**8**

Reference Books:

1. G Keiser, '*Optical Fiber Communications'*, McGraw Hill
2. D K Mynbaev and L L Scheiner, *'Fiber Optic Communication Technology'*, Pearson
3. John Gowar, *'Optical Communication Systems'*, PHI
4. R. G. Junsperger, *'Integrated Optics-Theory and Technology'*, Springer Series in Optical Sciences
5. Rajiv Ramaswami and Kumar N. Sivrajan, *'Optical networks-A practical perspective'*, Academic Press

6. A. Yariv and P. Yeh, *'Photonics: Optical Electronics in Modern Communications'*, Oxford University Press

PEC-III

PEC	**ECE417**	**Image Processing and Computer Vision**	**3L-0T-0P**	**3Credits**

Course Objectives

1. Understand the various steps in digital image processing.
2. Get a thorough understanding of digital image representation and processing techniques.
3. Ability to process the image in spatial and transform domain for better enhancement

Course Outcomes:

1. Demonstrate the methods of image acquisition, representation and manipulation to design and develop algorithms for solving image processing problems related to various applications like medicine, industry, communications etc.
2. Analyze various image processing algorithms for preprocessing, restoration, compression and segmentation using various spatial and frequency domain methods
3. Identify and solve complex real world problems in image processing using modern signal processing tools, active cooperative learning and be able to demonstrate them effectively.
4. Acquire skills to conduct independent study and analysis of image processing problems and techniques that would engage in lifelong learning.

Module	Content	Lecture
Module 1	**Digital Image Fundamentals :** Introduction – Origin – Steps In Digital Image Processing – Components – Elements Of Visual Perception – Image Sensing And Acquisition – Image Sampling And Quantization – Relationships Between Pixels – Color Models.	**5**
Module 2	**Image Enhancement:** Spatial Domain: Basic Gray Level Transformations –	**8**

	Histogram Processing – Basics Of Spatial Filtering– Smoothing And Sharpening Spatial Filtering – Frequency Domain: Introduction To Fourier Transform – Smoothing And Sharpening Frequency Domain Filters – Ideal, Butterworth And Gaussian Filters.	
Module 3	**Image Restoration :** Noise Models – Mean Filters – Order Statistics – Adaptive Filters – Band Reject Filters – Band Pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener Filtering	**5**
Module 4	**Colour Image Processing :** Colour fundamentals – Colour models – Colour transformation – Smoothing and Sharpening	**5**
Module 5	**Wavelets And Image Compression :** Wavelets – Sub band Coding – Multi resolution Expansions – Compression: Fundamentals – Image Compression Models – Error Free Compression –Lossy Compression – Compression Standards.	**5**
Module 6	**Morphological Processing :** Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, The Hit-or-Miss Transformation, Morphological Algorithms – Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening.	**8**
Module 7	**Segmentation :** Segmentation: Detection Of Discontinuities–Edge Linking And Boundary Detection – Thresholding – Region Based Segmentation.	**4**
Module 8	**Image Representation And Recognition :** Boundary Representation – Chain Code – Polygonal Approximation, Signature, Boundary Segments – Boundary Description – Shape Number – Fourier Descriptor, Moments- Regional Descriptors –Topological Feature, Texture – Patterns And Pattern Classes – Recognition Based On Matching.	**8**

References:

1. Digital Image Processing by Rafael C Gonzalez & Richard E Woods, 3rd Edition
2. Fundamentals of Digital Image Processing by Anil K Jain
3. Digital Image Processing by William K Pratt
4. Fundamentals of electronic image processing by Arthur R. Weeks Jr., Wiley
5. Digital Image Processing Using MATLAB, 2nd ed. by Gonzalez, Woods, and Eddins.

PEC	**ECE419**	**Medical Signal Processing**	**3L-0T-0P**	**3Credits**

Course Objectives

- To develop innovative techniques of signal processing for computational processing and analysis of biomedical signals.
- To extract useful information from biomedical signals by means of various signal processing techniques

Expected Outcome

- Understands how basic concepts and tools of science and engineering can be used in understanding and utilizing biological processes.
- Hands-on approach to learn about signal processing and physiological signals through the application of digital signal processing methods to biomedical problems

Module	Content	Lecture
Module 1	Introduction to biomedical signals. The nature of biomedical signals, types of biomedical signals: ECG EEG, EMG, EOG ERG etc. Objectives of biomedical signal analysis, difficulties in biomedical signal analysis, computer-aided diagnosis. Biomedical signal spectral analysis, digital and analog filtering, correlation and estimation techniques. EOG and EMG.	**10**
Module 2	Introduction to short term Fourier transform (STFT), Design of filters, Hamming window, Kaiser window, Haar window.	**8**
Module 3	Introduction to Electrocardiograph and ECG signals, Types of interferences in ECG signals, ECG signal analysis and noise removal, Detection of ECG abnormalities, Introduction to Electroencephalograph and EEG signals, EEG signal analysis, Kurtosis coefficients,	**15**
Module 4	Diagnostic Optical Spectroscopy – Photon Migration and Optical Imaging – Time Domain and Frequency Domain Methods for Imaging – Endoscopic imaging; Optical Coherence Tomography; Biomedical signal processing.	**12**

References

1. Biomedical Signal Processing Principles and Techniques D.C.Reddy, Tata Mc Graw-Hill
2. Biomedical Digital Signal Processing, Willis J. Tompkins, PHI.
3. Biomedical Signal and Image Processing 2nd Edition by K. Najarian and R. Splinter , The CRC Press (2012)
4. Biomedical Signal Analysis: A Case Study Approach by Rangaraj M. Rangayyan, Akay Metin (Editor) Wiley Interscience 2001

5. Medical Imaging Signals and Systems, Jerry L Prince & Jonathan M Links, Pearson Prentice Hall.

PEC	**ECE421**	**Adaptive Systems and Signal Processing**	**3L-0T-0P**	**3Credits**

Course Objectives

- Introduction to the goal and basics of adaptive signal processing.
- Familiarize with the design and analysis of various adaptive algorithms and filters
- Get an overall picture about applications of adaptive filters in various fields

Expected Outcome

- Understand basic concepts of adaptive signal processing
- Design and analyse convergence issues, computational complexities and optimality of different adaptive algorithms and filters
- Ability to develop adaptive systems for various applications

Module	Content	Lecture
Module 1	Discrete time stochastic process, correlation matrix and spectra; AR, MA and ARMA models; Yule-Walker equation; Levinson-Durbin algorithm; analysis and synthesis of lattice; Estimation and recursion methods; Adaptive filters, adaptive noise cancellation. Method of steepest descent; gradient adaptive lattice; Recursive least square formulation; filtering via orthogonal projection; Radial basis function; Blind convolution**;**	40

References

1. S. Haykin. (1986). Adaptive Filters Theory. Prentice-Hall.
2. Dimitris G. Manolakis, Vinay K. Ingle, Stephan M Krgon: Statistical and Adaptive Signal Processing,McGraw Hill (2000)
3. Jones D. Adaptive Filters [Connexions Web site]. May 12, 2005.

PEC-IV

PEC	**ECE403**	**RF & Microwave Engineering**	**3L-0T-0P**	**3Credits**

Module	Content	Lecture
Module 1	**RF & Microwave Spectrum:** Introduction and basic information	2
Module 2	**Microwave Waveguides :** Rectangular and Circular Waveguides– Mode structures, Cut-off frequency, Propagation Characteristics, wall currents, Attenuation constant, waveguide excitations.	8
Module 3	**Waveguide Passive Components :** Waveguide Resonators – Rectangular & Cylindrical; Resonant frequencies, Mode structures, Q-factor, Co-axial Resonators; Excitation & coupling of cavities, Design of resonators. Periodic Structures-Filters.	6
Module 4	**N-port networks :** circuit representations, transmission matrix,; attenuators, phase shifter, directional couplers, Bethe-hole coupler, Magic tee, hybrid ring, circulators, isolators,	6
Module 5	**Antennas :** Concepts of lines of force; Short antenna; Horns- sectoral horns, Pyramidal horns, Parabolic reflector, Cassigran feed, Patch antennas, antenna arrays. Scattering matrix representations of passive components. Transitions: coaxial lines to waveguide, to micro-strip lines. Design of transitions.	6
Module 6	**Planar structure:** Strip lines, Micro-strip lines, coplanar structure, Slot lines, Suspended strip lines, Fin lines – Configurations, Field patterns, propagation characteristics, Design considerations.	4
Module 7	**Microwave Tubes and semiconductor microwave devices :** Limitations of conventional tubes in microwaves; Multi-cavity Klystron, Reflex klystron; Magnetron, Travelling wave tube, Backward wave oscillator; Tunnel diode; Gunn diode; Avalanche diode; IMPATT, TRAPATT, Microwave bipolar transistor, hetero-junction bipolar transistor, Microwave field-effect transistor–JFET, MOSFET, MESFET, Parametric amplifiers;	8
Module 8	**Radar systems :** Basic concept of RADAR,Pulsed radar, MTI, Tracking radars	2
Module 9	**Microwave Measurements :** Microwave Bench, Slotted line, Tunable Probe, VSWR Meter, Slide screw tuner, Variable shorted line; Power Measurement – Calorimetric method, Thermocouple, Bolometers, Frequency measurement, Impedance measurement by shift in minima. Network Analysers,	4

Text/Reference Books:

1. S Liao, Microwave Devices and Circuits, ?
2. D Pozar, Microwave Engineering, John Wiley & Sons
3. Sisodia & Gupta, Microwave: Introduction to Circuits and Antennas, ?
4. Mathew M Radmanesh, Radio frequency and Microwave Electronics Illustrated, PHI

PEC	**ECE411**	**Radar Systems**	**3L-0T-0P**	**3 Credits**

Module	Content	Lecture
Module 1	**Introduction :** Nature of Radar, Maximum Unambiguous Range, Radar Waveforms, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Related Problems.	6
Module 2	**Radar Equation :** Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise and SNR, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment). Related Problems.	8
Module 3	**CW and Frequency Modulated Radar :** Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar.	8
Module 4	**FM :** CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics Approaching/ Receding Targets), FM-CW altimeter, Measurement Errors, Multiple Frequency CW Radar.	8
Module 5	**MTI and Pulse Doppler Radar :** Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter,	4
Module 6	**Tracking Radar :** Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar – Amplitude Comparison	4
Module 7	**Detection of Radar Signals in Noise :** Introduction, Matched Filter Receiver – Response Characteristics and Derivation, Correlation Function and Cross-correlation Receiver,	6

Text/Reference Books :

1. Introduction to Radar Systems – Merrill I. Skolnik, 2nd ed, McGraw-Hill, 1981.
2. Introduction to Radar Systems – Merrill I. Skolnik, 3rd ed, Tata McGraw-Hill, 2001

PEC	**ECE405**	**EMI/EMC Techniques**	**3L-0T-0P**	**3 Credits**

Module	Content	Lecture
Module 1	**Basic Theory:** Introduction to EMI and EMC, Intra and inter system EMI, Elements of Interference, Sources and Victims of EMI, Conducted and Radiated EMI emission and susceptibility, Various issues of EMC, EMC Testing categories, EMC Engineering Application.	**8**
Module 2	**Coupling Mechanism :** Electromagnetic field sources and Coupling paths, Coupling via the supply network, Common mode coupling, Differential mode coupling, Impedance coupling, Inductive and Capacitive coupling, Radiative coupling,	**9**
Module 3	**EMI Mitigation Techniques :** Working principle of Shielding and Murphy"s Law, LF Magnetic shielding, Apertures and shielding effectiveness, Choice of Materials for H, E, and free space fields, Gasketting and sealing, PCB Level shielding, Principle of Grounding, Isolated grounds, Grounding strategies for Large systems, Grounding for mixed signal systems, Filter types and operation, Surge protection devices, Transient protection.	**10**
Module 4	**Standards and Regulation :** Need for Standards, Generic/General Standards for Residential and Industrial environment.	**9**
Module 5	**EMI Test Methods and Instrumentation:** Fundamental considerations, EMI Shielding effectiveness tests, Open field test, TEM cell for immunity test, Shielded chamber, Shielded anechoic chamber. LISN.	**6**

Text/Reference Books :

1. Introduction to Electromagnetic Compatibility by Clayton R Paul, John Willey
2. EMI/EMC by G K Deb
3. Principles of Electromagnetic Compatibility by Bernhard Keiser, Artech House, 3rd ed

Semester VIII (Fourth year)

PEC	ECE402 ECE404 ECE406	PEC V	3L-0-0-3T	3Credits

SEE SYLLABUS FOR RESPECTIVE COURCES

PEC	ECE412 ECE410 ECE414	PEC VI	3L-0-0-3T	3Credits

SEE SYLLABUS FOR RESPECTIVE COURCES

HSMC	**MS432**	**Professional Values & Ethics**	**2L-0-0-2T**	**2Credits**

Module	Content	Lecture
Module 1	**Human Values :** Objectives , Morals ,Values , Ethics , Integrity, Work ethics, Service learning , Virtues, Respect for others , Living peacefully, Caring , Sharing, Honesty, Courage, Valuing time , Cooperation , Commitment , Empathy, Self-confidence, Challenges in the work place ,Spirituality,	**5**
Module 2	**Engineering Ethics :** Overview, Senses of engineering ethics , Variety of moral issues , Types of inquiries , Moral dilemma , Moral autonomy ,Moral development (theories) , Profession , Models of professional roles ,Theories about right action (Ethical theories)	**5**
Module 3	**Engineering as Social Experimentation :** Engineering as experimentation, Engineers as responsible experimenters, Codes of ethics, Industrial standards.	**4**
Module 4	**Safety, Responsibilities and Rights :** Safety definition, Safety and risk, Risk analysis, Assessment of safety and risk, Conflict of interests, Occupational crime, Human rights, Employee rights, Whistle blowing, Intellectual property rights.	**5**
Module 5	**Global Issues :** Globalization, Multinational corporations,Environmental ethics, Computer ethics, Engineers as managers, Engineers as advisors in	**5**

	planning and policy making, Moral leadership, Codes of ethics.	

Books:

1. A Textbook of Professional Ethics and Human Values, R.S. Naagarazan, New Age International Publishers
2. Blending the best of the East & West, Dr. Subir Chowdhury, EXCEL
3. Ethics & Mgmt. & Indian Ethos, Ghosh, VIKAS
4. Business Ethics,Pherwani,EPH
5. Ethics, Indian Ethos & Mgmt., Balachandran, Raja, Nair, Shroff Publishers

Business Ethics: concept and cases, Velasquez, Pearson.

PEC	**ECE492**	**Wireless and Mobile Communication lab (PEC-IV)**	**0 -0-2-2**	**1.5Credits**

Module	Content	Lecture
Module 1	Generation of baseband signal for GSM, CDMA, Bluetooth, WLAN and WiMAX. Estimation of the signal spectrum at baseband.	**3**
Module 2	Analyze the working of the RF section of a mobile cellular receiver.	**3**
Module 3	Signal generation, reception and analysis of Bluetooth signal using random number as information bits.	**3**
Module 4	Simulate the working of codec in a GSM receiver using MATLAB and Labview.	**3**
Module 5	Analyze propagation characteristics of GSM, IS95, CDMA2000 using Qualnet simulator.	**3**
Module 6	Determine the mobile channel transfer function using vector network analyzer, signal generator and spectrum analyzer.	**3**
Module 7	Test an error correction coding scheme using software defined radio system.	**3**
Module 8	Design equalizer for GSM receiver on a software defined radio system.	**3**
Module 9	Design a mobile CDMA receiver using software defined radio set.	**3**

PROJ	**ECE 472**	**Project II**	**0-0-16P-16T**	**8Credits**

Supervised Learning

Objective: To impart the essential knowledge of electronic circuit design and fault analysis, to enhance hands on experience and to encourage innovativeness.

Guidelines: The teacher will prepare an exact design problem with specified parameters and assign to the student. As such the teacher can further elaborate or specialize the problem creating enough room for the student to learn and innovate.

If same job is assigned to more than one student/group, it must be with different parameter values.

The students will find their own design solutions with minimum input from the teacher. Of course there can be more than one solution but the student should ultimately know their comparative merits/demerits.

The hardware assembly and testing has to be done only during assigned class hours under general supervision of a teacher. The student must always make a comparative study between the theoretical and measured performance parameters and analyze their causes.

At the end of each job, the student will prepare a report including detail technical specification of his design, circuit diagram, design calculations, theoretical & measured values, graphs, references etc.

PCC	**ECE482**	**Grand Viva**		**2Credits**

PEC-V

PEC	**ECE402**	**Wireless and Mobile Communication**	**3L-0T-0P**	**3 Credits**

Module	Content	Lecture
Module 1	Cellular concepts-Cell structure, frequency reuse, concept of cell splitting , Cellular radio system design, channel assignment, handoff/handover in cellular systems, Classification of Handoff/handover interference, capacity, power control.	8
Module 2	Introduction to mobile communication. Past, present and Future wireless– Mobile technology. Wireless Standards: Overview of 2G and 3G cellular standards. Introduction to GSM and CDMA Technology. GSM system architecture overview, GPRS architecture, UMTS architecture, call management and system operation. CDMA based cellular system.	8
Module 3	Signal propagation-Propagation mechanism- reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small scale fading- Doppler shift, statistical multipath channel models, narrowband and wideband fading models,power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading,.	8
Module 4	Multiple access schemes-FDMA, TDMA, CDMA and SDMA, Modulation schemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation ,OFDMA and SC-FDMA.	6
Module 5	MIMO and space time signal processing, spatial multiplexing,diversity/multiplexing tradeoff.Performance measures- Outage, average SNR, average symbol/bit error rate. System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.	6
Module 6	Receiver structure- Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Altamonte scheme.	6

PEC	**ECE404**	**Adhoc and Sensor Netwok**	**3L-0T-0P**	**3 Credits**

Course Outcomes:

At the end of the course the students will be able to

1. Design wireless sensor networks for a given application
2. Understand emerging research areas in the field of sensor networks
3. Understand MAC protocols used for different communication standards used in WSN
4. Explore new protocols for WSN

Module	Content	Lecture
Module 1	Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks.	6
Module 2	Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks.	6
Module 3	Classification of WSNs, Routing protocols, MAC layer protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee.	8
Module 4	Dissemination protocol for large sensor network. Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.	8
Module 5	Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication. Single-node architecture, Hardware components & design constraints.	6
Module 6	Operating systems and execution environments, introduction to Tiny OS and nesC ,TOSSIM.	6

Text/Reference Books:

1. Ad Hoc and sensor networks, Carlos Corderio Dharma P.Aggarwal, world scientific publication/Cambridge university press, March 2006

2. Fundamentals of Wireless Sensor Networks Theory And Practice, Waltenegus Dargie, Christian Poellabauer, By John Wiley & Sons Publications, 2011

3. Wireless Sensor Networks, An information processing approach Feng Zhao, Leonidas Guibas, Elsevier Publications, 2004

4. Wireless Sensor Networks: Technology, Protocols and Applications Kazem Sohrby, Daniel Minoli , Wiley-Inter science

5. Tiny OS Programming Philip Levis, And David Gay by Cambridge University Press 2009

PEC	**ECE406**	**Renewable Energy**	**3L-0T-0P**	**3Credits**

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
2. Understand the basic physics of wind and solar power generation.
3. Understand the power electronic interfaces for wind and solar generation.
4. Understand the issues related to the grid-integration of solar and wind energy systems.

Module	Content	Lecture
Module 1	**Physics of Wind Power :** History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.	**5**
Module 2	**Wind generator topologies:** Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.	**12**
Module 3	**The Solar Resource:** Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.	**3**
Module 4	**Solar photovoltaic:** Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.	**8**
Module 5	**Network Integration Issues:** Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behaviour during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind	**8**

	systems.	
Module 6	**Solar thermal power generation:** Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.	**3**

Text / References:

- T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.
- G. M. Masters, "Renewable and Efficient Electric Power Systems**",** John Wiley and Sons, 2004.
- S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.
- H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.
- G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004.
- J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, 1991.

PEC-VI

PCC	**ECE412**	**Soft Computing**	**3L-0T-0P**	**3Credits**

Course Objectives:

- The primary objective of this course is to provide an introduction to the basic principles, techniques, and applications of soft computing.
- Upon successful completion of the course, students will have an understanding of the basic areas of Soft Computing including Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms.
- Provide the mathematical background for carrying out the optimization associated with neural network learning. Aim of this course is to develop some familiarity with current research problems and research methods in Soft Computing by working on a research or design project.

Expected Outcome

- Identify and describe soft computing techniques and their roles in building intelligent machines
- Recognize the feasibility of applying a soft computing methodology for a particular problem
- Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems

Module	Content	Lecture
Module 1	**Introduction to Soft Computing**: Introduction to Soft Computing, Concept of computing systems., "Soft" computing versus "Hard" computing, Characteristics of Soft computing, Some applications of Soft computing techniques.	**5**
Module 2	**Fuzzy Set Theory & Fuzzy Systems :** Introduction to Fuzzy logic, Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, Fuzzy sets and membership functions. Operations on Fuzzy sets. Fuzzy relations, rules, propositions, implications and inferences. fuzzy IF THEN rules, Fuzzy Inference Systems, Sugeno and Mamdani type systems. Defuzzification techniques. Some applications of Fuzzy logic.	**15**
Module 3	**Fundamentals of Artificial Neural Network :** Introduction, Model of Artificial Neuron, Architectures, Learning Methods, Taxonomy of ANN Systems, Single Layer ANN System, supervised learning, and other learning techniques, Hebbian learning, Single neuron/ Perceptron networks: training methodology, typical application to linearly separable problems, Perceptrons, Adaline, Back-propagation, Mutilayer Perceptrons, Applications of ANNs to solve some real life problems.	**16**
Module 4	**Genetic Algorithms:** Genetic Algorithms: Introduction, Concept of "Genetics" and "Evolution" and its application to proablistic search techniques, Basic GA framework and different GA architectures, GA operators: Encoding, Crossover, Selection, Mutation, etc., Solving single-objective optimization problems using GAs.	**10**

Text/Reference Books

1. S. Haykin, *Neural Networks - A Comprehensive Foundation;* Pearson Education, India (The book is also published by Prentice Hall of India), 2008 (ISBN- 81-203-2373-4).
2. M.T. Hagan, Howard B. Demuth, Mark H. Beale; *Neural Network Design*; (ISBN: 0-9717321-0-8); Thomson 2002.

3. Jang, Sun and Mizutani; *Neuro-Fuzzy and Soft-Computing – A computational approach to learning and machine intelligence*; Prentice Hall of India; ISBN-81-203-2243-6
4. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003.
5. An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 2000.

PEC	**ECE410**	**Robotics and Intelligent Systems**	**3L-0T-0P**	**3 Credits**

Module	Content	Lecture
Module1	Robot configurations, types and applications to different range of industrial applications. Kinematics and Dynamics of robots. Analysis, synthesis and design of robot mechanisms. Control systems design. Motion and trajectory planning and control. Sensor fusion in trajectory planing and control. AI based systems in trajectory and motion planing and control. Basics of vision, monocular and stereo vision. Various vision processing algorithms and techniques for identification, feature extraction, tracking. Integration of vision with various functions of the robot. Advances in Robotics viz, Humanoid robot, toy /pet robots, service and health care robot systems.	40

Text /Reference Books:

1. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall
2. Computer and Robot Vision, Robert M. Haralick and Linda G. Shapiro, Volumes 1 and 2, Addison-Wesley Publishing Company, 1993.

PEC	**ECE414**	**Optical & Advanced Control**	**3L-0T-0P**	**3Credits**

Module	Content	Lecture
Module 1	General concept of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices.	6
Module 2	Optimal FIR (Wiener) filter, Method of steepest descent, extension to complex valued The LMS algorithm (real, complex), convergence analysis, weight error correlation matrix, excess	8

	mean square error and mis-adjustment.	
Module 3	Variants of the LMS algorithm: the sign LMS family, normalized LMS algorithm, block LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering.	6
Module 4	Signal space concepts - introduction to finite dimensional vectors pace theory, subspace, basis, dimension, linear operators, rank and nullity, inner product space, orthogonality, Gram-Schmidt orthogonalization, concepts of orthogonal projection, orthogonal decomposition of vector spaces.Vector space of random variables, correlation as inner product, forward and backward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice.	10
Module 5	Introduction to recursive least squares (RLS), vector space formulation of RLS estimation, pseudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters.	6
Module 6	Advanced topics: affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array.	6