Syllabus for
B.Tech in Electronics and Communication Engineering

Academic Year 2022-2023

Department of Electronics & Communication Engineering

School of Engineering and Technology

Central University of Rajasthan

NH-8 Jaipur- Ajmer Highway, Bandarsindri
Kishangarh -305817
District-Ajmer,
Rajasthan Website:
www.curaj.ac.in

. List of programs offered by the department (Officially correct nomenclature to be followed)

- B.Tech in Electronics & Communication Engineering (ECE)
- PhD in ECE

2. For B.Tech ECE program:

(a) Program specific Objectives:

1. Graduates of the programme will adapt to the continuous changes in the field of Electronics & Communication Engineering.
2. Graduates of the programme will have a successful professional career.
3. Graduates will be able to communicate and work as a part of a team in order to be an effective member of the work place and the society.

Program Outcomes:

PO1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

b. Approved Intake (60)

Admission through JEE Main: 60 (Seats)

c. Minimum Eligibility for entry

d. Course Structure – Semester-wise, identifying Core courses, Discipline Electives, Extra-Departmental Electives, Practice/Lab/Workshop Courses,

4 Year B.Tech in Electronics and Communication Engineering

Detailed Scheme

First Year

SEMESTER I						
Sr. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
			Hours/week			
1	ECE 101	Engineering Mathematics-I	3	1	0	4
2	ECE 102	Engineering Physics	3	0	0	3
3	ECE 103	Basic Electrical Engineering	3	0	1	4
4	ECE 104	English (Language and Communication Writing Skills-I)	3	1	0	4
5	ECE 105	Engineering Graphics & Design	3	0	2	4
6	ECE 106	Engineering Physics Lab	0	0	2	1
Total Credit						**20**

SEMESTER II						
Sr. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
			Hours/week			
1	ECE 107	Engineering Mathematics-II	3	1	0	4
2	ECE 108	Introduction to Programming	3	0	0	3
3	ECE 109	Basic Electronics Engineering	3	0	1	4
4	ECE 110	Universal Human Value (UHV)	3	0	0	3
5	ECE 111	Workshop Practice	1	0	4	4
6	ECE 112	Programming Lab	0	0	2	1
7	ECE 113	Engineering Chemistry	3	0	1	4
Total Credit						**20**

***** *The Course on University Human Value (UHV) is compulsory course as an audit course which should be cleared by all the students; however, this will not affect the credits of the programme.

Second Year

SEMESTER III						
Sr. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
			Hours/week			
1	ECE201	Discrete mathematics	3	1	0	4
2	ECE202	Electronics devices and circuits	3	0	0	3
3	ECE203	Electronic Measurement and Instrumentation	3	0	0	3
4	ECE204	Circuit theory and Network Analysis	3	1	0	4
5	ECE205	Data structures & Algorithms	3	0	0	3
6	ECE206	Electronic devices and circuits Lab	0	0	2	1
7	ECE207	Electronic measurement and instrumentation Lab	0	0	2	1
8	ECE208	Data structure and algorithm Lab	0	0	2	1
Total Credit						**20**

SEMESTER IV						
Sr. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
			Hours/week			
1	ECE209	Principles and Practices of management	3	0	0	3
2	ECE210	Electromagnetic wave and Transmission line	3	1	0	4
3	ECE211	Signal and System	3	0	0	3
4	ECE212	Analog and Linear Integrated Circuit	3	0	0	3
5	ECE213	Digital system design	3	0	0	3
6	ECE214	Signal and System Lab	0	0	2	1
7	ECE215	Analog and Linear Integrated Circuit Lab	0	0	2	1
8	ECE216	Digital system design Lab	0	0	2	1
9	ECE217	Seminar-I	0	0	1	1
Total Credit						**20**

Third Year

SEMESTER V						
Sr. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
			Hours/week			
1	ECE301	Environmental Studies	3	0	0	3
2	ECE302	Control System Engineering	3	1	0	4
3	ECE303	Analog Communication System	3	0	0	3
4	ECE304	Antenna and wave propagation	3	0	0	3
5	ECE305	Digital Communication and system	3	0	0	3
6	ECE306	Analog and Digital Communication Lab	0	0	2	1
7	ECE307	Antenna and wave propagation Lab	0	0	2	1
8	ECE308	Electronic Circuit Design workshop	0	0	4	2
Total Credit						**20**

SEMESTER VI						
Sr. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
			Hours/week			
1	ECE309	Managerial Economics	3	0	0	3
2	ECE310	Optical Fiber Communication	3	0	0	3
3	ECE311	Power Electronics	3	1	0	4
4	ECE312	Microcontrollers and embedded system	3	0	0	3
5	ECE313	Microwave theory and techniques	3	0	0	3
6	ECE314	Microcontrollers and embedded system lab	0	0	2	1
7	ECE315	Microwave theory and techniques Lab	0	0	2	1
8	ECE316	Optical Fiber Communication Lab	0	0	2	1
9	ECE317	Seminar-II	0	0	1	1
Total Credit						**20**

- **Internship: 6-8weeks industrial training can be conducted at the end of VI Semester but evaluation will be done next semester.**

Fourth Year

SEMESTER VII						
Sr. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
			Hours/week			
1	ECE401	VLSI Design and Technology	3	0	0	3
2	ECE402	Digital Signal Processing	3	0	0	3
3	--	Program elective 1	3	0	0	3
5	--	Open elective I	3	0	0	3
6	ECE403	VLSI Design and Technology Lab	0	0	2	1
7	ECE404	Digital Signal Processing Lab	0	0	2	1
8	ECE405	Project -I	0	1	6	4
9	ECE406	Internship	0	0	4	2
Total Credit						**20**

SEMESTER VIII						
Sr. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
			Hours/week			
1	--	Program elective 2	3	0	0	3
4	--	Program elective 3	3	0	0	3
2	--	Open Elective-II	3	0	0	3
3	--	Open Elective-III	3	0	0	3
4	ECE407	Project -II	0	1	9	8
Total Credit						**20**

Total Credit is: 20+20+20+20+20+20+20+20=160

Program elective1: Mobile Communication and Network

Program elective 2: Computer Network

Program elective 3: Satellite Communication

Open Elective I: Biomedical Electronics

Open Elective II: Nanoelectronics

Open Elective III: Machine learning and AI

List of electives/open electives

1. ECE501: Microprocessor theory applications

2. ECE502: Introduction to MEMS
3. ECE503: Electrical Machines
4. ECE504: Information Theory and Coding
5. ECE505: Speech and Audio Processing
6. ECE506: Electronic Device Modeling
7. ECE507: Problem solving using computer
8. ECE508: Embedded system and IOT
9. ECE509: Bio-Medical Electronics
10. ECE510: Computer Network
11. ECE511: Analog and Mixed signal RFIC design and Analysis
12. ECE512: Nano electronics
13. ECE513: Satellite communication
14. ECE514: Mobile Communications and network

List of Lab for B.Tech (ECE) Program

- **<u>First Year</u>**

  1. Basic Electrical Lab
  2. Programming in C lab
  3. Workshop practice lab

- **<u>Second Year</u>**

  1. Electronic Devices and Circuits Lab
  2. Electronic Measurement and instrumentation lab
  3. Data structure and algorithm lab
  4. Signal and system lab
  5. Analog Electronics and linear IC lab
  6. Digital system design lab

- **<u>Third year</u>**

  1. Analog and digital communication lab
  2. Antenna and wave propagation lab
  3. Microcontroller and embedded lab
  4. Microwave theory and techniques lab
  5. Electronics Circuit design workshop

- **<u>Fourth year</u>**

  1. VLSI design and technology lab
  2. Digital signal processing lab
  3. Internship
  4. Project -I
  5. Project -II

1st Year Engineering

1st SEMESTER

Engineering Mathematics-I (ECE101)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week+ Tutorial 1h/week	End of semester Examination-60 marks	Theory-3, Tutorial-1
Course Prerequisite: Knowledge of 10+2 Mathematics.		
Course Objective: To provide the students with sufficient knowledge in matrix, calculus, differentiation, so that it can be used in their respective fields of Engineering.		
Course Outcomes: On completion this course, students will be able to		
CO1: Apply elementary transformations to reduce the matrix into the echelon form and normal form to determine its rank and interpret the various solutions of system of linear equations. **CO2:** To understand mean values theorems, differentiation, curvature, concavity etc. **CO3:** To apply integration, integrals in higher order applications. **CO4:** To understand different functions of vector calculus and to apply in further synthesis.		
Level	Bachelor	
Course Content:		
Unit -I	Rank and inverse of matrix by elementary transformation, consistency of linear system of equations and their solution. Eigen values and Eigen vectors. Cayley-Hamilton theorem (statement only) & its applications.	10 hrs
Unit-II	Mean value theorems and their geometrical interpretations , Taylor's and Maclaurin's series expansions, Successive differentiation and Leibnitz theorem; Indeterminate forms, L'Hospital Rule, Asymptotes, Curvature, Concavity and convexity, point of inflexion.	10 hrs
Unit-III	Integration as inverse process of differentiation; Integration by substitution, The fundamental theorem of calculus, Definite integrals and its application to find area under simple curve and area between two curves, Area of a curve using multiple integral.	10 hrs
Unit-IV	Differentiation and integration of vector functions of scalar variables, scalar and vector fields, gradient, Directional derivative. Gauss's and Stokes's theorems (statement only) and their simple applications.	10 hrs
Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. R.K.Jain & S R K Iyengar, Advanced Engineering Mathematics, Narosa Pub.House
2. Thomas & Finney, Advanced calculus and geometry Addison-Wesley Pub. Co.
3. D. W. Jordan & P Smith, Mathematical Techniques, OXFORD
4. Peter V. O’Neil, Advanced Engineering Mathematics, Cengage Learning,NewDehli
5. B.V.Ramana, Higher Engineering Mathematics, McGraw – Hill.
6. Methods of Real Analysis by R. R. Goldberg.
7. Foundation of Differential Calculus by Euler, Translated by J.D. Blanton, Springer-Verlag, New York, 2000.
8. Calculus, Vol. 1, 2 by T. Apostol, John Wiley.
9. Differential and Integral Calculus by Shanti Narayan.

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1								2
CO2	3	3	3	1					1			2
CO3	3	3	3	2					2			2
CO4	3	3	3	2					2			2

Engineering Physics (ECE102)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week+ Tutorial 1h/week	End semester Examination-60 marks	Theory-3, Tutorial-1
Total		4

Course Prerequisite: Knowledge of 10+2 Physics.

Course Objective:

1. To explain Quantum Mechanics for understanding wave particle dualism and to understand the necessity of quantum mechanics to explore the behavior of sub atomic particles.
2. To demonstrate the success of quantum free electron theory over classical free electron theory.
3. To analyze the crystal parameters to investigate crystal structures and the type of the defect present in the crystals
4. To know the significance of Maxwell’s equations in the Engineering applications of electromagnetic waves.

Course Outcomes: On completion this course, students will be able to

CO1: Derive thermodynamic parameters and apply fundamental laws to solve thermodynamic problems

CO2: Differentiate between the terms atomic number, atomic mass, isotopes etc and apply various rules such as Hunds rule ,octet rules and Bohr’s energy levels.

CO3: Design and conduct simple experiments as well as analyze and interpret data.

CO4: Summarize the importance of free electrons in determining the properties of metals; understand the concept of Fermi energy. **CO5:** Apply the knowledge of basic quantum mechanics, to set up one dimensional Schrodinger's wave equation and its application to a matter wave system.		
Level	Bachelor	
Course Content:		
Unit -I	Transformation of scalars and vectors under Rotation transformation; Forces in Nature; Newton's laws and its completeness in describing particle motion; Form invariance of Newton's Second Law; Solving Newton's equations of motion in polar coordinates; Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance.	10 hrs
Unit-II	Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem.	10 hrs
Unit-III	Lasers: Introduction, characteristics of a laser beam, spontaneous and stimulated emission of radiation, population inversion, Ruby laser, He-Ne laser, semiconductor laser, applications of lasers Fibre optics: Introduction to optical fibers, principle of propagation of light in optical fibers, acceptance angle and acceptance cone, numerical aperture, types of optical fibers, modes of propagation and refractive index profiles.	10 hrs
Unit-IV	Introduction to Quantum mechanics, Wave nature of Particles, Time-dependent and time independent Schrodinger equation for wavefunction, Born interpretation, probability current, Expectation values, Free-particle wavefunction and wave-packets, Uncertainty principle.	10 hrs
Unit V	Solution of stationary-state Schrodinger equation for one dimensional problems– particle in a box, particle in attractive delta-function potential, square-well potential, linear harmonic oscillator, Schrodinger's time independent and time dependent wave equations, physical significance and properties of the wave function, application; Eigen wave functions and energy Eigen values of the particle Elements of Statistical mechanics: Elementary concepts of Maxwell-Boltzman , Bose-Einstein and Fermi-Dirac statistics (no derivation)	10 hrs
Internal assessment		

Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. Introduction to Mechanics — MK Verma.
2. Engineering Mechanics - Dynamics, 7th ed. - JL Meriam.
3. Introduction to Quantum Physics- Eisberg and Resnick.
4. Engineering Physics -- S.O.Pilai , Sivakami New Age International Publishers.
5. Engineering physics – V. Rajendran, McGrawHill Education Private Ltd

List of experiments:

1. Resonance phenomena in mechanical oscillators.
2. Experiment on moment of inertia measurement
3. Black box experiment; Identification of unknown passive electrical components and determine the value of Inductance and Capacitance.
4. Dielectric constant (Measurement of dielectric constant).
5. Frank-Hertz experiment; photoelectric effect experiment; recording hydrogen atom spectrums.
6. Torsional pendulum (Determination of M.I. of wire and Rigidity modulus)
7. Determination of Fermi energy. (Measurement of Fermi energy in copper).
8. Uniform Bending Experiment (Determination of Youngs modulus of material bar).
9. Newtons Rings, (Determination of radius of curvature of plano convex lens).
10. Diffraction and interference experiments (from ordinary light or laser pointers); measurement of speed of light on a table top using modulation; minimum deviation from a prism.

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	1						2
CO2	2	2	2	1					1			1
CO3	3	3	3	2					1			2
CO4	3	2	2	2	1				2			2
CO5	2	3	3			2					2	

Basic Electrical Engineering (ECE103)

Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3
Practical 2hrs/week	Internal assessment:40 marks	Lab-1
		Total-4
Course Prerequisite: Students should have basic knowledge on Physics and Mathematics		

Course Objective: The main objective of this course is to understand the laws of electrical technology, operation of power converter and working of important electrical installation used in domestics or household purposes		
Course Outcomes: On completion this course, students will be able to		
1. To understand and analyze basic electric and magnetic circuits 2. To study the working principles of electrical machines and power converters. 3. To introduce the components of low voltage electrical installations		
Course Content:		
Unit -I	**DC Circuits:** Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.	10 hrs
Unit-II	**AC Circuits:** Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits 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.	10 hrs
Unit-III	**Transformers:** Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.	10 hrs
Unit-IV	**Electrical Machines and power converter:** Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of	10 hrs

	torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators; DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation	
Unit-V	**Electrical Installations:** Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup	10 hrs
	Internal assessment	
Part A	CIA-I: Unit I, II and III	
	CIA-II: Unit IV, V, and VI	
	Basic Electrical Engineering Laboratory	
List of Experiments		

1. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Identification various passive components without multimeters.
3. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
4. Observation of the no-load current waveform on an oscilloscope (nonsinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
5. Observation of Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts

between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.

6. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
7. Torque Speed Characteristic of separately excited dc motor.
8. Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at supersynchronous speed.
9. Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.
10. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

Text Books:

1. Charles K. Alexander, Matthew N.O. Sadiku, “Fundamentals of Electric Circuits”, McGraw Hill Education; 5th edition (1 July 2013)
2. Abhijit Chakrabarti, and Sudipta Nath, “BASIC ELECTRICAL ENGINEERING”, McGraw Hill Education; 1st edition (1 July 2017).
3. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010

Reference Books:

1. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
2. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
3. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
4. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	1						2
CO2	2	2	2	1					1			1
CO3	3	3	3	2					1			2
CO4	3	2	2	2	1				2			2
CO5	2	3	3			2					2	

ECE104	**LANGUAGE AND COMMUNICATION SKILLS**	L	T	P	C
		3	1	0	4

Unit I Grammar and its Usage

i. Phrases, clauses and elements of a sentence
ii. Articles, Tenses and Modals

Unit II Oral and Written Communication

i. Letter Writing-Formal and Informal
ii. Short Presentation , so as to get across one's perspective, 200-250 words

Unit III Forms of Writing

i. Extract from Abdul Kalam's *Wings of Fire*, Section One : Orientation
ii. Resume Writing and Job Application.

Recommended Reading:

1. Thomson, A.J. & Martinet: *A Practical English Grammar*; Oxford University Press.
2. Hyland, Ken: *Second Language Writing*; University of Michigan Press.
3. Gabor Don: *How to start conversations and make friends*; New York: Fireside
4. Krishnaswamy, N: *Modern English – A Book of Grammar, Usage and Composition*, Macmillan India Ltd.
5. Quirk and Greenbaum: *A University Level Grammar of English*, Pearson.

<table>
<tr><th colspan="3">Engineering Graphics and Design (ECE105)</th></tr>
<tr><td>Teaching Scheme</td><td>Examination Scheme</td><td>Credits allocated</td></tr>
<tr><td>Theory 3 hrs/week</td><td>End of semester Examination-60 marks</td><td>Theory-3</td></tr>
<tr><td>Practical 2hrs/week</td><td>Internal assessment:40 marks</td><td>Lab-1</td></tr>
<tr><td></td><td></td><td>Total-4</td></tr>
<tr><td colspan="3">Course Prerequisite: Students should have basic knowledge on Physics and Mathematics</td></tr>
<tr><td colspan="3">Course Objective:
1. Comprehend general projection theory, with emphasis on orthographic projection to represent three-dimensional objects in two-dimensional views (principal, auxiliary, sections).
2. Dimension and annotate two-dimensional engineering drawings. The application of industry standards and best practices applied in engineering graphics.
3. Emphasize freehand sketching to aid in the visualization process and to efficiently communicate ideas graphically.
4. Introduce CAD software for the creation of 3D models and 2D engineering drawings.</td></tr>
<tr><td colspan="3">Course Outcomes: On completion this course, students will be able to</td></tr>
<tr><td colspan="3">CO1: Demonstrate spatial visualization skills through the creation of two-dimensional drawings
CO2: Recognize graphic symbols and read basic engineering drawings
CO3: Draw simple drawings on paper and also by using AutoCAD software
CO4: Use AutoCAD software to make two dimensional drawings and diagrams
CO5: Export drawing files that meet industry standards and practices.</td></tr>
</table>

Course Content:		
Unit -I	**Introduction to Engineering Drawing**: Principles of Engineering Graphics and their significance, Usage of drawing instruments, Different types of lines, Labelling of drawings- Numerals and different types of letters, Dimensioning of drawings, Introduction to IS codes of drawing, Paper sizes, Units of measurements and dimensions, Scales of drawings.	10 hrs
Unit-II	**Geometrical Constructions**: Orthographic Projections, Projections of regular solids (Cube, Prism, Cylinder, Pyramid, Cone, Sphere), Sections and Sectional Views of Right Angular Solids, Auxiliary Views, Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone, Isometric Projections, Principles of Isometric projection – Isometric Scale, Isometric Views, Isometric Views of lines, Planes, Simple and compound Solids, Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions	10 hrs
Unit-III	**Using computer aided software for drawings**: Making two dimensional drawings using AutoCAD (Examples of electronic circuits and components), Basic symbols for components, fixtures, furniture, windows, doors, etc., Simple floor-plans, sections and elevations (Examples like drawing of a workstation or computer lab), Simple designs on AutoCAD, Printing of drawings on a scale.	10 hrs
Unit-IV	**PROJECTION OF PLANE SURFACES** Construction of polygons-Projection of plane Surfaces–Plane surface parallel to one plane and Perpendicular toother two–Plane surface Perpendicular to one plane and inclined to the otherPlane surface inclined to both HP and VP.	10 hrs
Unit V	**Annotations, layering & other functions covering:** applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies.	10 hrs
	Internal assessment	
Part A	CIA-I: Unit I, II and III	
	CIA-II: Unit IV, V, and VI	

List of Experiments		
1.		
Text/Refrences Books: 1. Charles K. Alexander, Matthew N.O. Sadiku, "Fundamentals of Electric Circuits", McGraw Hill Education; 5th edition (1 July 2013) 2. Abhijit Chakrabarti, and Sudipta Nath, "BASIC ELECTRICAL ENGINEERING", McGraw Hill Education; 1st edition (1 July 2017). 3. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010		

CO/PO mapping												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	1	1	1						2
CO2	2	2	2	1					1			1
CO3	3	3	3	2					1			2
CO4	3	2	2	2	1				2			2
CO5	2	3	3			2					2	

2^{nd} SEMESTER

Engineering Mathematics-II (ECE107)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week+ Tutorial 1h/week	End of semester Examination-60 marks	Theory-3, Tutorial-1
Course Prerequisite: Knowledge of 10+2 Mathematics. ………….		
Course Objective: To provide the students with sufficient knowledge of differential equations, higher orders, power series and Fourier series, so that it can be used in their respective fields of Engineering.		
Course Outcomes: On completion this course, students will be able to		
CO1: Analyze the behavior of functions by using differential equations concepts. CO2: To understand second order and higher order differential equations. CO3:- To understand series solutions and to apply in higher order applications. CO4:- Analyze Fourier series, partial differential equations and to apply in further synthesis.		
Level	Bachelor	

Course Content:		
Unit -I	Differential equations of first order & of first degree: Linear form, reducible to linear form, exact form, Reducible to exact form, Picard's Theorem (Statement only).	10 hrs
Unit-II	Unit-2: Differential equations of second & higher order with constant coefficients.	10 hrs
Unit-III	Sequence, Power series, radius of conversions, solution in series of second order LDE with variable co-efficient (C.F. only). Regular Single points and extended power series (Frobenius Method).	10 hrs
Unit-IV	Fourier series, half range series, change of intervals, harmonic analysis. Formulation and classification of linear and quasi linear partial differential equation of the first order, Lagrange's method for linear Partial Differential Equation of the first order.	10 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathmatics, John Wiley.
2. B.V.Ramana, Higher Engineering Mathematics, McGraw – Hill.
3.Peter V. O'Neil, Advanced Engineering Mathematics, Cengage Learning, NewDehli
4. M Ray, A Text Book On Differential equations Students Friends & Co., Agra-2
5. Robert C. Mcowen, Partial Differential Equation Pearson Education.
6. George F. Simmons & S.G. krantz, Differential Equation Tata McGraw – Hill.
7. R.K.Jain & S R K Iyengar, Advanced Engineering Mathematics, Narosa
8. T Amarnath , An Elementary course in partial differential equations, Narosa, New Delhi.
9. S. G. Deo and V. Raghavendra: Ordinar Differential Equations, Tata McGraw Hill Pub. Co. ,New Delhi

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1								2
CO2	3	3	3	1					1			2
CO3	3	3	3	2					2			2
CO4	3	3	3	2					2			2

<table>
<tr><th colspan="4">Introduction to Programming (ECE108)</th></tr>
<tr><th colspan="2">Teaching Scheme</th><th>Examination Scheme</th><th>Credits</th></tr>
<tr><td colspan="2">Theory 3 hrs/week</td><td>End of semester Examination: 60 marks</td><td>Theory-3</td></tr>
<tr><td colspan="2"></td><td>Internal assessment: 40 marks</td><td></td></tr>
<tr><td colspan="2"></td><td></td><td>Total-3</td></tr>
<tr><td colspan="4">Course Prerequisite: Students should have basic knowledge of Computer fundamentals</td></tr>
<tr><td colspan="4">Course Objective: The main objective of this course is to understand the concept of problem solving using algorithm and programming.</td></tr>
<tr><td colspan="4">Course Outcomes: On completion this course, students will be able to
CO1: To develop algorithms for arithmetic and logical problems
CO2: To translate the algorithms to programs & execution
CO3: To decompose a problem into functions and synthesize a complete program
CO4: To apply the programming concepts in development of real-life applications</td></tr>
<tr><td colspan="3">Course Content:</td><td>Total Hrs</td></tr>
<tr><td>Unit -I</td><td colspan="2">Introduction to Programming:
Concept of programming, program development steps, programming languages, concept of high-level, assembly and low-level programming languages, Concept of algorithms, representing algorithms through flow chart, pseudo code, introduction to the editing tools such as vi or ms-vc editors, concepts of the finite storage</td><td>10 hrs</td></tr>
<tr><td>Unit-II</td><td colspan="2">Programming using C:
Structure of c program, a simple c program, identifiers, basic data types and sizes, constants, variables, arithmetic, relational and logical operators, increment and decrement operators, conditional operator, bit-wise operators, assignment operators, expressions, type conversions, conditional expressions, precedence and order of evaluation, c primitive input output using getchar and putchar, exposure to the scanf and printf function, statements and blocks, if and switch statements</td><td>10hrs</td></tr>
<tr><td>Unit-III</td><td colspan="2">Iterations and Subprograms:
Concept of loops, while, do-while and for statements, break, continue, goto and labels, introduction to arrays- concepts, declaration, definition, accessing elements, storing elements, two-dimensional and multi-dimensional arrays, applications of arrays. Concept of sub-programming, functions, parameter passing, storage classes- extern, auto, register, static, scope rules, user defined functions, standard library functions, recursive functions.</td><td>10hrs</td></tr>
<tr><td>Unit-IV</td><td colspan="2">Pointers, Structures and File Handling:
Pointers- concepts, character pointers and functions, pointers to pointers, pointers and arrays, argument passing using pointers, array of pointers, passing arrays as arguments, String and string functions. Derived types- structures- declaration, definition, passing strings as arguments, programming examples, union. File handling-reading from file, writing in file, updating in file.</td><td>10hrs</td></tr>
<tr><th colspan="4">Internal assessment</th></tr>
<tr><td colspan="2">Part A</td><td>CIA-I:Unit I, II</td><td></td></tr>
<tr><td colspan="2"></td><td>CIA-II: Unit III and IV</td><td></td></tr>
</table>

Text Books:

1. Schum‟s Outline of Programming with C by Byron Gottfried, McGraw-Hill
2. The C programming by Kernighan Brain W. and Ritchie Dennis M., Pearson Education.
3. Computer Basics and C Programming by V.Rajaraman , PHI Learning Pvt. Limited, 2015.
4. Computer Concepts and Programming in C, E Balaguruswami, McGraw Hill

Reference Books:

1. Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson Addison-Wesley, 2006.
2. Computer Concepts and Programming by Anami, Angadi and Manvi, PHI Publication.
3. Problem Solving and Programming in C, R.S. Salaria, Khanna Publishing House..
4. Computer Fundamentals and Programming in C. Reema Thareja, Oxford Publication.

CO/PO mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	1	1							2
CO2	3	2	2		2							2
CO3	3	3	3	3	2				1		1	3
CO4	3	3	3	3	2				1		1	3

Programming Lab (ECE112)		
Teaching Scheme	**Examination Scheme**	**Credit**
LAB 2 hrs/week	**End of semester Examination: 60 marks**	Lab-1
	Internal assessment: 40 marks	
		Total-1
Course Prerequisite: Students should have basic knowledge of Computer fundamentals		
Course Objective: The main objective of this course is to understand the concept of problem solving using algorithm and programming.		
Course Outcomes: On completion this course, students will be able to **CO1:** To develop algorithms for arithmetic and logical problems **CO2:** To translate the algorithms to programs & execution **CO3:** To decompose a problem into functions and synthesize a complete program **CO4:** To apply the programming concepts in development of real-life applications		
List of Experiments		

1. Write a program to calculate the area of triangle using formula at=√s(sa)(s−b)(s−c).
2. Basic salary of an employee is input through the keyboard. The DA is 25% of the basic salary while the HRA is 15% of the basic salary. Provident Fund is deducted at the rate of 10% of the gross salary (BS+DA+HRA). Program to calculate the Net Salary.
3. Write a C program for computation of slope of a straight line with following rules:
4. Consider the equation of line: y = mx+c
5. Here user will provide the value of (x,y and c) the compute slope of line.
6. If you find the slope of line the also write code to compute the value of "y" at any value of "x" given by user.
7. Write a C program to compute your age in number of days by given date of birth.
8. Write a C program to print table of any given number.
9. Write a C program to compute the factorial of any given number.
10. Write a C program to check whether number is prime or not prime.
11. Write a C program to print the list of all EVEN numbers upto the given range i.e user will input two numbers start and end; you have to print even numbers in this range.
12. Write a C program to print the following pattern:

```
*
**
***
****
*****
    *
   **
  ***
*****
******
```

13. Write a C program to check whether a number is palindrome or not.
14. Write a C program to find sum of first and last digit of a number.
15. WAP in c to merge two different 1-D arrays.
16. WAP in c to sort the array elements in ascending order.
17. WAP in c to find the median of array elements.
18. WAP in c to perform Matrix Multiplication of two matrices, the size of both matrices must be given by the user.
19. WAP in c to find that two matrices are equal.
20. WAP in c to input your name and print in uppercase letters.
21. WAP in c to store your enrolment numbers and print them in reverse order.
22. WAP in c to store any enrollment number from your batch, find the branch in enrollment number, and print the branch name.
23. Define a structure that can describe a hotel. It should have the member that includes the name, address, grade, room charge and number of rooms. Write a function to print out hotel of given grade in order of room charges.
24. Write a program to find the largest no among 20 integers array using dynamic memory allocation.
25. Write a program to print all the prime numbers in range of 1 to 100 in file prime.txt.
26. Write a program to read number from file and then write all 'odd' number to file ODD.txt & all even to file EVEN.txt.

Internal assessment

Part A	CIA-I:Experiments 1-13	
	CIA-II: Experiments 14-26	

Text Books:

1. Schum‟s Outline of Programming with C by Byron Gottfried, McGraw-Hill
2. The C programming by Kernighan Brain W. and Ritchie Dennis M., Pearson Education.
3. Computer Basics and C Programming by V.Rajaraman , PHI Learning Pvt. Limited, 2015.
4. Computer Concepts and Programming in C, E Balaguruswami, McGraw Hill

Reference Books:

1. Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson
2. Addison-Wesley, 2006.
3. Computer Concepts and Programming by Anami, Angadi and Manvi, PHI Publication.
4. Problem Solving and Programming in C, R.S. Salaria, Khanna Publishing House..
5. Computer Fundamentals and Programming in C. Reema Thareja, Oxford Publication.

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	1							2
CO2	3	2	2		2							2
CO3	3	3	3	3	2				1		1	3
CO4	3	3	3	3	2				1		1	3

Workshop Practice (ECE108)

Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-2
Practical 2hrs/week	Internal assessment:40 marks	Lab-4
		Total-4

Course Prerequisite: Students should have basic knowledge on Physics and Mathematics

Course Objective:

1. To learn the basic operation principles of various electrical and mechanical machines.
2. To demonstrate the use of different electronics components for building of circuits.
3. Skill development of the students for new electronics projects.

Course Outcomes: On completion this course, students will be able to

CO1: Have sound knowledge on the operation of electronics measuring instruments.

CO2: develop some required electronics projects by their own hand for household applications.

CO3: To handle the various electrical and mechanical machines.

CO4: To troubleshoot the household electrical/electronic faults.

Course Content:		
Unit -I	**Electrical and Electronics** Measuring instruments: Ammeter, Voltmeter, Wattmeter, Watt hour meter, their description and uses, CRO, function generator; Single phase A C, Two wire and three wire, 3 phase four wire; A.C; systems over-head systems and under-ground systems; Service connection, domestic lighting, Heating, mixed loads, Industrial wiring, Insulation and wiring of Industrial Motors. Estimating and costing of materials; Indian Electricity Rules, Electronics Troubleshooting, Testing of electronics components; connectors and switches.	12hrs
Unit-II	**Introduction to Cables, Connectors and Switches**: CABLES: General specifications of cables- characteristic impedance, current carrying capacity, flexibility. Types of cables: SWG Single core, Multi core, Single strand, Multi strand and their types, Shielded wires, Coaxial cables, Twisted pair, UTP cables, Flat ribbon cable, Teflon coated wires, optical Fiber Cable. CONNECTORS: General specifications of connectors- contact resistance, breakdown voltage, insulation resistance, applications of BNC, D series, Audio, Video, printer, edge, FRC, RJ 45 connectors. SWITCHES: Toggle switch- SPDT, DPDT, TPDT, Centre off, Without center-off, Rocker switch, Push button latch and non-latch, Tactile switch, Micro switch, Limit switch, DIP switch.	12 hrs
Unit-III	**Use of various workshop tools:** Nose pliers, wire stripper, wire cutter. Study and understanding; electronic circuit diagrams. Transfer and testing of circuit diagram to Bread. Introduction to PCB, Types of PCBs: Single sided PCB, double sided PCB and multilayered PCB, PCB Materials, Component identification on PCB; General purpose PCB, Custom made PCB- types of PCB and their use, Transfer and testing of circuit diagram to	14 hrs

	PCB, Soldering and De-soldering - technique-requirements and methods.	
Unit-IV	**Manufacturing** Metal casting, Methods of casting, forming and forging; machining, advanced manufacturing Methods, Additive manufacturing; Brief description and use of milling; Milling machine; glass cutting; Welding (arc welding & gas welding), Fitting operations & power tools	12 hrs
Internal assessment		
Part A	CIA-I: Unit I, II	
	CIA-III: Unit IV	
Lectures & videos: (10 hours)		

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

Text/Reference Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., “Elements of Workshop Technology”, Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, “Manufacturing Engineering and Technology”, 4th edition, Pearson Education India Edition, 2002.
3. (iii)Gowri P. Hariharan and A. Suresh Babu,”Manufacturing Technology – I” Pearson Education, 2008.
4. Roy A. Lindberg, “Processes and Materials of Manufacture”, 4th edition, Prentice Hall India, 1998.
5. Rao P.N., “Manufacturing Technology”, Vol. I and Vol. II, Tata McGrawHill House, 2017.

6. Basic Electronics & Linear Circuits, Bhargava N. N., D C Kulshreshtha and S C Gupta, Tata McGraw Hill, 2/e, 2013

Basic Electronic Engineering (ECE109)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3
Practical 2hrs/week	Internal assessment:40 marks	Lab-1
		Total-4
Course Prerequisite: Students should have basic knowledge on Physics and Mathematics		
Course Objective: 4. The students will learn about the concepts and theories of diodes and transistors used in almost every electronic device. 5. To make the students familiar with simple logic principles used in advance digital electronics and communication. 6. Give introduction to electronic instrumentation used to measure electronic/electrical parameters.		
Course Outcomes: On completion this course, students will be able to		
CO1: Learn the operation of diodes and transistors and their basic applications in electronic devices. **CO2:** Understand the number system and their interconversions. **CO3:** Understand about digital electronics. They will get insights on digital logics theorems and basic combinational logic devices. **CO4:** Develop understanding about the basic electronic instrumentation.		
Course Content:		
Unit -I	Diodes and Applications covering, Semiconductor Diode - Ideal versus Practical, Resistance Levels, Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Diode as clipper and clampers; Opto-Electronic Devices – LEDs, Photo Diode and Applications	10 hrs

Unit-II	Transistor Characteristics covering, Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Voltage Divider Bias Configuration; DC and AC load line analysis, Q point; Darlington pair, Field Effect Transistor (FET)	10 hrs
Unit-III	Binary Numbers, Decimal to Binary and Binary to Decimal Conversion, BCD, Octal and Hexadecimal numbers, Negative numbers representation, 1's, 2's, Complements, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean Algebra, Basic Theorems and properties of Boolean Algebra,Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR Integrated Circuits (ICs)	12 hrs
Unit-IV	Measurement, Sensors, Laboratory measuring instruments: digital multi-meters and Cathode Ray Oscilloscopes (CRO's), Measurement of resistance (Carey Foster bridge), Capacitance (De Sauty's bridge), and Self-inductance (Anderson's bridge) using different bridges.	8 hrs
Internal assessment		
Part A	CIA-I: Unit I, II and III	
	CIA-II: Unit IV, V, and VI	
Basic Electronics Engineering Laboratory		
List of Experiments		

1. V-I Characteristics of Silicon & Germanium PN Junction diodes
2. Signal characterization using CRO-Applications
3. Diode as clipper and clamper

4. V-I Characteristics of Zener Diode
5. Characteristics of BJT in Common Emitter Configuration
6. Regulated power supply using Transistor and Zenner Diodes
7. Half Wave and Full Wave Rectifier Without Filter
8. Half Wave and Full Wave Rectifier with Filter
9. Common Emitter BJT Amplifier
10. Applications of Operational Amplifier
11. Introduction to Logic Gates

Text/Reference Books:

1. Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India.
2. Electronics A Systems Approach", 4/e - Pearson Education Publishing Company Pvt Ltd, 2011 by Neil Storey.
3. Electronic Devices and Circuits" Salivahanan, N Suresh Kumar, 3/e, McGraw Hill Publications, 2013.
4. Basic Electronics & Linear Circuits, Bhargava N. N., D C Kulshreshtha and S C Gupta, Tata McGraw Hill, 2/e, 2013

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	3	3	2	2	2	2	2	1	1	3	2	3
CO2	2	2	3	1	3	1	1	2	1	2	1	3
CO3	2	1	2	2	2	3	1	3	1	1	1	2
CO4	3	3	2	1	1	2	2	2	2	2	2	2

Engineering Chemistry (ECE113)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3, Practical 2 hrs/week	End of semester Examination-60 marks	Theory-3, Practical-1
Total		4
Course Prerequisite: Knowledge of 10+2 Chemistry.		
Course Objective: 1. To study and compare between various theories of atomic structure		

2. To employ various spectroscopic techniques in identifying the structure and correlate it with their properties
3. To address concepts related to electrochemistry, such as corrosion, using thermodynamic principles
4. To exploit the periodic properties of elements for bulk property manipulation towards technological advancement
5. To employ various organic reactions towards the design of fine chemical and drug molecules for industries

Course Outcomes: On completion this course, students will be able to

CO1: Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
CO2: Learn various spectroscopic techniques and its applications in engineering.
CO3: Understand the bulk properties and processes applying thermodynamic considerations.
CO4: Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
CO5: Learn about major chemical reactions used in the synthesis of molecules.

Level	**Bachelor**	
Course Content:		
Unit -I	**Atomic and Molecular Structure** Schrodinger equation, Particle in a box solutions and their applications, Forms of the hydrogen atom wave functions, Molecular orbitals of diatomic molecules, Equations for atomic and molecular orbitals, Energy level diagrams of diatomic, Pi-molecular orbitals of butadiene and benzene and aromaticity, Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties, Band structure and the role of doping on band structures.	12 hrs
Unit-II	**Spectroscopic techniques and applications, Intermolecular forces and potential energy surfaces** Principles of spectroscopy and selection rules, Electronic spectroscopy, Fluorescence and its applications in medicine, Vibrational and rotational spectroscopy of diatomic molecules, Applications, Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques, Diffraction and scattering. Intermolecular forces and potential energy surfaces- Ionic, dipolar and van	12 hrs

	Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H_3, H_2F and HCN and trajectories on these surfaces.	
Unit-III	**Use of free energy in chemical equilibria and Periodic properties** Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams. Periodic properties- Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.	10 hrs
Unit-IV	**Stereochemistry** Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds.	4 hrs
Unit-V	**Organic reactions and synthesis of a drug molecule** Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.	4 hrs
Internal assessment		
Part A	CIA-I: Unit I, II and III	20 Marks
	CIA-II: Unit IV, and V	20 Marks

Part B	EoSE: Term Exam	60 Marks

Text/Reference Books:

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane.
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistry, by P. W. Atkins
6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition.

CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	3	2	1	1	1	2	1	1	1	2	2	1
CO2	3	2	2	1	3	1	1	1	1	2	2	1
CO3	2	2	1	2	2	1	1	1	1	1	2	1
CO4	2	1	2	1	1	1	1	1	1	2	2	1
CO5	1	2	2	1	1	1	1	1	1	1	2	1

List of Experiments

Choice of 10-12 experiments from the following:

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Colligative properties using freezing point depression
6. Determination of the rate constant of a reaction
7. Determination of cell constant and conductance of solutions
8. Potentiometry - determination of redox potentials and emfs
9. Synthesis of a polymer/drug
10. Saponification/acid value of an oil
11. Chemical analysis of a salt
12. Chemical oscillations- Iodine clock reaction
13. Determination of the partition coefficient of a substance between two immiscible liquids
14. Adsorption of acetic acid by charcoal
15. Use of the capillary viscometers to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

2nd Year Syllabus details

SEMESTER III

ECE 201	**DISCRETE MATHEMATICS**	L	T	P	C
		3	1	0	4

Electronics Devices and Circuits (ECE202)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3
	Internal assessment:40 marks	
		Total-3
Course Prerequisite: Students should have basic knowledge on Basic Electronics and fundamental of Engineering mathematics.		
Course Objective: **1.** To introduce the students to details concept on semiconductor devices (such as BJT, MOSFET). **2.** To introduce the concept of positive and negative feedback in electronic circuits. **3.** To analyse and interpret FET and MOSFET circuits for small signal at low and high frequencies.		
Course Outcomes: On completion this course, students will be able to		
CO1: Understand the semiconductor devices principles and their performances to apply for different purposes. **CO2:** Comply and verify the device parameters. **CO3:** Simulate electronics circuits using required simulation software to obtain desired results. **CO4:** Implement hardwired circuit to test performance and application for what it is being designed.		
Course Content:		
Unit -I	**Bipolar Junction Transistors DC Circuits:** Transistor Configurations: CE,CB and CC, The Operating Point, Bias Stability, Transistor, Fixed bias, Emitter Bias, Self-Bias etc., Stabilization against Variations in ICO, VBE and β, Bias Compensation Techniques, Thermal Runaway, Thermal Stability.	10 hrs
Unit-II	**BJT at Low and High Frequencies:** Two Port Devices and the Hybrid Model, Transistor Hybrid Model, Small Signal Amplifier Performance in terms of h-parameters, exact analysis of BJT CE, Comparison of CE, CC & CB Amplifier's	12 hrs

	performance parameters, High Input Impedance Transistor Circuits; Frequency Response of an Amplifier, Step Response of an Amplifier, Bandpass of Cascaded Stages, RC-Coupled Amplifier, Low-Frequency Response of an RC-Coupled Stage, The Hybrid-π Common-Emitter Transistor Model, Hybrid-π Conductance, The Hybrid-π Capacitances, The CE short-Circuit Current Gain, Current Gain with Resistive Load.	
Unit-III	**Feedback amplifiers and Oscillators:** The Feedback Concept, The Transfer gain with Feedback, General Characteristics of Negative-Feedback Amplifiers, Topologies of Negative-Feedback, Summery of Effect of Negative- Feedback on Gain, Input Resistance, Output Resistance & Bandwidth of Amplifier, Sinusoidal Oscillators, The Transistor Phase-Shift Oscillator, A General form of LC Oscillator Circuit, Transistor Hartley & Colpitts Oscillator.	8 hrs
Unit-IV	**Large Signal Low Frequency Amplifiers** Classification of Amplifies, Class A Large-Signal Amplifiers, Second – Harmonic Distortion, The Transformer-Coupled Audio Power Amplifier & it's Efficiency, Class B Amplifiers, Class B Push-Pull & Complementary-Symmetry Amplifier, Class AB Operation.	10 hrs
	Internal assessment	
Part A	CIA-I: Unit I and II	
	CIA-II: Unit III and IV	

Text Books:

1. Electronics Fundamentals And Applications, "P C Chattopadhyay, D. Rakshit", 16^{th} Edition, New Age International Private Limited.
2. Donald Neaman, "Electronic Circuit Analysis and Design",3rd Edition, Tata McGraw Hill.
3. David A. Bell,"Electronic Devices and Circuits", 5thEdition, Oxford press

4. R. L. Boylstad, and L. Nashlesky, "Electronic Devices and circuits Theory", 9th Edition, Prentice Hall of India, 2006.
Reference Books: 1. Millman Halkias, "Integrated Electronics-Analog and Digital Circuits and Systems", Tata McGraw Hill, 2000. 2. Phillip E. Allen, Douglas R. Holberg, "CMOS Analog Circuit Design", Second Edition, Oxford. 3. K. R. Botkar, "Integrated Circuits", 5th Edition, Khanna Publication.

CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	2	3	2	2	2	1	2	2
CO2	2	2	3	1	1	1	1	2	1	2	2	1
CO3	1	1	3	1	1	1	1	2	1	1	1	1
CO4	2	2	3	2	3	3	3	3	1	1	2	2

Electronic Measurement and Instrumentation (ECE203)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3
Course Prerequisite: Knowledge of fundamental concepts of basic electrical and electronics technology.		
Course Objective: The objective of the teaching of this course is to make the students skilled in handling the various instruments for measurement purposes. In addition to this, they will get familiar with measurement errors, AC and DC bridges, and various transducers used in measurement for different quantities.		
Course Outcomes: On completion this course, students will be able to		
CO1: To understand the basic electronic instrumentation and learn about various errors occurred in measurement systems. **CO2:** Know different bridges used for resistance, capacitance, and inductance measurements. **CO3:** Understand the basic principles of transducers and learn various transducers used for electrical/not-electrical quantity measurements. **CO4:** Learn about CRO, function generators and various analyzers.		
Level	Bachelor	
Course Content:		
Unit -I	**Instruments and Measurement:** **Instruments and Measurement**: Definition, Application and Methods of measurements, instrument	10 hrs

	classification, Functional Elements of an instrument. **Measurement Errors:** Accuracy, precision, resolution and significant figures, Gross error, systematic error, absolute error and relative error, guaranteed error, Measurement error combination, basics of statistical analysis.	
Unit-II	**DC & AC Measurement:** Galvanometers, Analog Ammeter, Voltmeter, PMMC, Moving Iron, Electrostatic, Ohmmeter, AC voltmeter using rectifier, true RMS voltmeter, Digital VOM meter.	12 hrs
Unit-III	**Resistance, Capacitance, and Inductance Measurements:** Voltmeter and ammeter methods, Wheatstone bridge, low, medium and high resistance measurements, AC bridge theory, capacitance bridges, Inductance bridges, Q meter.	10 hrs
Unit-IV	**Transducers and CROs** **Transducers:** Principles, Classification and selection of Transducers, Requirements, Types and Application of Transducers, Resistance, Capacitance, inductance Transducers, Potentiometer, Strain gauges, LVDT, Piezo Electric transducers, Resistance Thermometers, Thermocouples, Thermistors. **Cathode Ray Oscilloscopes:** Block Schematic, Principles and applications. Dual Trace and Dual Beam Oscilloscopes, Digital Storage Oscilloscopes.	12 hrs
Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	EoSE: Term Exam	60 Marks

Text/Reference Books:

1. Electronic Instrumentation & Measurement by William D Cooper & Albert C. Helfric, PHI Publications.

2. Electrical and Electronic Measurements and Instrumentation by A. K Sawhne, Dhanpar Rai & Co. 3. Electronic Measurements and Instrumentation by R.S. Sedha, S. Chand Publications.

Circuit Theory and Network Analysis (ECE204)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3
Course Prerequisite: 10+2 physics and linear algebra.		
Course Objective: To introduce the fundamentals of electrical network analysis using graph theory, matrices, differential equations, network theorems, symmetrical component analysis. To introduce transient network analysis and their application. To introduce multi-port network, network function and network synthesis techniques.		
Course Outcomes: On completion this course, students will be able to		
CO1: Understand the use of network topology and network solving techniques for solving complex electrical networks. **CO2:** Understand the importance of transients in electrical circuits and can apply to real life problem. **CO3:** Students would be able to know various two port parameters, network functions, pole zero plot and the time domain behavior of electrical networks. **CO4:** Students would be able to design and analyze passive electrical circuits using network synthesis techniques and the basic idea about electrical filters.		
Level	Bachelor	
Course Content:		
Unit -I	Network Topology: Concept of network graphs, tree, link, cut set, network matrices, node incidence matrix, loop incidence matrix, cut set incidence matrix, Formulation and solution of network equilibrium equations on loop and node basis.	9 hrs
Unit-II	Network Analysis Techniques and Theorems: Elements of electrical circuits and their properties, Mesh current and Node voltage analysis using matrices, Thevenin's, Norton's, Superposition, Maximum power transfer theorem, Substitution theorem, Compensation theorem, Reciprocity theorem, Millman's theorem, Tellegen's theorem for AC and DC networks, Duality and concept of dual network, Resonance in series and parallel circuits. Transient Network Analysis: Laplace transform fundamentals, properties, initial and final value theorems, convolution integral, waveform synthesis, Response of RL, RC and RLC networks using Laplace Transforms for unit step, impulse, ramp, sinusoidal, exponential and combination of these inputs, application of transient network analysis.	12 hrs
Unit-III	Two-port networks and Network functions: z-parameters, y-parameters, h-parameters, and ABCD parameters; reciprocity and symmetry in two-port networks, image and iterative impedances; poles and zeros, driving point and transfer functions, restrictions on poles and zeros for	12 hrs

	network functions, time domain behavior from pole zero plot.	
Unit-IV	Network Synthesis: Poles and zeros of network functions, positive real functions and their properties, tests for positive real functions, Hurwitz polynomials; Driving-point synthesis of LC, RC and RL networks, Foster forms and Causer forms. Introduction to filters.	9 hrs
Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. M.E. Valkenburg, "Network Analysis," 3rd Ed., Pearson Prentice Hall, 2006.
2. F. F. Kuo, "Network Analysis and Synthesis," 2nd Ed., Wiley India, 2007.
3. W.H. Hayt, J. E. Kemmerly and S. M. Durbin, "Engineering Circuit Analysis," 6th Edition, Tata McGraw Hill, 2007.
4. C.K. Alexander and M.N.O. Sadiku, "Fundamentals of Electric Circuits," 3rd Edition, Tata McGraw Hill, 2008.
5. Sudhakar, S S Palli, "Circuits and Networks", 2nd Edition, Tata McGraw Hill.

CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2		1					
CO2	3	3	2	1	2		1					
CO3	3	3	2	1	2		1					
CO4	3	3	2	1	2		1					

Electronic Devices and Circuits Lab (ECE206)		
Teaching Scheme	Examination Scheme	Credits allocated
Lab 3 hrs/week	End of semester Examination-60 marks	02
	Internal assessment:40 marks	
		Total-02

Course Prerequisite: Students should have basic knowledge on Basic Electronics and fundamental of Engineering mathematics.

Course Objective:

1. To introduce the students to details concept on semiconductor devices (such as BJT, MOSFET).
2. To introduce the concept of positive and negative feedback in electronic circuits.
3. To analyse and interpret FET and MOSFET circuits for small signal at low and high frequencies.

Course Outcomes: On completion this course, students will be able to

CO1: Have complete knowledge on the operation of semiconductor devices.
CO2: Improve experimental skill on various circuit and devices.
CO3: Have details knowledge on the concept of positive/negative feedback and various oscillators.

Course Content:	**List of Experiments**

	1) Construct the HW, FW and Bridge rectifier using IN4007 diode on Breadboard 2) Study of clipper, clamper and doubler of diode using DSO 3) Construct the regulated power supply using Zenner diode and Transistor 4) Construct the CE/CB/CC Transistor Configuration for the verification of input and output Characteristics. Find out the h-parameter values from CE IV characteristics. 5) Verify DC operating point for a single stage BJT in CE configuration. • Calculate values biasing resistors (R1,R2,RE) to operate BJT at a certain VCEQ & ICQ • Build the circuit with these components Measure VCEQ, ICQ, IBQ and VBEQ and Compare measured quantities with theoretical values 6) Build and test single stage CE amplifier. • Connect coupling and emitter bypass capacitors • To measure the voltage gain, input resistance (Ri), output Resistance (Ro) of the amplifier. • Verify phase difference between input and output voltage. To measure the bandwidth using square wave testing. 7) Simulate a Single stage BJT amplifier (CE, CB and CC) for given specifications.(DC & AC Analysis) • To measure the voltage gain (AV), input resistance (Ri), output • Resistance (RO) of the CE, CB and CC amplifier. • To observe and print input and output waveforms to understand the phase difference in each configuration. 8) Construct frequency response of single stage CE RC coupled amplifier • To study the effect of coupling capacitor and bypass capacitor on low frequency response. • To study effect of external shunting capacitor on high frequency response (To restrict bandwidth). • To understand dominant RC circuit for fL and fH. 9) Voltage-Series feedback amplifier • To identify topology of feedback with proper justification. • To measure voltage gain, input resistance, output resistance and bandwidth (using square wave testing) for without feedback. • To measure voltage gain, input resistance, output resistance and bandwidth (using square wave testing) for with feedback. • To verify the improvement in various parameters as per the derived equations. 10) Simulation of current shunt feedback amplifier

	To identify topology of feedback with proper justification. • To measure current gain, input resistance, output resistance and bandwidth for without feedback. • To measure current gain, input resistance, output resistance and bandwidth for with feedback. • To verify the improvement in various parameters as per the derived equations. 11) Simulation of transistorized oscillator • Implement the Phase shift oscillator. • Verify Barkhausen criteria. • Implement the crystal oscillator (series / parallel resonance circuit). • To observe the output voltage waveform. • To calculate frequency of oscillation theoretically and practically. 12) Build & Test transistorized oscillator • Implement the LC (Colpitts / Hartley) oscillator. • Verify Barkhausen criteria. • To observe the output voltage waveform. • To calculate frequency of oscillation theoretically and practically. 13) Complementary Symmetry push pull amplifier • To verify DC condition • To understand class of operation. • To calculate the percentage conversion efficiency. • To calculate power dissipation of both transistors. • To observe and elimination of crossover distortion. **Assessment Method:** Lab examination.

Internal assessment		
Part A	CIA-I: First 4 Experiments	
	CIA-II: First 6 Experiments	

CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	1	1	3	2	2	2	2	2	3
CO2	2	2	1	1	2	2	1	2	2	2	2	2
CO3	1	2	1	1	2	1	1	2	3	2	1	2

Electronic Measurement and Instrumentation Lab (ECE207)		
Teaching Scheme	Examination Scheme	Credits allocated
Lab 2 hrs/week	End of semester Examination-60 marks	Lab-1

Course Prerequisite: Knowledge of fundamental concepts of basic electrical and electronics technology.

Course Objective: The objective of the teaching of this lab course is to make the students skilled in handling the various instruments for measurement purposes. In addition to this, they will get familiar with measurement errors, AC and DC bridges, DSO, and various transducers used in measurement for different quantities.

Course Outcomes: On completion this course, students will be able to

CO1: To understand the basic electronic instrumentation and learn about various errors occurred in measurement systems.

CO2: Know different bridges used for resistance, capacitance, and inductance measurements.

CO3: Understand the basic principles of transducers and learn various transducers used for electrical/not-electrical quantity measurements.

CO4: Learn about CRO, and DSO.

Level	Bachelor

List of Experiments

1. Carry out Statistical Analysis of Digital Voltmeter
   - Calculate mean, standard deviation, average deviation, and variance.
   - Calculate probable error.
   - Plot Gaussian curve.
2. Perform the following using DSO
   - Observe alternate, chop modes.
   - Measure unknown frequency and phase using XY mode.
   - Perform various math operations like addition, subtraction and multiplication of two waves.
3. Study Lissajous patterns using CRO.
4. Study function generator/Arbitrary waveform generator
   - Generate signal of required amplitude, frequency, duty cycle, offset etc.
5. Resistance measurement using Wheatstone bridge.
6. Measure Q and dissipation factor using LCR meter.
7. Capacitance measure using Schering bridge / De Sauty's bridge.
8. Inductance measure using Maxwell bridge / Hay bridge.
9. Measurement of strain using strain gauge.
10. Temperature measurement using Thermistor/ Thermocouple/ Resistant Thermometers.
11. Measurement of displacement using LVDT.

Internal assessment

Part A	CIA-I	20 Marks
	CIA-II	20 Marks
Part B	EoSE: Term Exam	60 Marks

Text/Reference Books:

1. Electronic Instrumentation & Measurement by William D Cooper & Albert C. Helfric, PHI Publications.
2. Electrical and Electronic Measurements and Instrumentation by A. K Sawhne, Dhanpar Rai & Co.
3. Electronic Measurements and Instrumentation by R.S. Sedha, S. Chand Publications.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	1	1			1							
CO2		3	3									
CO3			3			3		4		3		
CO4			3					4				

CO/PO Mapping

SEMESTER-IV

Course: Principle and Practices in Management (ECE 209)		
TEACHING SCHEME	**EXAMINATION SCHEME**	**CREDITS ALLOTED**
Theory: 3 hrs per week	End Semester Examination: 60 marks Internal Assessment: 40 marks	Theory: 3
L: 3, T: 1, P:0		
		Total: 3

Course Pre-requisites:	
1	Must have aptitude for management
2	Skill in dealing with practical managerial issues and challenges
3	Verbal comprehension and writing ability

Course Objective:		
	To familiarize engineering students with the various concepts and functions of management so as to enhance their managerial knowledge and skills for better decision making	
Course Outcomes: The students will be able to		
CO1:	Learn the principles of management in general and its implications on business organizations.	
CO2:	Outline the steps of the decision-making process	
CO3:	Evaluate the need for management in different facets such as financial, marketing, supply chain, etc. in order to justify the need of planning across organization's levels and operations	
Course Content:		
UNIT I	**Approaches and Functions of Management:** Overview and Definition of Management, Managerial Roles and Skills; Evolution of Management Thoughts: Scientific Management, Administrative Approach, Behavioral Approach, Systems Approach, Contingency Approach; Management Functions: Planning, Organizing, Controlling, Decision Making	10 hrs
UNIT II	**Human Resource Management:** Introduction to Human Resource Management: Human Resource Planning (HRP), Recruitment, Selection, Training and Development, Compensation and Benefit, Performance Appraisal, Ethics in Human Resource Management	6 hrs
UNIT III	**Financial Management:** Financial Statement Analysis: Ratio Analysis and Cash Flow Statement, Introduction to Financial Management: Capital Structure Decisions, Working Capital Decisions, Performance Management: Balanced Scorecard and Economic Value Added (EVA), Ethics in Financial Management.	10 hrs
UNIT IV	**Marketing Management:** Concepts of Marketing, Marketing Mix, Marketing Research and Survey, Market Segmentation, Targeting and Positioning, Product Life Cycle (PLC), New Product Development, Branding and Packaging, Pricing Policy, Distribution Channels, Supply Chain Management, Ethics in Marketing Management	10 hrs
Internal Assessment:		
CIA 1	Unit I, Unit II	
CIA 2	Assignment submission and/or presentation	

Text Books:

1. Management - principles & applications - Ricky.W. Griffin, 3rd Indian 2009, Cengage Learning
2. Robbins, Stephen P., & Coulter, Mary A. (2018). Management. 14th ed. Pearson.

Reference Books:

1. Human Resource Management - Snell & Bohlander, 5th Indian Reprint, 2009, Cengage Learning.
2. Personnel & Human Resource Management - P. Subha Rao, 4th Revised Edition, Himalaya Publishing House.
3. Financial Management - Theory, Concepts and problems - R.P. Rustagi, 3rd Edition, Galgotia.
4. Marketing Management - Philip Kotler, PHP, 2009
5. Marketing Management - Ranjan Saxena, 3rd Edition, Tata McGraw-Hill

PO/CO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	1	1	1	1	2	2	2
CO2	1	1	1	1	1	1	1	1	2	3	3	2
CO3	1	1	1	1	1	1	1	1	2	2	2	1

*1: Low, 2: Medium, 3: High

Electromagnetic Wave and Transmission Line (ECE210)

Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3

Course Prerequisite: Linear Algebra, Calculus, Vector analysis

Course Objective: This course is intended to introduce the concept of electromagnetic waves and it's application to the students. The course will develop understanding of the principles underlying time-varying fields and Maxwell's equations, describe plane electromagnetic waves and develop its mathematical model for different media for its interaction with interfering planes.

Course Outcomes: On completion this course, students will be able to

CO1: Apply the principles of Coulombs Law, Superposition principle to electric fields in different coordinate systems.

CO2: determine the electric field intensity resulting from various configurations of charge distributions.

CO3: Understanding of time-varying electromagnetic field as governed by Maxwell's equations. **CO4:** Understand the general electromagnetic wave propagation, plane wave reflection and transmission at conductor and dielectric boundaries.		
Level	Bachelor	
Course Content:		
Unit -I	Static Electric Field: Co-ordinate System, line, Curl, Divergence and Gradient, Stokes theorem, Divergence theorem, Coulomb's Law, Principle of Superposition, Electric Field, Electric Scalar Potential, Dipole, Electric Flux Density, Gauss Law.	9 hrs
Unit-II	Static Magnetic Field: Biot-Savart Law, Magnetic Field intensity due to a finite and infinite wire carrying a current, Magnetic field intensity on the axis of a circular and rectangular loop carrying a current, Ampere's circuital law, Magnetic flux density, Lorentz force equation for a moving charge, Magnetic moment, Magnetic Vector potential	12 hrs
Unit-III	Electric and Magnetic Fields in Materials: Poisson's and Laplace's equation, Electric Polarization, dielectric materials, Capacitance, Electrostatic energy, Boundary conditions, Electric current, point form of ohm's law, continuity equation for current, Inductance, Inductance of loops and solenoids, mutual inductance, magnetic materials, magnetization and permeability, magnetic boundary conditions. Time Varying Electric and Magnetic Fields: Maxwell's equations, Faraday's law, Displacement current, Ampere's circuital law, modified Ampere's circuital law, Maxwell's equations in different form, Maxwell's equation in Phasor form, Poynting theorem, Instantaneous average and Complex Poynting Vector.	15 hrs
Unit-IV	Electromagnetic Wave: Wave Equation, Uniform Plane Waves, Plane waves in free space and in homogenous material, Wave equation for a conducting medium, Plane waves in lossy dielectrics, Skin effect, Linear, Elliptical and circular polarization, Plane Wave interaction with different media, normal incidence and oblique incidence.	9 hrs

	Internal assessment	
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. Mathew N.O Sadiku, "Elements of Electromagnetics", Oxford University press, New Delhi
2. William H. Hayt , "Engineering electromagnetics" Tata-McGraw Hill, New Delhi.
3. N.N. Rao, "Fundamentals of Electromagnetics for Engineering", Pearson education, New Delhi.
4. E.C Jordan and K.G Balman , "Electromagnetic waves and radiating system", Pearson Education, New Delhi.

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2		1					
CO2	3	3	2	1	2		1					
CO3	3	3	2	1	2	1	1		1			
CO4	3	3	2	1	2	1	1		1			

Signal and System (ECE211)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3
Course Prerequisite: 10+2 mathematics, linear algebra and calculus.		
Course Objective: This course introduces the basics concepts of continuous and discrete time signal representation, Linear Time Invariant Systems (LTI), Fourier series representation of periodic signals, continuous and discrete time Fourier transform, Laplace and Z-transforms and their application to the student. This course discusses the different properties of discrete time system and continuous time system.		
Course Outcomes: On completion this course, students will be able to		
CO1: Analyze the properties of continuous time- and discrete time- signals and systems. **CO2:** Analyze continuous time- and discrete time- systems in the time domain using convolution and frequency domain using Fourier Analysis tools. **CO3:** Analyze continuous time- and discrete time- systems using Z Transforms.		
Level	Bachelor	
Course Content:		
Unit -I	Discrete-Time Signals: Some Elementary Discrete-Time signals, Classification of Discrete-Time Signals, Simple Manipulation; Discrete-Time Systems: Input-Output Description, Block Diagram Representation, Classification, Interconnection; Analysis of Discrete-Time LTI Systems: Techniques, Response of LTI Systems, Properties of Convolution, Causal LTI Systems, Stability of LTI Systems; Discrete-Time Systems Described by Difference Equations; Implementation of Discrete-Time Systems; Correlation of Discrete-Time Signals: Cross-correlation and Autocorrelation Sequences, Properties.	10 hrs
Unit-II	Properties of Continuous-Time Systems: Block Diagram and System Terminology, System Properties: Homogeneity, Time Invariance, Additivity, Linearity and Superposition, Stability, Causality; The Continuous-Time Fourier Series: Basic Concepts and Development of the Fourier Series, Calculation of the Fourier Series, Properties of the Fourier Series. Continuous-Time Fourier Transform: Basic Concepts and Development of the Fourier Transform, Properties of the Continuous-Time Fourier Transform.	12 hrs
Unit-III		12 hrs

	The Z-Transform and Its Application to the Analysis of LTI Systems: Direct Z- Transform, Inverse Z-Transform; Properties of the Z-Transform; Rational Z-Transforms: Poles and Zeros, Pole Location and Time-Domain Behavior for Causal Signals, System Function of a Linear Time-Invariant System; Inversion of the Z- Transforms: using Power Series Expansion and Partial-Fraction Expansion; one sided Z- Transform.	
Unit-IV	The Discrete Fourier Transform: Its Properties and Applications: Frequency Domain Sampling: The Discrete Fourier Transform; Properties of the DFT: Periodicity, Linearity, and Symmetry Properties, Multiplication of Two DFTs and Circular Convolution, Additional DFT Properties.	10 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. B.P. Lathi, "Principles of Signal Processing and Linear Systems" Oxford.
2. Alan V. Oppenheim, Alan S. Wilsky and Hamid Nawab S., "Signals & Systems", Prentice Hall, New Delhi, 2005.
3. Rodger E Zaimer and William H Tranter, "Signals & Systems – Continuous and Discrete", McMillan Publishing Company, Bangalore ,2005.
4. Simon Haykin and Barry Van Veen, "Signals & Systems", John Wiley and Sons Inc., New Delhi, 2008
5. John. G. Proakis, "Digital Signal Processing Principles, Algorithms and Applications , Prentice Hall, New Delhi 2006.

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2		1					1
CO2	3	3	2	1	2		1					1
CO3	3	3	2	1	2		1					1

Analog and Linear Integrated Circuit (ECE212)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3

Course Prerequisite: Knowledge of fundamental concepts of basic electrical and electronics technology.

Course Objective:

- To study various op-amp parameters and their significance for Op-Amp.
- To learn frequency response and transient response for Op-Amp.
- To analyze and identify linear and nonlinear applications of Op-Amp.
- To understand the functionalities of 555 Timer IC and PLL. Their uses in various applications in communication and control systems.

Course Outcomes: On completion this course, students will be able to		
1. Design op-amp circuits to perform arithmetic operations. **2.** Determine various performances and their significance for Op-Amp. **3.** Analyze and design oscillators and filters using functional ICs. **4.** Analyze and identify linear and nonlinear applications of Op-Amp. **5.** Understand and apply the functionalities of 555 Timer IC and PLL IC for different applications.		
Level	Bachelor	
Course Content:		
Unit -I	**OP-AMP Basics:** Introduction to op-amps, ideal Characteristics, Pin configuration of 741 op-amp, Block diagram of OP-AMP, Voltage series and voltage shunt feedback amplifier and its effect on R_i, R_o, bandwidth, and voltage gain, Differential Amplifier; Bias, offsets and drift, CMRR, slew rate, Frequency compensation of OP-AMP.	12 hrs
Unit-II	**Linear and Non-linear applications of OPAMP:** Inverting and non- inverting summing, scaling and averaging Amplifier Differential Amplifier configurations, Current to Voltage and Voltage to Current Convertor, Integrator, Differentiator; Comparator, characteristics of comparator, applications of comparator, Schmitt trigger, voltage limiters, clippers and clampers, peak detectors, sample and hold circuits.	12 hrs
Unit-III	**Active Filters and Oscillators:** Active Filters, Low pass, High pass, Band pass and Band Reject filters, Design and frequency scaling of First order and second order, Butterworth filters. Oscillators, Oscillator principle, types and frequency stability, design of phase shift, wein bridge, and Quadrature Oscillators, voltage controlled oscillators.	10 hrs
Unit-IV	**555 Timer and Phase Locked Loop:** 555 Timer functional diagram, monostable and astable operation, applications, Block diagram of PLL and its function, PLL types, characteristics/parameters of PLL, and different applications of PLL.	8 hrs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	1					1						
CO2										2	2	
CO3			3									
CO4									9			12
CO5			5									

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	EoSE: Term Exam	60 Marks

Text/Reference Books:

1. Ramakant A. Gaikwad, “Op Amps and Linear Integrated Circuits”, Pearson Education 2000.
2. Salivahanan and Kanchana Bhaskaran, “Linear Integrated Circuits”, Tata McGraw Hill,India 2008.
3. George Clayton and Steve Winder, “Operational Amplifiers”, 5th Edition Newnes.
4. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, Tata McGraw Hill.
5. S. P. Bali,”Linear Integrated Circuits”, Mc Graw Hill 2008.

CO/PO Mapping

Digital System Design (ECE213)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3
	Internal assessment: 40 marks	
		Total-3

Course Prerequisite: Students should have basic knowledge on Basic Electronics, and Electronic devices and circuits.

Course Objective:

4. To acquaint the students with the fundamental principles of two-valued logic and various devices used to implement logical operations on variables.
5. To lay the foundation for further studies in areas such as VLSI, computer, microprocessor etc.

Course Outcomes: On completion this course, students will be able to

CO1: Use the basic logic gates and various reduction techniques of digital logic circuit in detail.
CO2: Design combinational and sequential circuits.
CO3: Design and implement hardware circuit to test performance and application.
CO4: Understand the basic operation of memory devices.

Course Content:

Unit -I	**Combinational Logic Design:** Review of Boolean algebra and DeMorgan's theorem, Standard representations of logic functions, k map representation (upto 6 variables) of logic functions (SOP and POS forms), minimization of logical functions for min-terms and max-terms, don't care conditions, Design Examples: Arithmetic Circuits, BCD - to – 7 segment decoder, Code converters. Adders and subtractor, ALU, Digital Comparator, Parity generators/checkers, Multiplexers and their use in combinational logic designs, multiplexer trees, De-multiplexers and their use in combinational logic designs, Decoders, demultiplexer trees.	10 hrs
Unit-II	**Sequential Logic Design and VHDL basic:** Flip flop basics, Building blocks of SR, JK, MS J-K flip flop, D and T flip-flops. Use of preset and clear terminals, Excitation Table for flip flops, Conversion of flip flops. Application of Flip flops: Registers, Shift registers, Synchronous and ripple Counters (ring counters, twisted ring counters), Sequence Generators, up/down counters, Clock Skew, Clock jitter, Effect on synchronous designs; Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.	12 hrs
Unit-III	**Logic Families** Classification of logic families, Characteristics of digital ICs-Speed of operation, power dissipation, figure of merit, fan in, fan out, current and voltage parameters, noise immunity, operating temperatures and power supply requirements; TTL logic: Operation of TTL NAND gate,	8 hrs

	active pull up, wired AND, open collector output, unconnected inputs; Tri-State logic. CMOS logic – CMOS inverter, NAND, NOR gates, unconnected inputs, wired logic, open drain output. Interfacing CMOS and TTL; Comparison table of Characteristics of TTL, CMOS, ECL, RTL, I2L, DCTL.	
Unit-IV	Programmable Logic Devices and Semiconductor Memories Programmable logic devices: Detail architecture, Study of PROM, PAL, PLA, Designing combinational circuits using PLDs. General Architecture of FPGA and CPLD Semiconductor memories: memory organization and operation, expanding memory size, Classification and characteristics of memories, RAM, ROM, EPROM, EEPROM, NVRAM, SRAM, DRAM.	10 hrs
	Internal assessment	
Part A	CIA-I: Unit I and II	
	CIA-II: Unit III and IV	

Text Books:

1. R.P. Jain, "Modern digital electronics", 3rd edition, 12threprint Tata McGraw Hill Publication, 2007.
2. M. Morris Mano, "Digital Logic and Computer Design" 4th edition, Prentice Hall of India, 2013.
3. P. Albert Malvino and A. Jerrald Brown, "Digital Computer Electronics" Glencore Publishers.
4. R. J. Tocci, N. S. Widmer and G. L. Moss, "Digital Systems, Principles and Applications", Pearson Publishers.

Reference Books:

1. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition, 2006.
2. A. Kumar, "Fundamentals of digital circuits" 1st edition, Prentice Hall of India, 2001.

CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	1	1	3	2	2	2	2	2	3
CO2	2	2	1	1	2	2	1	2	2	2	2	2

CO3	1	2	1	1	2	1	1	2	3	2	1	2
CO4	2	2	3	2	2	1	3	3	1	1	2	2

<table>
<tr><th colspan="3">Signal & System Lab (ECE214)</th></tr>
<tr><td>Teaching Scheme</td><td>Examination Scheme</td><td>Credits allocated</td></tr>
<tr><td>Lab 2 hrs/week</td><td>End of semester Examination-60 marks</td><td>Lab-1</td></tr>
<tr><td colspan="3">Course Prerequisite: 10+2 mathematics, linear algebra and calculus.</td></tr>
<tr><td colspan="3">Course Objective: This signal and system lab introduces the basics concepts of continuous and discrete time signal representation, Linear Time Invariant Systems (LTI), Fourier series representation of periodic signals, continuous and discrete time Fourier transform, Laplace and Z-transforms and their application to the student by implementing in MATLAB.</td></tr>
<tr><td colspan="3">Course Outcomes: On completion this course, students will be able to</td></tr>
<tr><td colspan="3">CO1: Write a code to analyze the properties of continuous time- and discrete time- signals and systems.
CO2: Write a code to analyze continuous time- and discrete time- systems in the time domain using convolution and frequency domain using Fourier Analysis tools.
CO3: Analyze continuous time- and discrete time- systems using Z Transforms using MATLAB codes.</td></tr>
<tr><td>Level</td><td colspan="2">Bachelor</td></tr>
<tr><td colspan="3">List of Experiments</td></tr>
<tr><td colspan="3">1. Introduction to MATLAB, basics of scripting, 1D/2D/3D plotting.
2. Write MATLAB code to perform Arithmetic operation Addition, Subtraction, Multiplication and Division on signals.
3. Write MATLAB code for plotting Continuous-Time Signals, Discreate-Time Signals and Sampled-Signal.
4. Write a MATLAB code to perform signal processing operations: amplitude scaling, Time shifting, Time scaling, and Time inversion.
5. Write a MATLAB code to convolute two discrete time sequences. Plot all the sequences and verify the result by analytical calculation.
6. Write a MATLAB program to compute the autocorrelation of a sequence x(n), and cross correlation of sequences x(n) and y(n). Verify their properties.
a. Write a MATLAB code to calculate Fourier series coefficients associated with Square Wave. Reconstruct the signal by combining the first 50 terms and plot the Fourier series as a function of time.
b. Write a MATLAB code to find the trigonometric and exponential Fourier series coefficients of a periodic rectangular signal. Plot the discrete spectrum of the signal.
7. Find Fourier transform and Z-transform of a given signal. Plot its Magnitude and Phase spectra.
8. Write a MATLAB program to find the impulse response and step response of a system form its difference equation. Also, compute and plot the response of a given system to a given input.
9. Write a MATLAB program to find pole-zero diagram and bode diagram of a given system from the given system function.
10. Write a MATLAB program to plot magnitude and phase response of a given system. Also, find frequency response of discrete time system using D.T.F. transform.</td></tr>
</table>

11. Generate a discrete time sequence by sampling a continuous time signal. Show that with sampling rates less than Nyquist rate, aliasing occurs while reconstructing the signal.		
Internal assessment		
Part A	CIA-I	20 Marks
	CIA-II	20 Marks
Part B	EoSE: Term Exam	60 Marks

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2		1		2		1	
CO2	3	3	2	1	2		1		2		1	
CO3	3	3	2	1	2		1		2		1	

Analog and Linear Integrated Circuit Lab (ECE215)		
Teaching Scheme	Examination Scheme	Credits allocated
Lab 2 hrs/week	End of semester Examination-60 marks	Lab-1
Course Prerequisite: Knowledge of fundamental concepts of basic electrical and electronics technology.		
Course Objective: This subject introduces the practical & circuit aspects of Analog circuits and Op-amps which are the backbone for the basics of linear ICs.		
Course Outcomes: On completion this course, students will be able to		
CO1: Infer the DC and AC characteristics of operational amplifiers and its effect on input/output characteristics. **CO2:** Elucidate and design the linear and non-linear applications of an Op-amp and various application ICs. **CO3:** Explain and compare the working of multivibrators and timer using IC 555 and their applications.		
Level	Bachelor	
List of Experiments		
12. Design the Inverting, Non-Inverting and Differential Amplifiers using op-amp IC 741. 13. Design an Integrator and Differentiator using op-amp IC 741. 14. Design an Instrumentation amplifier using op-amp IC741. 15. Determine CMRR of Op-Amp IC 741. 16. Design a zero-crossing detector circuit with OP AMP 741. 17. Design an Active Low pass and Band Pass Filter using op-amp 741. 18. Design a Narrow Band Pass / Notch Filter by Op-amp IC 741. 19. Design an Astable and Monostable multivibrator and using op-amp IC 741. 20. Design a Schmitt trigger using op-amp IC 741. 21. Design RC Phase Shift and Wien Bridge Oscillator using op-amp 741. 22. Design of Astable and Monostable multivibrator using Transistors and 555 timer IC. 23. Design a Schmitt trigger using 555 Timer ICs.		
Internal assessment		

Part A	CIA-I	20 Marks
	CIA-II	20 Marks
Part B	EoSE: Term Exam	60 Marks

Text/Reference Books:

1. Ramakant A. Gaikwad, “Op Amps and Linear Integrated Circuits”, Pearson Education 2000.
2. Salivahanan and Kanchana Bhaskaran, “Linear Integrated Circuits”, Tata McGraw Hill,India 2008.
3. George Clayton and Steve Winder, “Operational Amplifiers”, 5th Edition Newnes.
4. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, Tata McGraw Hill.
5. S. P. Bali,”Linear Integrated Circuits”, Mc Graw Hill 2008.

Digital System Design Lab (ECE 216)		
Teaching Scheme	Examination Scheme	Credits allocated
Lab 3 hrs/week	End of semester Examination-60 marks	02
	Internal assessment:40 marks	
		Total-02

Course Prerequisite: Students should have basic knowledge on Basic Electronics and Electronics Devices and Circuits.

Course Objective:

1. To know the concepts of Combinational circuits.
2. To understand the concepts of flipflops, registers and counters etc.

Course Outcomes: On completion this course, students will be able to

CO1: Learn basics of logics gates.
CO2: Construct basic combinational circuits and verify their functionalities.
CO3: Learn the designing of various sequential circuits.
CO4: Construct various digital circuits and their operations.

Course Content:

1) Study of switches using discrete components a)Diode as a Switch b)Transistor as a switch
2) Verify four voltage and current parameters for TTL and CMOS (IC 74LSXX, 74HCXX), (Refer Data-Sheet).
3) Study of Universal Gates (NAND Gate and NOR Gate) and Implementation of a function using universal gate
4) Verification of Demorgan's Law using TTL IC
5) Study of IC-74LS153 as a Multiplexer. (Refer Data-Sheet).
   - Design and Implement 8:1 MUX using IC-74LS153 & Verify its Truth Table.
   - Design & Implement the given 4 variable function using IC74LS153. Verify its Truth-Table.
6) Study of IC-74LS138 as a Demultiplexer/ Decoder (Test benches and FSM excluded)
   - Design and Implement full adder and subtractor function using IC-74LS138.
   - Design & Implement 3-bit code converter using IC-74LS138.(Gray to Binary/Binary to Gray)
7) Study of IC-74LS83 as a BCD adder,(Refer Data-Sheet).
   - Design and Implement 1 digit BCD adder using IC-74LS83
   - Design and Implement 4-bit Binary subtractor using IC-74LS83.
8) Study of IC-74LS85 as a magnitude comparator,(Refer Data-Sheet)
   - Design and Implement 4-bit Comparator.
   - Design and Implement 8-bit Comparator
9) Study of encoders and 7 segment converter
10) Study of Counter ICs (74LS90/74LS93). (Refer Data-Sheet
    - Design and Implement MOD-N and divide by N counter using IC-74LS90 and draw Timing Diagram.
    - Design and Implement MOD-N and divide by N counter using IC-74LS93 and draw Timing Diagram.

11) Study of synchronous counter • Design & Implement 4-bit Up/down Counter and MOD-N Up/down Counter using IC-74HC191/IC74HC193. Draw Timing Diagram 12) Study of Shift Register (74HC194/74LS95) • Design and Implement Pulse train generator using IC-74HC194/IC74LS95 (Use right shift/left shift). • Design and Implement 4-bit Ring Counter/ Twisted ring counter using shift registers IC 74HC194/IC74LS95. 13) Study of Flipflop: RS Flip-Flop, D Flip-Flop, JK Flip-Flop, T Flip-Flop and Master-Slave Flip-Flop.
Internal assessment

Part A	CIA-I: First 4 Experiments	
	CIA-II: First 6 Experiments	

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	1		1					1				
CO2		2	2			2	2	2			2	
CO3			3		3				3	3		

Third Year

SEMESTER V

Environmental Studies (ECE301)

Syllabus will be provided by respective department

CONTROL SYSTEM ENGINEERING (ECE302)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3
Course Prerequisite: Knowledge of 10+2 Math, Fourier and Laplace Transforms.		
Course Objective: 1. To introduce the elements of control system and their modeling using various techniques. 2. To introduce methods for analyzing the time response, the frequency response and the stability of systems. 3. To understand the compensation technique that can be used to stabilize the control system. 4. To introduce the state variable analysis method.		
Course Outcomes: On completion this course, students will be able to		

CO1: Perform time domain and frequency domain analysis of control systems required for stability analysis. **CO2:** Design of compensators that can be used to stabilize the control systems. **CO3:** Demonstrate the ability to apply Laplace transform, transfer functions, and block diagrams for simulation and control. **CO4:** Identify, evaluate and solve control engineering problems.		
Level	Bachelor	
Course Content:		
Unit -I	**Control Systems and Components:** Systems and their representation: Basic elements in control systems, open and closed loop systems, Electrical analogy of mechanical systems, Transfer function, Block diagram reduction techniques, Signal flow graphs- AC and DC servomotor, synchro-, stepper motor.	10 hrs
Unit-II	**Time Response Analysis and Design Specifications:** Time response: Time domain specifications, Types of test input, I and II order system response, Error coefficients, Generalized error series, Steady state error, P, PI, PD and PID compensation.	12 hrs
Unit-III	**Frequency Response Analysis:** Frequency response: Bode plot, Polar plot, frequency domain specifications, Correlation between frequency domain and time domain specifications, Introduction to the design of lead, lag and lag-lead compensators.	12 hrs
Unit-IV	**Concepts of Stability:** Stability Analysis: Characteristics equation, Location of roots in S plane for stability, Routh Hurwitz criterion, Root locus diagram and its application, Dominant poles-Nyquist stability criterion, relative stability.	10 hrs
Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	EoSE: Term Exam	60 Marks
Text/Reference Books:		

1. Norman S. Nise, “Control Systems Engineering”, 4th Ed, John Wiley, New Delhi, 2007.
2. K. Ogata, “Modern Control Engineering”, 4th Ed, PHI, New Delhi, 2002.
3. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International Publishers, 2003.
4. Benjamin C. Kuo, “Automatic Control Systems”, Pearson Education, New Delhi, 2003.

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	2	2	1			2						
CO2		2	2		3							
CO3	1			2	2					1		
CO4			2		1					2		1

Analog Communication System (ECE303)

Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3

Course Prerequisite: Knowledge of 10+2 Math, Linear Algebra, signal and systems, and Fourier Transforms.

Course Objective: This course represents various forms of analog communication such as amplitude modulation, angle modulation etc. Noise has a great importance in communication systems. Different forms of noise have been covered here. Pulse amplitude modulation has also been discussed in which students could be benefitted for the study digital communications.

1. Study and analyze the mathematical techniques of generation, transmission and reception of amplitude modulation (AM), frequency modulation (FM) and phase modulation (PM) signals.
2. Evaluation of the performance levels (Signal-to-Noise Ratio) of AM, FM and PM systems in the presence of additive white noise.

Course Outcomes: On completion this course, students will be able to

CO1: Understand and identify the fundamental concepts and various components of analog communication systems.
CO2: Understand AM, FM, and PM.
CO3: Understand AM and FM generation, detection and their applications.
CO4: Develop understanding of different noise that comes in analog communication systems.

Level	Bachelor	
Course Content:		
Unit -I	**Introduction:** Introduction to Communication Process, Communication Channels,	08 hrs

	Modulation, Need for modulation; Review of Signals and Systems, Frequency domain representation of signals; Transmission of Random Process through an LTI Filter, Multiplexing: FDM and TDM.	
Unit-II	**Amplitude Modulation:** Amplitude Modulation (AM), Generation of AM and its spectrum, Modulation Index, Envelop Detection, Power relations applied to sinusoidal signals, Limitations of AM, DSB-SC Modulation, Coherent Detection; SSB-SC, ISB & VSB, their generation methods & Comparison, AM Detection: Rectifier detection, Envelope detection; Demodulation of DSBSC: Synchronous detection; Demodulation of SSBSC: Envelope detection.	14 hrs
Unit-III	**Angle Modulation:** Concept of Angle Modulation, frequency spectrum & Eigen Values, Frequency Modulation, Narrowband & wideband FM, Modulation index, Bandwidth Generation of FM, Detection of FM, Phase Modulation (PM), Generation of PM, Bessel's Function and its mathematical analysis, Comparison of FM and PM, Generation of FM (Direct & Indirect Method), FM detection using Slope detector, Balanced Slope detector etc. Block diagram of FM Transmitter and Receiver.	12 hrs
Unit-IV	**Noise:** Noise concept, Sources of Noise, Types of Noise, White Noise, Thermal noise, shot noise, partition noise, Low frequency or flicker noise, burst noise, avalanche noise, Signal to Noise Ratio, SNR of tandem connection, Noise Figure, Noise Temperature, Friss formula for Noise Figure, Noise Bandwidth, Behavior of Baseband	10 hrs

	systems and Amplitude modulated systems i.e.DSBSC and SSBSC in presence of noise.	
Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	EoSE: Term Exam	60 Marks

Text/Reference Books:

1. S. Haykin.and M. Moher, "Communications Systems, 5th Edition", John Wiley and Sons, 2009.
2. Sanjay Sharma, "Analog Communication Systems" Katson publication.
3. B.P lathi, "Modern Digital and Analog Communication Systems, 3rd Edition", Oxford University press 2010.
4. H. Taub and D.L. Schilling, "Principles of Communication Systems", Tata McGraw Hill, 2013.
5. G. Kennedy, "Electronic Communication Systems" 5th Edition, McGraw-Hill.
6. D. Roddy & Coolen, "Electronic Communication",4th Edition, Prentice Hall.

Antenna and Wave Propagation (ECE304)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3

Course Prerequisite: Undergraduate course on Electromagnetic wave and transmission line.

Course Objective: This course introduces the basics of antennas and wave propagation to the students which focused on introductory study of wave radiation, different parameters to characterize an antenna, and various types of antennas. The course covers three types of antenna types, basic antennas, broadband and directive antennas and planar antennas. Various antennas are discussed which can be used to radiate electromagnetic waves of different polarization. An introduction to the antenna arrays is covers in this course.

Course Outcomes: On completion this course, students will be able to

- **CO1:** Understand different antenna properties and electromagnetic wave radiation mechanism.
- **CO2:** Design and analyse different antennas used in our daily life.
- **CO3:** Design and analyse reflector antennas.
- **CO4:** Design and analyse printed antennas for different polarization.
- **CO5:** Design and analyse broadband, directive antennas and antennas arrays.

Level	Bachelor	
Course Content:		
Unit -I	Fundamental Concepts: Physical concept of radiation, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions, Radiation from Wires and Loops, Infinitesimal dipole, finite-length dipole, crossed dipole antenna, small circular loop.	10 hrs

Unit-II	Aperture and Reflector Antennas: Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas, Monopole antenna	12 hrs
Unit-III	Broadband and Directive Antennas- Log-periodic and Yagi-Uda antennas, Helix antenna, eggbeater antenna, frequency independent antennas, broadcast antennas, wideband standard horn antenna. Microstrip Antennas, feeding methods, methods of analysis, design of rectangular, circular and elliptical patch antennas, circularly polarized microstrip patch antennas.	12 hrs
Unit-IV	Antenna Arrays: Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays, synthesis of antenna arrays using Schelkunoff polynomial method, Woodward-Lawson method.	10 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. C.A. Balanis, “Antenna Theory: Analysis and Design”, John Wiley, 1982.
2. AR. Harish and M. Sachidananda, “Antennas and Wave Propagation”, Oxford Higher Education, 2007
3. J. D. Kraus, “Antennas”, McGraw Hill, 1988.
4. R.E. Collin, “Antennas and Radio Wave Propagation”, McGraw Hill, 1985.
5. I.J. Bahl and P. Bhartia, “Micro Strip Antennas”, Artech House, 1980.

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2		2			2		1
CO2	3	3	2	1	2		2			2		1
CO3	3	3	2	1	2		2			2		1
CO4	3	3	2	1	2		2			2		1
CO5	3	3	3	1	2		2			2		1

DIGITAL COMMUNICATION AND SYSTEM (ECE305)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3
Course Prerequisite: Knowledge of 10+2 Math, Linear Algebra, Fourier and Laplace Transforms.		
Course Objective:		

1. To understand the building blocks, principles, techniques and limitations of digital communication system. 2. To prepare mathematical background for communication signal analysis. 3. To understand and analyze the signal flow in a digital communication system. 4. To analyze error performance of a digital communication system in presence of noise and other interferences. 5. To understand concept of spread spectrum communication system.		
Course Outcomes: On completion this course, students will be able to		
CO1: Understand the working of waveform coding techniques and analyse their performance. **CO2:** Study generation, detection and performance analysis of a baseband and pass band digital communication system in terms of error rate and spectral efficiency. **CO3:** Perform the time and frequency domain analysis of the signals in a digital communication system. **CO4:** To apply the concept of information theory in digital systems		
Level	Bachelor	
Course Content:		
Unit -I	**Digital Communication Basics:** Fundamentals of Digital communication system, analog vs. digital communication, Limitations of communication systems; Block Diagram and transformations, Basic Digital Communication Nomenclature: Sampling Process, PCM Generation and Reconstruction, Quantization Noise, Non-uniform Quantization and Companding, PCM with noise: Decoding noise, Error threshold, Delta Modulation, adaptive delta modulation, Delta Sigma Modulation.	12 hrs
Unit-II	**Digital Modulation Techniques:** Digital Modulation formats, Coherent binary modulation techniques (BPSK, BFSK), Passband transmission, Coherent and non-coherent detection of signals in noise, Generation and detection of PSK, DPSK, QPSK, OOK, FSK, QAM and MSK differential phase shift keying, differential encoded PSK, QPSK, Quadrate Amplitude shift keying (QASK), power spectra, bandwidth efficiency; BER for BPSK.	12 hrs
Unit-III	**Data Transmission:**	11 hrs

	Digital Multiplexing: Multiplexers and hierarchies, Data Multiplexers, synchronization: Bit Synchronization, Scramblers, Frame Synchronization, Equalization, Base band signal receiver, probability of error, the optimum filter, and white noise-the matched filter, probability of error of the matched filter, coherent reception: correlation, application of coherent reception in PSK and FSK. Correlation receiver for QPSK.	
Unit-IV	**Information Coding and Decoding:** Coding for error detection and correction, Block coding – coding, anticoding, Hadamard code, Hamming code, Cyclic Codes, Convolution coding and decoding, Viterbi algorithm, Shannon Fano and Hoffman Codes.	10 hrs
	Internal assessment	
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	EoSE: Term Exam	60 Marks

Text/Reference Books:

1. P Ramkrishna Rao, Digital Communication, McGraw Hill Publication
2. Ha Nguyen, Ed Shwedyk, ―A First Course in Digital Communication‖, Cambridge University Pres
3. B P Lathi, Zhi Ding ―Modern Analog and Digital Communication System‖, Oxford University Press, Fourth Edition.
4. Bernard Sklar, Prabitra Kumar Ray, ―Digital Communications Fundamentals and Applications‖ Second Edition, Pearson Education.

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	1		2	2								
CO2		3	1		2							1
CO3			2	2		1						
CO4		1	3	2								1

Analog and Digital Communication Lab (ECE306)		
Teaching Scheme	Examination Scheme	Credits allocated
Lab 2 hrs/week	End of semester Examination-60 marks	Lab-1

Course Prerequisite: 10+2 Math, Linear Algebra, Fourier and Laplace Transforms.

Course Objective: To enhance the details knowledge on communication systems, various experiments have been incorporated. The main objective of this lab course is to enhance the details knowledge on communication systems. Details of the experiments to skill the students are described as follows:

1. To study and analyze the generation, transmission and reception of amplitude modulation (AM), frequency modulation (FM).
2. To study and analyze the various digital modulation techniques.

Course Outcomes: On completion this course, students will be able to

CO1: Understand and analyze the generation of AM/FM and their comparative study

CO2: Develop the experimental skills to compare and contrast the strengths and weaknesses of various communication systems.

CO3: Have knowledge on coding schemes for a given communication link.

Level	Bachelor

List of Experiments

1. Design, Build & Test class C tuned amplifier for AM Generation
2. AM Generation (DSB-FC): Calculation of modulation index by graphical method, Power of AM Wave for different modulating signal.
3. Generation of DSB-SC with the help of Balanced Modulator IC1496/1596 & its detection
4. SSB modulator using Filter method/ phase shift method & its detection
5. Frequency modulator & demodulator using IC 565 (PLL based), calculation of modulation index & BW of FM.
6. Frequency modulator & demodulator using Varicap/Varactor Diode and NE 566 VCO.
7. Verification of Sampling Theorem, PAM Techniques, (Flat top & Natural sampling), reconstruction of original signal, Observe Aliasing Effect in frequency domain. Following can be performed using suitable software (Any One).
8. Prove sampling Theorem. Reconstruct the analog signal from its samples. Observe aliasing effect by varying sampling frequency.
9. Amplitude shift keying (ASK): Generation and detection.
10. Frequency Shift Keying (FSK): Generation and detection.
11. Study and analysis of Time division multiplexing (TDM)/ Frequency Division Multiplexing.
12. Generation and detection of Pulse Code Modulation technique.

Internal assessment		
Part A	CIA-I	20 Marks
	CIA-II	20 Marks
Part B	EoSE: Term Exam	60 Marks

Text/Reference Books:

1. S. Haykin.and M. Moher, "Communications Systems, 5th Edition", John Wiley and Sons, 2009.
2. Sanjay Sharma, “Analog Communication Systems” Katson publication.

3. B.P lathi, "Modern Digital and Analog Communication Systems, 3rd Edition", Oxford University press 2010.
4. H. Taub and D.L. Schilling, "Principles of Communication Systems", Tata McGraw Hill, 2013.
5. G. Kennedy, "Electronic Communication Systems" 5th Edition, McGraw-Hill.
6. D. Roddy & Coolen, "Electronic Communication",4th Edition, Prentice Hall.

Antenna and Wave Propagation Lab (ECE307)		
Teaching Scheme	Examination Scheme	Credits allocated
Lab 2 hrs/week	End of semester Examination-60 marks	Lab-1
Course Prerequisite: Undergraduate course on Electromagnetic wave and transmission line.		
Course Objective: This lab introduces the basics of antennas and wave propagation to the students which focused on the design and simulation of the antennas used in our day-to-day life. An opensource EM simulator is used for the antenna simulation. Student will understand the various parameter and properties of the antennas using the full wave EM simulation by designing different antennas at given frequency of interest targeting the real-world application.		
Course Outcomes: On completion this course, students will be able to		
CO1: Understand different antenna properties and electromagnetic wave radiation mechanism. **CO2:** Design and analyse different antennas used in our daily life. **CO3:** Design and analyse reflector antennas. **CO4:** Design and analyse printed antennas for different polarization. **CO5:** Design and analyse broadband, directive antennas and antennas arrays.		
Level	Bachelor	
List of Experiments		
1. Introduction to full wave EM simulation 2. Design, simulate and measure dipole and folded dipole antenna 3. Design, simulate and measure different Loop antenna 4. Design, simulate and measure crossed-dipole antenna for circular polarization 5. Design, simulate and measure Yagi-Uda antenna 6. Design, simulate and measure log-periodic antenna 7. Design, simulate and measure microstrip patch antenna and different feeding techniques 8. Design, simulate and measure planar wideband dipole antenna 9. Design, simulate and measure array antenna 10. Study the effect of reflector on vertical and horizontal dipole antenna. 11. Study the different reflector and antennas backed with reflector.		
Internal assessment		
Part A	CIA-I	20 Marks
	CIA-II	20 Marks
Part B	EoSE: Term Exam	60 Marks

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	3	3	2	1	2		2	2		2		1
CO2	3	3	2	1	2		2	2		2		1
CO3	3	3	2	1	2		2	2		2		1
CO4	3	3	2	1	2		2	2		2		1
CO5	3	3	3	1	2		2	2		2		1

Electronics Circuit Design Workshop (ECE308)		
Teaching Scheme	Examination Scheme	Credits allocated
Lab 2 hrs/week	End of semester Examination-60 marks	Lab-1
Course Prerequisite: An undergraduate level course on Electronics circuit and devices.		
Course Objective: This lab course practically describes different aspects of professional electronics circuit design, fabrication and assembling. This lab is focused on electronic printed circuit board design using KiCAD software, different fabrication techniques, fabrication of PCB and its assembling.		
Course Outcomes: On completion this course, students will be able to		
1. Practically implement electronics circuit in a professional manner. 2. Understand the EDA and steps for the commercialization of an electronics product 3. Ability to develop concepts, logics towards solving problem in industry and research.		
Level	Bachelor	
List of Experiments		
1. Introduction to PCB design using KiCAD. 2. Design a PCB for regulated power supply using KiCAD. 3. Design a PCB for audio amplifier using KiCAD. 4. Design a PCB for Ex-OR gate using transistor in KiCAD. 5. Design a PCB for a musical keyboard using 555 timer IC in KiCAD. 6. Design a PCB for universal IC application. 7. PCB Fabrication technique and PCB fabrication 8. Assemble and test the fabricated PCB. 9. PCB trouble shooting, and reverse engineering. 10. Introduction to SMD components and PCB design.		
Internal assessment		
Part A	CIA-I	20 Marks
	CIA-II	20 Marks
Part B	EoSE: Term Exam	60 Marks

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	3		3	2		1		2
CO2	3	3	2	3	3		3	2		1		2
CO3	3	3	2	3	3		3	2		1		2

SEMESTER VI

Managerial Economics (ECE 309)

Course: Managerial Economics (ECE 309)		
TEACHING SCHEME	**EXAMINATION SCHEME**	**CREDITS ALLOTED**
Theory: 3 hrs per week	End Semester Examination: 60 marks Internal Assessment: 40 marks	Theory: 3
L: 3, T: 1, P:0		
		Total: 3

Course Pre-requisites:

1	Must possess analytical thinking
2	Skill in dealing with practical economic issues and challenges related to resource allocation
3	Knowledge of graphical structure and differentiation of algebraic functions

Course Objective:

To make students in understanding of working of the economic system as a whole, with special reference to the Indian situation, and also the functioning of individual microeconomic agents under different types of market structures

Course Outcomes: The students will be able to

CO1: Identify and define key variables of mico and macroeconomics in managerial prospective

CO2: Analyze the relationships between various micro-economic variables from the perspective of a consumer, firm, industry, market, and competition.

CO3: Develop critical thinking about the macroeconomic policy and its implications.

Course Content:

UNIT I	**Introduction and Demand Analysis:**	10 hrs

	Introduction to Micro Economics. Demand Analysis for Decision-making: - Determinants of Demand - Law of Demand - Elasticities of Demand - Demand forecasting - Utility analysis and consumer's equilibrium – Indifference Curve.	
UNIT II	**Production and Cost Function Analysis:** Production Analysis: - Law of variable proportions - Returns to scale – Isoquant - Empirical Production Function and producer's equilibrium. Cost Analysis: - Short run cost functions - Long run cost functions - Economies and Dis-economies of scale. Break-even Analysis:- Concept and Applications.	8 hrs
UNIT III	**Pricing in different market structures:** Pricing under Different Market Structures: - Perfect Competition - Monopoly - Monopolistic Competition – Oligopoly	6 hrs
UNIT IV	**Macro Economics:** An Overview. Fundamentals of macro-economic models - The classical approach and the keynesian Approach. National Income: - Circular flow – National Income Accounting – Methods of Measurement. Consumption Function and Savings. Investment Function. Business cycle - What and why ? Inflation - causes and cures. Inflation and unemployment.	12 hrs
Internal Assessment:		
CIA 1	Unit I, Unit II	
CIA 2	Assignment submission and/or presentation	
Text Books:		
3. N. Gregory Mankiw; Principle of Economics, Harcourt Publication, 2020		
4. D.N. Dwivedi, Managerial Economics, Vikas, New Delhi		
Reference Books:		
6. Joel Dean, Managerial Economics		
7. Paul A Samuelson, Economics, Mc Graw Hill International , New York		
8. P.L. Mehta, Managerial Economics, Analysis and Cases ,Sultan Chand &Sons, N. Delhi		
9. R.L. Varshney& K.L. Maheshwari, Managerial Economics, Sultan Chand &Sons, New Delhi		
10. U.L. Mote, Samuel Paul and G.S. Gupta, Managerial Economics, Tata Mc Graw Hill, Mumbai		

CO/PO mapping												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	2	1	1	2	3	1	2
CO2	1	1	1	1	1	1	1	1	1	2	1	1
CO3	1	1	1	1	1	2	1	1	1	3	1	2
*1: Low, 2: Medium, 3: High												

Optical Fiber Communication (ECE310)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3
Course Prerequisite: Knowledge of 10+2 mathematics, linear algebra and calculus.		
Course Objective: This course covers basic of optical fiber communication, optical sources and detectors, and optical networks in details. The student will be able to understand basics of signal propagation through optical fibers, fiber impairments, components and devices, and optical network design.		
Course Outcomes: On completion this course, students will be able to		
CO1: Understand optical fiber waveguides, electromagnetic modes, including single and multimode fiber, fiber connectors. **CO2:** Understand and analyze various losses in optical fiber. **CO3:** Classify the Optical sources and detectors and to discuss their principle. **CO4:** Design, construct, and test a basic fiber communication link.		
Level	Bachelor	
Course Content:		
Unit -I	**Overview of Optical Fiber Communications:** **Introduction**: Optical fiber communication, Optical spectral bands, advantages and disadvantages. **Optical Fiber waveguides:** Introduction, Ray theory transmission, Total internal reflection, acceptance angle, numerical aperture, skew rays. **Types of optical fibers:** Cylindrical Fiber: modes, mode coupling, step index fibers, Graded index fibers, Single mode Fiber: Cut-off wavelength,	12 hrs
Unit-II	**Losses in Optical Fiber:** Attenuation, Material absorption losses in silica glass fibers, linear and non-linear scattering losses, fiber bend loss,	10 hrs

	Dispersion, Chromatic dispersion, intermodal dispersion, overall fiber dispersion, Dispersion shifted and dispersion flattened fibers, Polarization, Non-linear effects (Scattering effects and Kerr nonlinearity).	
Unit-III	**Optical Sources and Detectors:** **Sources:** LED- LED structures, surface emitting LED, Edge emitting LED, quantum efficiency and LED power, light source materials, modulation of LED, LASER diodes- modes and threshold conditions, Rate equations, external quantum efficiency, resonant frequencies, structures and radiation patterns, single mode laser, external modulation, temperature effort. **Detectors:** PIN photo detector, Avalanche photo diodes-Photo detector noise-noise sources-SNR-detector response time-Avalanche multiplication noise-temperature effects-comparisons of photo detectors.	10 hrs
Unit-IV	**Optical Receiver, Measurements and Coupling:** **Optical Receiver:** Fundamental receiver operation, digital signal transmission, error sources, Front-end amplifier, digital receiver performance, probability of error, receiver sensitivity, quantum limit, Eye Diagram, Eye Pattern Features, BER and Q Factor Measurement. **Optical fiber measurements:** Attenuation measurement, Dispersion measurement, Fiber cut-off Wave length Measurements, Fiber Numerical Aperture Measurements, Fiber diameter measurements, **Power Launching and couplings:** Source to Fiber Power Launching, Lensing Schemes for Coupling Management, Fiber to Fiber Joints, LED Coupling to Single Mode Fibers, Fiber Splicing, Optical Fiber connectors.	12 hrs
	Internal assessment	
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks

Part B	EoSE: Term Exam	60 Marks
Text/Reference Books: 1. Optical Fiber Communication Principles & Practice by John M.Senior, PHI Publication (3rd Edition). 2. Optical Fiber Communications by Gerd Keiser, Mc Graw Hill.		

CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1		1	1				1		1			1
CO2								2		2		
CO3		3						3				
CO4				4			4		4	4		4

Power Electronics (ECE311)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3
	Internal assessment: 40 marks	
		Total-3
Course Prerequisite: Students should have basic knowledge on Basic Electronics, and Electronic devices and circuits.		
Course Objective: • To give a details concept to students of working & analysis of controlled rectifiers for different loads, inverters, DC choppers, AC voltage controllers and resonant converters. • To study the different motor drives, various power electronics applications like UPS, SMPS, etc. and some protection circuits. • To introduce the students on various power devices: operations their construction, characteristics and turning on circuits.		
Course Outcomes: On completion this course, students will be able to		
CO1: Design & implement a triggering / gate drive circuit for a power device **CO2:** Understand, perform & analyze different controlled converters. **CO3:** Evaluate battery backup time & design a battery charger. **CO4:** Design & implement over voltage / over current protection circuit.		
Course Content:		
Unit -I	**Semiconductor Power Devices** Construction, Steady state characteristics & Switching characteristics of SCR, SCR	10 hrs

	ratings: IL, IH, VBO, VBR, dv/dt, di/dt, surge current & rated current. Gate characteristics, Gate drive requirements, Construction, power MOSFET and IGBT, Gate drive circuits for Power MOSFET & IGBT, opto isolator driving circuits for SCR. Series and parallel operations of SCR‘s. Applications of above power devices as a switch, TRIAC, MOS controlled Thyristor (MCT), Power Integrated Circuit (PIC).	
Unit-II	**Power Converter and Choppers:** Concept of line & forced commutation, Single phase Semi & Full converters for R, R-L loads, Performance parameters, Effect of freewheeling diode, Three phase Semi & Full converters for R load, effect of source inductance; Single phase bridge inverter for R and R-L load using MOSFET / IGBT, single phase PWM inverters. Three Phase voltage source inverter for balanced star R load with 120° and 180 mode of operation, Device utilization factor, Harmonics Elimination/Modulation Techniques; Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper.	12 hrs
Unit-III	**Single-phase inverters:** Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at	8 hrs

	output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter.	
Unit-IV	**Switching Power Supplies:** Analysis of fly back, forward converters for SMPS, resonant converters - need, concept of soft switching, switching trajectory and SOAR, Load resonant converter - series loaded half bridge DC-DC converter; Applications: Power line disturbances, EMI/EMC, power conditioners; Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS.	10 hrs
Internal assessment		
Part A	CIA-I: Unit I and II	
	CIA-II: Unit III and IV	

Text Books:

1. M. H. Rashid, ―Power Electronics circuits devices and applications‖, PHI 3rd edition, 2004 edition, New Delhi.
2. Dr. P.S. Bhibhra, "Power Electronics", Khanna Publishers, Delhi
3. M. S. Jamil Asghar, "Power Electronics", PHI, 2004, New Delhi.

Reference Books:

1. V.R.Moorthi, "Power Electronics", Oxford University Press.

CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	1	1	3	2	2	2	2	2	3
CO2	2	2	1	1	2	2	1	2	2	2	2	2
CO3	1	2	1	1	2	1	1	2	3	2	1	2
CO4	2	1	1	3	3	1	2	1	2	2	2	3

Microcontroller and Embedded System (ECE312)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3

Course Prerequisite: An undergraduate level course on Digital Electronics and C programming Language.

Course Objective: This course introduces the basics of microcontrollers and embedded systems to the students which focused on introductory study of embedded systems using 8051 microcontroller and its interfacing to different components covering daily life problems to industrial problems. The course is heavily oriented towards the programming and interfacing of different input/output devices to 8051 microcontroller and their practical applications.

Course Outcomes: On completion this course, students will be able to

- **CO1:** Implement and use 8051 microcontrollers for embedded systems
- **CO2:** Apply Embedded system concepts to solve real word problems and can present solution to automated systems using microcontrollers for real-life situations.
- **CO3:** Apply concepts of embedded systems and microcontroller to enhance existing systems by effectively implementing data handling and processing.
- **CO4:** Ability to develop concepts, logics towards solving unknown problem in research and industry using microcontrollers and embedded systems.

Level	Bachelor	
Course Content:		
Unit -I	Introduction to Embedded Systems: Overview of Embedded systems, Design Process in Embedded systems and System Integration, Challenges in Embedded System Design, RTOS	10 hrs
Unit-II	Embedded System Architecture: Instruction Set Architecture, CISC and RISC instruction set architecture, Basic Embedded Processor/Microcontroller Architecture, 8051/ PIC/AVR microcontrollers, 8051 Microcontroller, pin configuration, I/O ports and pin, counters, timers, serial I/O, interrupts, physical systems, assembly language for 8051, Instruction syntax, assembly language, moving data, logical operations, arithmetic operations, Jump and Call instructions	10 hrs
Unit-III	8051 input-output Interfacing and signal conversion: LED, Switch, 7segment display, LED array, LCD, keyboard, buzzer interfacing, serial communication, ADC and DAC interfacing, sensor interfacing and processing	10 hrs
Unit-IV	External memory, RTC and mechanical interfacing: External memory interface, real time clock interfacing, interfacing to relay, DC motor, Stepper Motor, servo motor.	10 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
2. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.

3. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
4. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.
5. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996
6. Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rollin D. McKinlay, "The 8051 Microcontroller and Embedded Systems using assembly and C", Pearson, 2006.

CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	1	2				2		1
CO2	3	3	3	3	1	2				2		1
CO3	3	3	3	3	1	2				2		1
CO4	3	3	1	2	1	2				2		1

Microwave Theory and Techniques (ECE313)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3
Course Prerequisite: An undergraduate level course on Electromagnetic Wave and Transmission Line.		
Course Objective: This course introduces the basics of microwave theory and techniques to the students which focused on introductory study of microwave engineering, different passive and active microwave components used in the high frequency systems such as LNA, transmission lines, filter, power divider, mixer, RF switch etc. The course is heavily oriented towards the high frequency circuit analysis and design covering low power components and high-power components. This course also covers the design and analysis of planar microwave passive components used in modern communication systems.		
Course Outcomes: On completion this course, students will be able to		
CO1: Explain different microwave system components and their properties. **CO2:** Analyze microwave systems which is different compared to general circuit analysis. **CO3:** Design microwave passive components that can be used for different practical application.		

Level	Bachelor	
Course Content:		
Unit -I	Introduction to Microwaves: Microwave Frequency bands, Applications of Microwaves, Waveguide (rectangular and circular), Microwave Transmission Lines, coaxial line, Strip line, Micro strip line, Smith chart, Microwave Network Analysis, Network parameters for microwave circuits, Scattering Parameters.	10 hrs
Unit-II	Passive and Active Microwave Devices: Microwave waveguide components, waveguide Tee, Directional Coupler, Power Divider, Magic Tee, Attenuator, Resonator, Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes, Amplifier and Oscillator	12 hrs
Unit-III	Microwave Tubes: Introduction to Klystron, TWT, Magnetron and their design.	12 hrs

Unit-IV	Microwave Passive Components Design: Impedance transformation, Microwave Filter Design, Microwave Mixer, directional coupler, power divider.	9 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. Rober.E.Collin, "Foundations of Microwave Engineering", John Wiley, 3/e, 2001
2. D.M.Pozar, "Microwave engineering", John Wiley, 3/e, 2005
3. Samuel Y.Liao, "Microwave Devices and Circuits", 3/e, PHI, New Delhi,1987.
4. K.C. Gupta and I.J. Bahl, "Microwave Circuits", Artech house.

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	2					2		
CO2	3	3	3	3	2							
CO3	3	3	3	3	3					2		

Microcontroller and Embedded Lab (ECE314)		
Teaching Scheme	Examination Scheme	Credits allocated
Lab 2 hrs/week	End of semester Examination-60 marks	Lab-1

Course Prerequisite: An undergraduate level course on Digital Electronics and C programming Language.

Course Objective: This lab course practically describes different aspects of embedded systems using 8051 microcontroller and its interfacing with different IO modules. This lab also focused on embedded C programming language. This lab is the foundation to implement the embedded systems to solve the daily life problems to industrial problems.

Course Outcomes: On completion this course, students will be able to

- **CO1:** Solve real-world problems by applying embedded system concepts.
- **CO2:** Practically implement embedded systems using microcontrollers and interfacing with the I/O modules.
- **CO3:** Ability to develop concepts, logics towards solving problem in industry and research.

Level	Bachelor

List of Experiments

1. Familiarity to 8051 microcontroller and trainer kit
2. 8051 C programming, hex generation and programming
3. 8051 timer and LED blinking and input port
4. 8051 interfacing to LED, LED array
5. 8051 interfacing to 7 segment and 7 segment array
6. 8051 interfacing to 16 X 2 LCD and switch

7. 8051 Serial Communication and interrupts
8. Interfacing to ADC and DAC
9. Interfacing to LDR and Temperature Sensor
10. Interfacing to External Memory and Real time clock (RTC)
11. Interfacing to DC motor and Stepper Motor.

Internal assessment		
Part A	CIA-I	20 Marks
	CIA-II	20 Marks
Part B	EoSE: Term Exam	60 Marks

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	1	2		2		2		1
CO2	3	3	3	3	1	2		2		2		1
CO3	3	3	3	3	1	2		2		2		1

Microwave Theory and Techniques Lab (ECE315)		
Teaching Scheme	Examination Scheme	Credits allocated
Lab 2 hrs/week	End of semester Examination-60 marks	Lab-1

Course Prerequisite: An undergraduate level course on Electromagnetic Wave and Transmission Line.

Course Objective: This course introduces the basics of microwave theory and techniques to the students which focused on introductory study of microwave engineering, different passive and active microwave components used in the high frequency systems such as LNA, transmission lines, filter, power divider, mixer, RF switch etc. The course is heavily oriented towards the high frequency circuit analysis and design covering low power components and high-power components. This course also covers the design and analysis of planar microwave passive components used in modern communication systems.

Course Outcomes: On completion this course, students will be able to

- **CO1:** Explain different microwave system components and their properties.
- **CO2:** Analyze microwave systems which is different compared to general circuit analysis.
- **CO3:** Design microwave passive components that can be used for different practical application.

Level	Bachelor

List of Experiments

1. Study of Microwave Components
2. Mode Characteristics of Reflex Klystron
3. V-I characteristics of GUNN Diode
4. VSWR Measurement of unknown load
5. Study of E-plane, H-plane Tee and Magic Tee

6. Study of Directional Coupler
7. Study of Circulator & Isolator
8. Study of transmission line circuits and Micro strip lines.
9. Design and simulate different transmission line.
10. Design and Simulate microwave power divider
11. Design RF switch using PIN diode.
12. Design and simulate directional coupler.

Internal assessment		
Part A	CIA-I	20 Marks
	CIA-II	20 Marks
Part B	EoSE: Term Exam	60 Marks

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	2			3		2		
CO2	3	3	3	3	2			3				
CO3	3	3	3	3	3			3		2		

Optical Fiber Communication Lab (ECE316)		
Teaching Scheme	Examination Scheme	Credits allocated
Lab 2 hrs/week	End of semester Examination-60 marks	Lab-1

Course Prerequisite: Knowledge of fundamental concepts of communication systems.

Course Objective: This is a lab course of optical fiber communication. The student will be able to understand signal propagation through optical fibers, optical source and detector characteristics, and various losses in optical fiber.

Course Outcomes: On completion this course, students will be able to

CO1: Understand and analyze various losses in optical fiber.

CO2: Understand Optical sources and detectors characteristics.

CO3: Design, construct, and test a basic fiber communication link.

Level	Bachelor

List of Experiments

1) Determine the Numerical Aperture of the optical fiber.
2) Measure the propagation loss and bending loss in optical fiber.

3) Measurement of attenuation with OTDR.
4) Measurement of Dispersion of optical fiber.
5) Measurement of Mode field diameter of a single mode fiber.
6) Performing Experiments on the V-I characteristics of the optical Sources.
7) Performing Experiments on the characteristics of the optical detectors.
8) Measurement of emission wavelength of LED/LASER source.
9) Setting -up of Analog Optical communication Link.
10) Setting -up of Digital Optical communication Link.
11) Study and verify about data communication using a fiber optic system (transmitting and receiving audio signals through fiber optic system).
12) Eye Pattern Measurement.

Internal assessment

Part A	CIA-I	20 Marks
	CIA-II	20 Marks
Part B	EoSE: Term Exam	60 Marks

Text/Reference Books:

1. Optical Fiber Communication Principles & Practice by John M.Senior, PHI Publication (3rd Edition).
2. Optical Fiber Communications by Gerd Keiser, Mc Graw Hill.

CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1		1	1			1		2				
CO2			2			2		2				
CO3			3	3	3				3	3		3

SEMESTER VII

VLSI Design and Technology (ECE401)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination- 60 marks.	Theory-3
	Internal assessment: 40 marks	
		Total-3
Course Prerequisite: Students should have basic knowledge on Digital Electronics, and Electronic devices and circuits.		
Course Objective: 1. To study HDL based design approach. 2. To learn digital CMOS logic design. 3. To nurture students with CMOS analog circuit designs. 4. To realize importance of testability in logic circuit design. 5. To overview SoC issues and understand PLD architectures with advanced features**.**		
Course Outcomes: On completion this course, students will be able to		
CO1: Model digital circuit with HDL, simulate, synthesis and prototype in PLDs. **CO2:** Understand chip level issues and need of testability. **CO3:** Design analog & digital CMOS circuits for specified applications.		
Course Content:		
Unit -I	**HDL based design**: Data objects, Data types, Entity, Architecture & types of modeling, Sequential statements, Concurrent statements, Packages, Sub programs, Attributes, VHDL Test bench, Test benches using text files. VHDL modeling of Combinational, Sequential logics & FSM, Meta-stability	10 hrs
Unit-II		12 hrs

	Basics of logic devices for design: PROM, PLA, PAL: Architectures and applications. Software Design Flow, CPLD Architecture, Features, Specifications, Applications. FPGA Architecture, Features, Specifications and Applications, Interconnect routing techniques; wire parasitic, Signal integrity issues. I/O architecture, pad design. Architectures for low power.	
Unit-III	**MOS devices:** MOS Capacitor, MOS Transistor theory, C-V characteristics, Non ideal I-V effects, Technology Scaling. CMOS inverters, DC transfer characteristics, Power components, Power delay product. Transmission gate. CMOS combo logic design. Delays: RC delay model, Effective resistance, Gate and diffusion capacitance, Equivalent RC circuits; Linear delay model, Logical effort, Parasitic delay, Delay in a logic gate, Path logical efforts.	8 hrs
Unit-IV	**VLSI Technology:** Clean room and safety requirements, Wafer cleaning processes and wet chemical etching techniques; Solid State diffusion modeling and technology; Ion Implantation modeling, technology and damage annealing; characterization of Impurity profiles; Oxidation Technologies in VLSI and ULSI; Characterization of oxide films; Photolithography, E-beam lithography and newer lithography techniques for VLSI/ULSI; Mask generation.	10 hrs

Internal assessment		
Part A	CIA-I: Unit I and II	
	CIA-II: Unit III and IV	

Text Books:

1. M. H. Rashid, ―Power Electronics circuits devices and applications‖, PHI 3rd edition, 2004 edition, New Delhi.
2. Dr. P.S. Bhibhra, "Power Electronics", Khanna Publishers, Delhi
3. M. S. Jamil Asghar, "Power Electronics", PHI, 2004, New Delhi.

Reference Books:

1. V.R.Moorthi, "Power Electronics", Oxford University Press.

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	3	1	3	2	2	2	2	2	3
CO2	2	2	1	2	2	2	1	2	2	2	2	2
CO3	1	2	1	2	2	1	1	2	3	2	1	2
CO4	2	1	2	3	1	2	1	2	1	2	2	3

Digital Signal Processing (ECE402)

Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3

Course Prerequisite: An undergraduate level course on Signals and Systems

Course Objective: This course introduces the basics concepts of Discrete fourier transform, digital filter design and application of digital signal processing. The design of IIR and FIR filter, their structure and implementation is also addressed in this course. DSP processor is also discussed in this course.

Course Outcomes: On completion this course, students will be able to

CO1: Analyze and study discrete fourier transform (DFT) and their implementation.
CO2: Analyze and implementation of IIR and FIR filters and their implementation.
CO3: Application and introduction to digital signal processors.

Level	Bachelor	
Course Content:		
Unit -I	Discrete Fourier Transforms (DFT): Frequency domain sampling and Reconstruction of Discrete Time Signals, The Discrete Fourier Transform, DFT as a linear transformation,	12 hrs

	Properties of the DFT: Periodicity, Linearity and Symmetry properties, Multiplication of two DFTs and Circular Convolution, Additional DFT properties. Linear filtering methods based on the DFT: Use of DFT in Linear Filtering, Filtering of Long data Sequences, Fast-Fourier-Transform (FFT) algorithms, Efficient Computation of the DFT: Radix-2 FFT algorithms for the computation of DFT and IDFT--decimation in-time and decimation-in-frequency algorithms.	
Unit-II	Design of FIR Filters: Characteristics of practical frequency -selective filters, Symmetric and Antisymmetric FIR filters, Design of Linear-phase FIR filters using windows-Rectangular, Hamming, Hanning, Bartlett windows. Design of FIR filters using frequency sampling method. Structure for FIR Systems: Direct form, Cascade form and Lattice structures.	12 hrs
Unit-III	IIR Filter Design: Infinite Impulse response Filter Format, Bilinear Transformation Design Method, Analog Filters using Lowpass prototype transformation. Normalized Butterworth Functions, Bilinear Transformation and Frequency Warping, Bilinear Transformation Design Procedure, Digital Butterworth Filter Design using BLT. Realization of IIR Filters in Direct form I and II.	10 hrs
Unit-IV	Digital Signal Processors: DSP Architecture, DSP Hardware Units, Fixed point format, Floating point Format, IFixed point digital signal processors, Floating point processors. Application of Digital Signal Processors.	9 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. Proakis & Manolakis, "Digital Signal Processing- Principles Algorithms &Applications", 4th Edition, Pearson education, New Delhi, 2007. ISBN: 81-317-1000-9.
2. Oppenheim & Schaffer, "Discrete Time Signal Processing" ,PHI, 2003.
3. Sanjit K Mitra, "Digital Signal Processing, A Computer Based Approach", 4th Edition. McGraw Hill Education, 2013.
4. D.Ganesh Rao and Vineeth P Gejji, "Digital Signal Processing" Cengage India Private Limited, 2017, ISBN: 9386858231

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2		1					1
CO2	3	3	2	1	2		1					1
CO3	3	3	2	1	2		1					1

Biomedical Electronics (Prog. Elective)

Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3

Course Prerequisite: An undergraduate level course on Signals and Systems, EDC.

Course Objective: This course introduces the students to the concept of biomedical electronics and instrumentation. To understand role of electronics in biology.

Course Outcomes: On completion this course, students will be able to

- **CO1:** Understand the application of the electronic systems in biological and medical applications.
- **CO2:** Understand the practical limitations on the electronic components while handling bio substances.
- **CO3:** Understand and analyze the biological processes like other electronic processes.

Level	Bachelor	
Course Content:		
Unit -I	Brief introduction to human physiology. Biomedical transducers: displacement, velocity, force, acceleration, flow, temperature, potential, dissolved ions and gases. Bio-electrodes and biopotential amplifiers for ECG, EMG, EEG, etc.	10 hrs
Unit-II	Measurement of blood temperature, pressure and flow. Impedanceple thysmography. Ultrasonic, X-ray and nuclear imaging; Prostheses and aids: pacemakers, defibrillators, heart-lung machine, artificial kidney, aids for the handicapped, Safety aspects.	12 hrs
Unit-III	Preamplifier, Signal conditioning: Differential amplifier, current to voltage converter, instrumentation amplifier; biomedical filters: LPF, HPF, bandpass, band stop (Notch filter); source of noise in low level measurement, Recording systems for ECG, PCG, EEG and EMG	12 hrs
Unit-IV	EEG Instrumentation requirements: EEG electrode, frequency bands, recording systems; EMG basic principle: block diagram of a recorder, Bed side monitor, block diagram- measuring parameters, cardiac tachometer, X-ray imaging, ultrasonic imaging systems, Magnetic resonance imaging system.	12 hrs

Internal assessment

Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. W.F. Ganong, Review of Medical Physiology, 8th Asian Ed, Medical Publishers, 1977.
2. J.G. Websster, ed., Medical Instrumentation, Houghton Mifflin, 1978.
3. A.M. Cook and J.G. Webster, eds., Therapeutic Medical Devices, Prentice-Hall, 1982.

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2		1			2		2
CO2	3	3	2	1	2		1			2		2
CO3	3	3	2	1	2		1			2		2

Mobile Communication and Network (ECE514)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3
Course Prerequisite: Knowledge of 10+2 mathematics, basic analog and digital communication systems.		
Course Objective: This course covers basics of mobile communication. The student will be able to understand the basics of GSM and other mobile technologies. The frequency management and handoff concepts that are used in mobile cellular networks will be discussed in detail.		
Course Outcomes: On completion this course, students will be able to		
1. Understand cellular concepts and system design parameters. 2. Understand and analyze various interferences that occur in mobile networks. 3. Frequency management and handoff mechanisms that occur in mobile communication. 4. Understand GSM architecture and other advanced technologies.		
Level	Bachelor	
Course Content:		
Unit -I	**Introduction**: **Cellular concepts:** Basic cellular systems, Performance criteria, Uniqueness of mobile radio environment, Operation of cellular systems, analog & digital cellular systems. **Cellular System Design Fundamentals:** Concept of frequency reuse channels, Co-channel interference reduction factor, Desired C/I from a normal case in an omnidirectional antenna system, Handoff mechanism, Cell splitting.	10 hrs
Unit-II	**Interference in Cellular Mobile System:** Channel & co-channel interference, Channel antenna system design considerations, umbrella pattern effect, Adjacent-channel interference, Near-end – far-end interference, Effect on near-end mobile units.	08 hrs
Unit-III	**Frequency management, channel assignment and handoffs:**	10 hrs

	Frequency management, Frequency-spectrum utilization, Set-up channels, Fixed channel assignment schemes, Non-fixed channel assignment schemes, Concept of handoff, Initiation of a hard handoff, Delaying a handoff, Forced handoffs, Queuing of handoffs, Power difference, handoffs, Mobile assisted handoff, Soft handoffs, Cell-site handoff, Intersystem handoff, dropout calls.	
Unit-IV	**GSM system overview:** GSM system architecture, GSM radio subsystem, GSM channel types, Frame structure for GSM, Signal processing in GSM, GPRS and EDGE, CDMA 2000, Wireless Local Loop, IMT 2000 and UMTS, Long Term Evolution (LTE), Mobile data networks, Introduction to 4G and concept of NGN.	10 hrs
Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	EoSE: Term Exam	60 Marks

Text/Reference Books:

1. Mobile Cellular Telecommunications: Analog and Digital Systems by William C. Y. Lee; Tata McGraw Hill Publication.
2. Wireless Communications: Principles and Practice by Theodore S. Rappaport; Pearson/PHI Publication.
3. Wireless Communications and Networks: 3G and Beyond by Iti Saha Misra; Tata McGraw Hill Publication.
4. Wireless and Digital Communications by Dr. Kamilo Feher; PHI Publication.
5. T L Singal ,“Wireless Communications ”, McGraw Hill Education.

Open Elective1

Syllabus will be given by respective department

VLSI Design and Technology Lab (ECE403)		
Teaching Scheme	Examination Scheme	Credits allocated
Lab 2 hrs/week	End of semester Examination-60 marks	Lab-1
Course Prerequisite: An undergraduate level course on Digital System Design and EDC		

Course Objective:

- To study HDL based design approach.
- To learn digital CMOS logic design.
- To nurture students with CMOS analog circuit designs.

Course Outcomes: On completion this course, students will be able to At the end of the course, students will be able to CO1: Model digital circuit with HDL, simulate, synthesis and prototype in PLDs. CO2: Understand the CMOS layout designing.

Level	Bachelor	
List of Experiments		

1. **To write VHDL code, simulate with test bench, synthesis, implement on PLD.**
   1) To design 4 bit ALU for add, subtract, AND, NAND, XOR, XNOR, OR, & ALU pass.
   2) To design Universal shift register with mode selection input for SISO, SIPO, PISO, & PIPO modes.
   3) To design FIFO memory.
   4) To interface keypad with FPGA
2. **Simulation of Layout**
   1) CMOS Inverter, NAND, NOR gates, Half Adder
   2) 2:1 Multiplexer using logic gates and transmission gates.
   3) Single bit SRAM cell.
   4) D flip-flip

Internal assessment		
Part A	CIA-I	20 Marks
	CIA-II	20 Marks
Part B	EoSE: Term Exam	60 Marks

CO/PO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	3	1	3	2	2	2	2	1	3
CO2	2	2	1	3	2	2	1	2	2	2	1	3

Digital Signal Processing Lab (ECE404)		
Teaching Scheme	Examination Scheme	Credits allocated
Lab 2 hrs/week	End of semester Examination-60 marks	Lab-1
Course Prerequisite: 10+2 mathematics, linear algebra and calculus.		
Course Objective: This digital signal processing (DSP) lab introduces the basics concepts of discrete fourier transform, digital filter, realization of IIR and FIR filter etc and their application to the student by implementing in MATLAB. This lab also focus on the application of digital signal processor that can be used for different DSP related applications.		

Course Outcomes: On completion this course, students will be able to

CO1: Write a code to analyze the properties of discrete signal and fourier transform and other operations.

CO2: Write a code to implement digital filter (IIR and FIR filters).

CO3: Analyze the digital signal and system evaluation of digital filter using MATLAB codes.

Level	Bachelor

List of Experiments

1. Introduction to DSP related basic commands in MATLAB.
2. Write MATLAB code to perform different operations on sequences
3. Write MATLAB code to find DFT / IDFT of given DT signal
4. Write MATLAB code to obtain Linear Convolution of two finite length sequences
5. Write MATLAB code to compute auto correlation.
6. Write MATLAB code to find frequency response of a given system(transfer function/ difference equation).
7. Write MATLAB code to implementation of FFT of given sequence and determination of Power Spectrum of a given signal.
8. Write MATLAB code to implementation of low pass and high pass FIR filter for a given sequence.
9. Write MATLAB code to design the linear-phase FIR bandpass filter.
10. Write MATLAB code to implementation of low pass and high pass IIR filter for a given sequence.
11. Write MATLAB code to determine/plot Impulse Response of First Order and Second Order Systems.
12. Write MATLAB code to implementation of Decimation Process and Interpolation Process.
13. Demonstration of DSP processor and implementation.

Internal assessment

Part A	CIA-I	20 Marks
	CIA-II	20 Marks
Part B	EoSE: Term Exam	60 Marks

Project Stage-I

Internship

SEMESTER VIII

Satellite Communication (ECE513)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3
Course Prerequisite: Knowledge of 10+2 physics, basic analog and digital communication systems.		
Course Objective: This course covers basics of satellite communication. The student will be able to understand the orbital mechanism and satellite sub-systems. The satellite links and modulation techniques used in satellite communication will be discussed.		
Course Outcomes: On completion this course, students will be able to		
1. Understand the orbital mechanism for satellite communication. 2. Understand satellite sub-system architecture, TTC & M, and AOCS. 3. Learn and design satellite links. 4. Understand different modulation techniques used in satellite communication.		
Level	Bachelor	
Course Content:		
Unit -I	**Orbital Mechanism**: Satellite orbit and orbital equations, Kepler‟s laws of planetary motion, locating satellite in the orbit, locating satellite with respect to earth, Look angle calculation, coverage angle and slant range, orbital perturbations, satellite launching, orbital effects in communication subsystem performance.	10 hrs
Unit-II	**Satellite Sub-Systems:** Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc.	08 hrs
Unit-III	**Satellite Link Design:** Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.	10 hrs
Unit-IV	**Modulation and Multiple Access Schemes:**	10 hrs

	Various modulation schemes used in satellite communication, Meaning of Multiple Access, Multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA.	
Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	EoSE: Term Exam	60 Marks

Text/Reference Books:

1. Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications: Wiley India. 2nd edition 2002.
2. Tri T. Ha: Digital Satellite Communications: (Second Edition) Tata McGraw Hill, 2009.
3. Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill,2009.
4. G S Rao, "Global Navigation Satellite Systems," Tata McGraw Hill.
5. G.D. Gordon and W.L. Morgan, Principles of Communication Satellites, John Wiley & Sons, Inc.

Nanoelectronics (Open Elective-II)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 hrs/week	End of semester Examination-60 marks	Theory-3

Course Prerequisite: An undergraduate level course on Physics and Basic Electronics.

Course Objective:

1. To introduce the students to the concept of nanoelectronics, nanodevices, spintronics and molecular electronics.
2. To identify quantum mechanics behind nanoelectronics.
3. To describe the principle and the operation of nanoelectronic devices.

Course Outcomes: On completion this course, students will be able to

- **CO1:** Explain the fundamental science and quantum mechanics behind nanoelectronics.
- **CO2:** Explain the concepts of a quantum well, quantum transport and tunnelling effects.
- **CO3:** Differentiate between microelectronics and nanoelectronics.
- **CO4:** Summarise the applications of nanotechnology and nanoelectronics.
- **CO5:** Understand the impact of nanoelectronics in our real lives applications.

Level	Bachelor	
Course Content:		
Unit -I	Introduction to nanotechnology, meso structures, Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box Concepts, Degeneracy. Band Theory of Solids. Kronig-Penny Model. Brillouin Zones	10 hrs
Unit-II		12 hrs

	Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets,Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.).	
Unit-III	Electrons in low-dimensional structure: Electrons in quantum wells, Electrons in quantum wires, Electrons in quantum dots; Fabrication of nanostructures: Crystal growth, Nanolithography, Nanotube growth, Characterization of nanostructures.	12 hrs
Unit-IV	Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotube electronics, Bandstructure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation.	12 hrs

	Internal assessment	
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications, Vladimir V. Mitin, Viatcheslav A. Kochelap and Michael A. Stroscio
2. Fundamentals of Nanoelectronics, Pearson India; 1st edition (1 January 2009) George W. Hanson.

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	2	1	2	2	1	2
CO2	3	1	1	1	1	2	1	2	2	2	1	2
CO3	2	2	1	1	2	1	1	2	2	2	1	2
CO4	3	2	1	1	2	3	1	2	2	2	1	2

(Open Elective-III)

Syllabus will be provided by respective department

Project Stage-II