COURSE STRUCTURE AND SYLLABUS

(Aligned with AICTE Model Curriculum)

For

B.Tech.

Electronics and Communication Technology

With effective from the Academic Year

2021-2022

COURSE STRUCTURE AND DETAILED SYLLABUS

For

B.Tech.in

Electronics and Communication Technology

With effect from the academic year

2021-2022

Course Structure for I B.Tech ECT Under the Regulations of SITE-21

Semester -I

S.No	Course Code	Subject Code	Course	L	T	P	C
1	BS	21CMMAT1010	Engineering Mathematics - I	3	0	0	3
2	BS	21ETPHT1020	Engineering Physics	3	0	0	3
3	BS	21CMCHT1030	Engineering Chemistry	3	0	0	3
4	ES	21CMCST1040	Programming for Problem Solving	3	0	0	3
5	ES	21ETMEL1050	Computer aided Engineering Graphics	2	0	2	3
6	BS LAB	21ETPHL1060	Engineering Physics Lab	0	0	3	1.5
7	BS LAB	21CMCHL1070	Engineering Chemistry Lab	0	0	3	1.5
8	ES LAB	21CMCSL1080	Programming for Problem Solving Lab	0	0	3	1.5
9	MC	21CMMSN1090	Constitution of India, Professional Ethics & Human Rights	2	0	0	0
TOTAL							**19.5**

Course Structure for II B.Tech ECT Under the Regulations of SITE-21

Semester -II

S.No	Course Code	Subject Code	Course	L	T	P	C
1	HS	21CMEGT2010	Technical English	3	0	0	3
2	BS	21CMMAT2020	Engineering Mathematics - II	3	0	0	3
3	ES	21CMEET2030	Basic Electrical Engineering	3	0	0	3
4	ES	21CMCST2040	Python Programming	1	0	4	3
5	ES	21ETETT2050	Network Analysis	3	0	0	3
6	HS LAB	21CMEGL2060	English Communication Skills Lab	0	0	3	1.5
7	ES LAB	21CMEEL2070	Basic Electrical Engineering Lab	0	0	3	1.5
8	ES LAB	21ETMEL2080	Engineering Workshop Lab	0	0	3	1.5
9	MC	21CMCHN2090	Environmental Science	2	0	0	0
TOTAL							**19.5**

ENGINEERING MATHEMATICS-I

(Calculus & Differential Equations)

Common to all the branches

SEMESTER I

Subject Code	21CMMAT1010	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Course Objectives:

1. To solve the differential equations related to various engineering fields
2. To enlighten the learners in the concept of differential equations.
3. To familiarize with functions of several variables which is useful in optimization
4. To solve the partial differential equations of first order
5. To apply double integration techniques in evaluating areas bounded by region.

Unit -1	**Hours**
Differential Equations of first order and first degree : Linear differential equations - Bernoulli's equations – Exact equations and Equations reducible to exact form. Applications: Newton's law of cooling - Law of natural growth and decay - Orthogonal trajectories.	**10**
Unit -2	
Linear differential equations of higher order: Homogeneous and Non-homogeneous differential equations of higher order with constant coefficients – with non-homogeneous term of the type e^{ax}, sin ax, cos ax, polynomials in x^n, e^{ax} V(x) and x^n V(x) – Method of Variation of parameters. Applications: LCR circuit.	**10**
Unit – 3	
Partial differentiation: Introduction – Homogeneous function – Euler's theorem– Total derivative– Chain rule– Jacobian – Functional dependence –Taylor's and MacLaurin's series expansion of functions of two variables. Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method.	**10**
Unit – 4	
PDE of first order: Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.	**08**
Unit – 5	
Multiple integrals: Double and Triple integrals – Change of order of integration in double integrals – Change of variables to polar, cylindrical and spherical coordinates. Applications: Finding Areas and Volumes.	**12**

Course outcomes:

On completion of this course, students are able to

1. Solve the differential equations related to various engineering fields (L3)

2. Solve the differential equations of higher order related to various engineering fields (L3)
3. familiarize with functions of several variables which is useful in optimization (L3)
4. Solve the partial differential equations of first order (L3)
5. Apply double integration techniques in evaluating areas bounded by region (L3).

Question paper pattern:

1. Question paper consists of 10 questions.
2. Each full question carrying 14 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. B. V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. Joel Hass, Christopher Heil and Maurice D. Weir, Thomas calculus, 14thEdition, Pearson.
3. Lawrence Turyn, Advanced Engineering Mathematics, CRC Press, 2013.
4. Srimantha Pal, S C Bhunia, Engineering Mathematics, Oxford University Press.

COURSE OUTCOMES TO PROGRAM OUTCOMES MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	3	-	-	-	-	-	-	-	-	-	-
2	3	3	-	-	-	-	-	-	-	-	-	-
3	3	3	-	-	-	-	-	-	-	-	-	-
4	3	3	-	-	-	-	-	-	-	-	-	-
5	3	3	-	-	-	-	-	-	-	-	-	-
Course	3	3	-	-	-	-	-	-	-	-	-	-

ENGINEERING PHYSICS
(Introduction to Electromagnetic Theory)
SEMESTER I

Subject Code	**21ETPHT1020**	IA Marks	30
Number of Lecture HR/Week	03	Exam Marks	70
Total Number of Lecture Hr	50	Exam Hours	03

Credits – 03

COURSE OBJECTIVES:

The objectives of this course, help the students:

- **To impart** the knowledge of Electrostatics and Magneto statics in vacuum and in dielectric medium.
- **To impart** the knowledge of Maxwell's equations to understanding the propagation of EM waves.

Unit -1	**Hours**
Electrostatics in vacuum: Coulomb's law, Electrostatic field (E) and Electrostatic potential or Scalar potential (V) due to a point charge, Equi potential surfaces, Relation between E&V, Gauss law in electrostatics, Applications of Gauss law-Calculation of Electric field strength and potential due to the uniform charge distribution over a (i) wire (ii) sheet (c) solid sphere and (e) solid cylinder, Divergence and Curl of electrostatic field, Energy of a discrete and continuous charge distribution.	**10**
Unit -2	
Electrostatics in dielectric medium: Electrostatic field and potential due to a Electric dipole, Types of dielectrics, Electric displacement (D), Dielectric polarization (P), Dielectric polarizability, Susceptibility and Dielectric constant, Relation between D, E and P, Bound charge due to electric polarization, Boundary conditions at interface of dielectric media,Types of polarizations- Electronic (Quantitative),Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field- Clausius-Mossotti equation.	**10**
Unit – 3	
Magneto statics: Biot- Savart's law, Magnetic field due to long straight current carrying conductor,Magnetic field on the axis of a current loop, Helmholtz coils, Magnetic field induction due to a solenoid, Divergence of magnetic field (Gauss law in magneto statics), Curl of Magnetic field (Ampere's circuital law); Magnetic Scalar and Vector potential, Motion of charged particle in electrical field and in a magnetic field, Hall effect.	**11**
Unit – 4	
Electromagnetic induction: Electromotive force,Faradays laws of electromagnetic induction, Differential form of Faraday's law, motional EMF; Relation betweenelectric potential and magnetic vector potential using faraday's law, Lenz's law, Self-inductance of Solenoid, Energy density stored in an inductor, Continuity equation for current densities; Displace current; Modified Amperes circuital law.	**10**
Unit – 5	

Maxwell's equations and EM waves: Maxwell's equation in vacuum and non-conducting medium; Wave equationof EM waves; Plane electromagnetic waves in vacuum, their transverse nature; Relation between electric and magnetic fields of an electromagnetic wave; Energy density in EM fields, Pointing Theorem, polarization of EM waves, Momentum carried by electromagnetic waves and radiation pressure.	**9**

COURSE OUTCOMES:

On completion of the course student will able to

1. **Formulate** the electric field and electric potential using fundamental laws in electrostatics.
2. **Understand** the microscopic behavior of dielectrics in electrical field**.**
3. **Calculate** the static magnetic fields due to current carrying conductors.
4. **Estimate** the physical parameters of a system using the basic laws of electricity and magnetism.
5. **Recognize** the relation between electrical fields and time varying magnetic fields.
6. **Apply** Maxwell's equations for the propagation of EM waves.

Question paper pattern:

1. Question paper consists of 10 questions.
2. Each full question carrying 14 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit.

TEXT BOOKS:

1. Saroj K. Dash, Smaruti R. Khuntia, Fundamentals of Electromagnetic theory.
2. David Griffiths, Introduction to Electrodynamics.

REFERENCE BOOKS:

1. W. Saslow, Electricity, magnetism and light.
2. S.L Gupta& D.L. Gupta, Unified physics.
3. Ch. Srinivas, Ch. Seshubabu, Engineering Physics, Cengage learning.

ENGINEERING CHEMISTRY SEMESTER I			
Subject Code	21CMCHT1030	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

COURSE OBJECTIVES:

The objectives of this course, help the students to

1. Explain the mechanism of corrosion
2. Interpret various boiler troubles and importance of water quality standards.
3. Learn preparation of semiconducting materials, nano materials and liquid crystals – their applications
4. Acquire knowledge on nonconventional energy resources and different types of batteries
5. Know various spectroscopic techniques.
6. Acquire knowledge on volumetric analysis.

Unit -1	**Hours**
Electrochemistry and Corrosion **Electro chemistry:** Introduction, electrode potential, standard electrodes – Hydrogen and Calomel electrodes, Nernst equation and applications. **Corrosion:** Introduction, Mechanism of Wet chemical corrosion, control methods – proper designing, cathodic protection- Sacrificial anodic and impressed current cathodic protection.	**9**
Unit -2	
Water Chemistry and Surface Properties **Water chemistry:** Surface and subsurface water quality parameters – turbidity, pH, total dissolved salts, chloride content, Hardness of water, Temporary and Permanent hardness, Units, determination of hardness by complex metric method. Boiler troubles, Caustic Embrittlement, Priming and foaming, Boiler corrosion. Break point chlorination. **Surface properties:** Determination of surface tension and viscosity of liquids.	**9**
Unit -3	

Material Chemistry **Non-elemental semiconducting materials:** Stoichiometric, controlled valency and chalcogen photo/semiconductors and preparation of semiconductors (distillation, zone refining, Czochralski crystal pulling, epitaxy, diffusion and ion implantation). **Liquid crystals:** Introduction, types and applications. **Nanoparticles**: Introduction, preparation methods – Sol-gel method, Chemical reduction method – Preparation of carbon nanotubes (Arc discharge, chemical vapour deposition and laser ablation methods) properties and applications.	**10**
Unit -4	
ENERGY SOURCES: **Non-conventional energy sources,** Design, working, schematic diagram, advantages and disadvantages of photovoltaic cell, hydropower, geothermal power, tidal and wave power, ocean thermal energy conversion. **Batteries and fuel cells:** Primary and secondary batteries - Dry cell, Lead Acid Cell, Lithium ion battery and Zinc air cells and fuel cells - H_2-O_2, CH_3OH-O_2, Phosphoric acid and molten carbonate.	**10**
Unit -5	
SPECTROSCOPY AND CHROMATOGRAPHY TECHNIQUES Regions of electromagnetic spectrum - Principles of vibrational and rotational spectroscopy. Vibrational and rotational spectroscopy of diatomic molecules: Rigid diatomic molecules - selection rule - simple Harmonic Oscillator - diatomic vibrating rotator. Nuclear magnetic resonance – Principle and Instrumentation. Principles of chromatography – Thin Layer & Paper Chromatography.	**10**
COURSE OUTCOMES: On completion of the course student will be able to 1. Interpret the mechanism of corrosion 2. Summarize the problems faced in industries due to boiler troubles. 3. Recall the properties and applications of advanced materials. 4. Summarize the advantages of non-conventional energy resources and batteries. 5. Able to gain knowledge on spectroscopic techniques and the ranges of the electromagnetic spectrum used for exciting different molecular energy levels. 6. Determine the strength of acid, base and some elements by volumetric and instrumental analysis.	
Question paper pattern: 1. Question paper consists of 10 questions. 2. Each full question carrying 14 marks. 3. Each full question will have sub question covering all topics under a unit. 4. The student will have to answer 5 full questions selecting one full question from each unit.	

TEXT BOOKS:

1. P.C. Jain and M. Jain "**Engineering Chemistry**", 15/e, Dhanpat Rai & Sons, Delhi, (Latest edition).
2. Shikha Agarwal, "**Engineering Chemistry**", Cambridge University Press, New Delhi, (2019).
3. S.S. Dara, "**A Textbook of Engineering Chemistry**", S.Chand & Co, (2010).
4. Shashi Chawla, "Engineering Chemistry", Dhanpat Rai Publicating Co. (Latest edition).
5. Fundamentals of Molecular Spectroscopy, by C. N. Banwell.

REFERENCE BOOKS:

1. K. Sesha Maheshwarammam and Mridula Chugh, "**Engineering Chemistry**", Pearson India Edn.
2. O.G. Palana, "**Engineering Chemistry**", Tata McGraw Hill Education Private Limited, (2009).
3. CNR Rao and JM Honig (Eds) "**Preparation and characterization of materials**" Academic press, New York (latest edition)

COURSE OUTCOMES TO PROGRAM OUTCOMES MAPPING:

CO	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
1	3	-	-	-	-	-	-	-	-	-	-	-
2	-	3	-	-	-	-	-	-	-	-	-	-
3	-	3	-	-	-	-	-	-	-	-	-	-
4	-	3	-	-	-	-	-	-	-	-	-	-
5	-	-	3	-	-	-	-	-	-	-	-	-
6	3	-	-	-	-	-	-	-	-	-	-	-
Course	2	2	1	-	-	-	-	-	-	-	-	-

PROGRAMMING FOR PROBLEM SOLVING SEMESTER I (Common to All)			
Subject Code	21CMCST1040	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

COURSE OBJECTIVES:

The Objectives of Programming for problem solving are:

- To learn about C programming language syntax, semantics, and the runtime environment
- To be familiarized with general computer programming concepts like data types, conditional statements, loops and functions.
- Tobefamiliarizedwithgeneralcodingtechniquesandprocedure-orientedprogramming.

Unit -1	**Hours**
History & Hardware: Computer Hardware, Components, Types of Software, Memory Units. **Introduction to Problem solving**: Algorithm, Characteristics of Algorithms, Pseudo Code, Flowchart, Types of Languages, Relation between Data, Information, Input and Output. **Basics of C**: History and Features of C, Importance of C, Procedural Language, Compiler versus Interpreter, Structure of C Program, Program Development Steps, Programming Errors.	**10**
Unit -2	
Overview of C: Character Set, C-Tokens, Data Types, Variables, Constants, Operators, Operator Precedence and Associativity, Evaluation of C-Expressions, Input/output Functions. **Conditional Branching:** if statement, if...else statement, Nested if...else statement, If…else…if ladder, switch statement. **Unconditional Branching:** go to**. Control flow Statements:** break, continue**. Looping Constructs:** do-while statement, while statement, for statement	**10**
Unit -3	
Arrays: Introduction,1-DArrays,Character arrays and string representation, 2-D Arrays(Matrix),Multi-Dimensional Arrays. **Strings**: Working with Strings, String Handling Functions (both library and user defined).**Functions:** Basics, Necessity and Advantages, Types of Functions, Parameter Passing Mechanisms, Recursion, Storage Classes, Command Line Arguments, Conversion from Recursion to Iteration and Vice-Versa.	**10**
Unit -4	

Pointers: Understanding Pointers, Pointer Expressions, Pointer and Arrays, Pointers and Strings, Pointers to Functions. **Dynamic Memory Allocation:** Introduction to Dynamic Memory Alloca-tion-malloc(),calloc(),realloc(),free(). **Structures and Unions:** Defining a Structure, type def, Advantage of Structure, Nested Structures, Arrays of Structures, Structures and Arrays, Structures and Functions, Structures andPointers,DefiningUnions,Self-ReferentialStructures,Bitfields,Enumerations.	**10**
Unit -5	
Preprocessing Directives: () acro Substitution, File Inclusion, Conditional Compilation and Other Directives. **FileManagementInC:**)IntroductiontoFileManagement,ModesandOperationsonFiles,TypesofFiles,ErrorHandlingduringI/O Operations.	**10**

COURSE OUTCOMES:

On completion of the course student will be able to

- Demonstrate computer components, algorithms, translate them into programs.
- Choose the suitable control structures for the problem to be solved.
- Make use of arrays, pointers, structures, and unions effectively.
- Organize reusable code in a program into functions.
- Demonstration of file operations.

Question paper pattern:

1 Question paper consists of 10 questions.
2 Each full question carrying 14 marks.
3 Each full question will have sub question covering all topics under a unit.
4 The student will have to answer 5 full questions selecting one full question from each unit.

TEXT BOOKS:

1) Programming in C ,PradipDey, Manas Ghosh, OXFORD
2) Programming in, C Reema Thareja, Second Edition, OXFORD
3) Programming for Problem Solving, BehrouzA.Forouzan,RichardF.Gilberg,CENGAGE.

REFERENCE BOOKS:

1) Computer Fundamentals and Programming, Sumithabha Das,McGrawHill.
2) Programming in C,AshokN.Kamthane, AmitKamthane, Pearson.

Course Outcomes to Program Outcomes Mapping:

COs VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1)

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 1 0	PO 1 1	PO 1 2	PSO 1	PSO 2
1	2				3					2				3
2	2				3					2				3
3	2				3					2				3
4	2				3					2				3
5	2				3					2				3
Over all	2				3					2				3

COMPUTER AIDED ENGINEERING GRAPHICS

(Common to AI&M, CSE, CST,ECE,ECT & IT)

SEMESTER I

Subject Code	21ETMEL1050	IA Marks	30
Number of Lecture Hours/Week	1(L)+0(T)+4(P)	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	3

Credits – 03

COURSE OBJECTIVES: On successful completion of this course, Students should be able to

1. draw engineering objects with appropriate lettering and dimensioning using various commands of AutoCAD
2. draw geometric constructions, polygons, various types of curves and scales
3. construct multi views of points, lines and planes
4. construct multi views of solids by orthographic projection method
5. convert the orthographic views into isometric views and vice versa by 2D- Commands in AutoCAD

Unit -1: INTRODUCTION	**Teaching Hours**
Introduction to Engineering Graphics, sheet sizes & layouts (ISO), line types with application, scales, drawing sheet sizes, title block, sheet markings, dimensioning **AutoCAD:** Overview of Computer Graphics, starting with AutoCAD, templates, menu- bar, drawing area, option buttons (drawing settings), command line area, draw commands (point, line, polyline, circle, circular arc, ellipse, elliptical arc, spline fit, spline CV, rectangle &polygon), modify commands (move, rotate, trim/extend, erase, copy, mirror, chamfer/ fillet, explode, stretch, scale, array & offset), layers (layering, setting up and use of layers, layers to create drawings and create, edit and use customized layers) &annotation commands (applying dimensions/ annotations to drawings), drawing settings (grid, snap-mode, ortho, polar tracking, object snap, iso-draft), dimension settings (edit/ modify dimension style: text size & style, arrow size & style, line types & thickness and setting other parameters of dimension text, dimension lines & extension lines) Printing documents to paper and to PDF using plot command.	12
Unit -2: CONICS AND SCALES	
Geometrical constructions, polygons, conic sections – ellipse, parabola, hyperbola (Eccentricity method only); scales – plain, diagonal and vernier scales**.**	10
Unit – 3: ORTHOGRAPHIC PROJECTION OF POINTS, LINE AND PLANES	
Principles of Orthographic Projections, Projections of Points, projection of lines (inclined to HP & VP); Projections of planes (inclined to one reference plane).	10
Unit – 4: ORTHOGRAPHIC PROJECTION OF SOLIDS	
Projections of Regular Solids- Prisms, Pyramids, Cylinder & Cone (simple position	8

and inclined to one reference plane only).	
Unit-5: ISOMETRIC PROJECTIONS AND ORTHOGRAPHIC VIEWS	
Isometric Projections and orthographic views: Principles of isometric projection – isometric scale, isometric views, conventions; isometric views of lines, planes, simple solids, Conversion of Isometric Views to Orthographic Views and vice-versa	10

COURSE OUTCOMES: On successful completion of this course, students will be able to

1. understand the BIS conventions of engineering drawing with basic concepts & draw engineering objects with appropriate lettering and dimensioning using various commands of AutoCAD
2. construct polygons, various types of Curves and scales used engineering application like maps, buildings, bridges
3. draw multi views of points, lines and planes by orthographic projection method
4. draw multi views of solids by orthographic projection method
5. convert the orthographic views into isometric views and vice versa by 2D- Commands in AutoCAD

Text Books

1. N.D. Bhatt & V.M. Panchal, Engineering Drawing, 48th edition, 2005, Charotar Publishing House, Gujarat
2. R.B.Choudary, Engineering Drawing with AutoCAD 2008, Anuradha Publishers

Reference Books

1. S. Trymbaka Murthy, Computer Aided Engineering Drawing, I.K. International Publishing House Pvt. Ltd., New Delhi, 3rd revised edition 2006.
2. K.R. Gopalkrishna, Engineering Graphics, 32nd edition, 2005 Subash Publishers, Bangalore

COs VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 1 0	PO 1 1	PO 1 2	PSO 1	PSO 2
1	2				3					2				3
2	2				3					2				3
3	2				3					2				3
4	2				3					2				3
5	2				3					2				3
Over all	2				3					2				3

ENGINEERING PHYSICS LAB (Common for ECE &ECT) SEMESTER I			
Subject Code	**21ETPHL1060**	IA Marks	15
Number of Practice Hours/Week	03	Exam Marks	35
Total Number of Practice Hours	36	Exam Hours	03
Credits – 1.5			

COURSE OBJECTIVES:

The objectives of this course, help the students

- **To apply** the theoretical knowledge of Physics through hands on the experimental instruments
- **To improve** the experimental knowledge in the later studies
- **To understand** the basic need of experiment**s.**
- **To know** how to measure the different physical quantities.
- **To acquire** ability to use instrumentation techniques.
- **To train** the students to develop techniques based on the principles related to various devices or components.

List of Experiments

1. Determination of the dielectric constant of the dielectric material in the given capacitor using a RC charging and discharging circuit.
2. Measuring of the magnetic field induction of circular coil-Stewart-Gee's experiment.
3. Determination of the horizontal component of earth magnetic field using Helmholtz coil galvanometer..
4. Study of the motion of charged particle in electric and magnetic fields and determine the value of e/m by magnetic focusing.
5. Determination of the frequency of the AC Source using Sonometer.
6. Determination of the electromotive force (emf) of an unknown cell using a stretched wire potentiometer.
7. Study of the particle behavior of EM waveand estimation of Planck's constant using photocell.
8. Determination of the frequency of electrical vibrator-Melde's experiment.
9. Determination of the wavelength and frequency of the electromagnetic wave using diffraction.
10. Verification of laws of transverse waves in a stretched string.

Demonstration experiments:

1. Estimation of Hall coefficient and estimate the concentration of charge carriers using Hall Effect.
2. Determination of the self inductance and resistance of a coil with air core.

COURSE OUTCOMES:

On completion of the course student will able to

1. **Compare** the theory and correlated with experiments
2. **Design** experiments
3. **Analyze** the experimental result
4. **Apply** appropriate techniques to perform the experiments
5. **Apply** the fundamental laws in electromagnetism to understand the behavior of electromagnetic fields.

6. **Calculate** the frequency and wavelength of EM Waves**.**

Question paper pattern:

Ten questions are given, and student should choose one question (blind option), which carries 50 marks in total.

a. 15 marks are allotted for procedure including circuit diagrams and model graphs.
b. 15 marks for conduction of the experiment.
c. 10 marks for results and conclusions.
d. 10 marks for viva voce.

TEXT BOOKS:"*Physics Laboratory Manual"* Prepared by Department of Physics, SITE.

REFERENCE BOOKS:

1. S. Balasubrahmanian, M.N. Srinivasan ''A Text book of Practical Physics''- S. Chand Publishers, 2017.
2. Advanced Practical Physics Vol 1& 2 SP Singh & M.S Chauhan Pragati Prakashan, Meerut

WEB SOURCES:http://vlab.amrita.edu/index.php -Virtual Labs, Amrita University.

COURSE OUTCOMES TO PROGRAM OUTCOMES MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
2	**2**	**1**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
3	**2**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
4	**3**	**1**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
5	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
6	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Course	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

ENGINEERING CHEMISTRY LABORATORY

(Common to All)

SEMESTER I

Subject Code	21CMCHL1070	IA Marks	15
Number of Practice Hr/Week	3	Exam Marks	35
Total Number of Practice Hr	36	Exam Hours	03

Credits – 1.5

List of Experiments

(Any 10 experiments must be conducted)

1. Determination of HCl using standard Na2CO3 solution
2. Determination of alkalinity of a sample containing Na2CO3 and NaOH
3. Determination of surface tension
4. Determination of viscosity of a liquid by Ostwald viscometer
5. Determination of chloride content of water
6. Determination total hardness of water by EDTA.
7. Determination of Mg^{+2}using standard oxalic acid solution.
8. Determination of Cu^{+2}using standard hypo solution.
9. Determination of the rate constant of first order reaction (Ester hydrolysis)
10. Determination of strength of strong acid using conductometeric titration.
11. Determination of strength of weak acid using conductometeric titration .
12. Determination of Ferrous iron using potentiometer.
13. Chemical oscillations- Iodine clock reaction
14. Estimation of Vitamin C.

Demonstration Experiments

1. Thin Layer Chromatography
2. Determination of $Fe^{+3}$by a colorimetric method.

Question paper pattern:

Ten questions are given, and student should choose one question (blind option), which carries 50 marks in total.

a. 15 marks are allotted for procedure including circuit diagrams and model graphs.

b. 15 marks for conduction of the experiment.

c. 10 marks for results and conclusions.

d. 10 marks for viva voce.

PROGRAMMING FOR PROBLEMSOLVING LAB

Common to All)

SEMESTER I

Subject Code	21CMCSL1080	Internal Marks	15
Number of Lecture Hours/Week	3	External Marks	35
Total Number of Hours	36	Exam Hours	03

Credits – 1.5

Course Objectives:

This course will enable students to

1. To understand the various steps in Program development.
2. To understand the basic concepts in C Programming Language.
3. To learn how to write modular and readable C Programs.
4. To learn to write programs (using structured programming approach) in C to solve problems.
5. To introduce basic data structures such as lists, stacks and queues.

Exercise1(Familiarization with programming environment)

a) Familiarization of CODEBLOCKS C++Editor to edit, compile, Execute, Test and debugging C programs.

b) Familiarization of RAPTOR Tool to draw flow charts and understand flow of control. Acquaintance with basic LINUX commands.

Exercise2(Simple computational problems using arithmetic expressions)

a) Write a C Program to display real number with 2 decimal places.

b) Write a C Program to convert Celsius to Fahrenheit and vice versa.

c) Write a C Program to calculate the area of triangle using the formula
area = √ (s(s−a)(s−b)(s −c) where =a+b+c/2

d) Write a C program to find the largest of three numbers using ternary operator.

) Write a C Program to swap two numbers without using a temporary variable.

Exercise3(Problems involving if-then-else structures)

a) Write a C Program to check whether a given number is even or odd using bitwise operator, shif operator and arithmetic operator.

b) Write C program to find the roots of a quadratic equation.

c) Write a C Program to display grade basedon6subjectmarks using if…else…if ladder.

d) Write a C Program, which takes two integer operands and one operator form the user, performs the operation &then prints the result using switch control statement.(Consider the operators +, -,*,/,%)

Exercise4(Iterative problems)

a) WriteaCProgramtocountnumberof0'sand1's in a binary representation of a given number.

b) WriteaCprogramtogeneratealltheprimenumbersbetweentwonumberssuppliedbytheuser.

c) Write a C Program to print the multiplication table corresponding to number supplied as input

Exercise5(Iterative problems)

a) Write a C Program to Find Whether the Given Number is i)Armstrong Number) Palindrome Number

b) Writea C Program to print sum of digits of a given number

Exercise6(Series examples)

a) Write a C Program to calculate sum of following series

b) 1+2+3+….n b) 1+1/2+1/3+……+1/nc)1+x+x2+x3……+xn

Exercise7(1DArraymanipulation)

a) Write a C program to interchange the largest and smallest numbers in the array.
b) Write a C program to search an element in an array (linear search).
c) Write a C Program to print the following pattern using a character array SA SASSASI

Exercise8(Matrix problems, String operations)

a) Write a C program to add two matrices.
b) Write a C program to multiply two matrices if they are compatible or print an error message **"Incompatible matrix sizes" otherwise.**
c) Write a C program to check given matrix is symmetric or not.

Implementthefollowingstringoperationswithandwithoutlibraryfunctions.i)copy ii)concatenate iii)length iv)compare

Exercise 9 (Simple functions)

a) Write a C Program demonstrating the following function types
b) With arguments and with return value.
c) With arguments and without return alue
d) Without arguments and without return value.
e) Without arguments and with return value.
f) Write a C Program illustrating call by reference

Exercise 10 (Recursive functions)

Write a C Program illustrating the following with Recursion without Recursion
a)Factorial b) GCD c) Power d) Fibonacci

Exercise 11(Pointers and structures)

a) Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc () function.
b) Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc () function. Note: Understand the difference between the above two programs.
c) Write a C Program to read and print student details using structures.

Exercise 12 (File operations)

a) Write a C program to open a file and to print it contents on screen.
b) Write a C program to copy files
c) Write a C program merges two files onto a new file.
d) Write a C program to delete a file.

Course outcomes:

Question paper pattern:

Ten questions are given, and student should choose one question (blind option), which carries 50 marks in total.

a. 15 marks are allotted for procedure including circuit diagrams and model graphs.
b. 15 marks for conduction of the experiment.
c. 10 marks for results and conclusions.
d. 10 marks for viva voce.

Text Books:

1. ComputerProgramingANSIC,EBalagurusamy,McGrawHillEducation(Private),Limited (TB1)
2. Programming in C,Reema Thareja, Second Edition, Oxford Higher Education(TB2)

Reference Books:

1. Computer Basics and C Programming, V Raja Raman, Second Edition, PHI (RB1)

Course Outcomes:

2. Attain knowledge on using CODE BLOCKS and RAPTOR tools in solving problems. Examine and analyze alternative solutions to a problem.
3. Design an algorithmic solution to a problem using problem decomposition and step-wise refinement.
4. Demonstrate conversion of iterative functions to recursive and vice-versa.

Course Outcomes to Program Outcomes Mapping

CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
1	3	3	3										3	
2	3	3	3		2								3	
3	3	3	3		2								3	
4	3	3	3		2								3	
5	3	3	3		2								3	
Course	**3**	**3**	**3**		**2**								**3**	

CONSTITUTION OF INDIA, PROFESSIONAL ETHICS & HUMAN RIGHTS

(Common to all Branches)

SEMESTER I

Subject Code	21CMMSN1090	IA Marks	30
Number of Lecture Hr/week	03	Exam Marks	70
Total Number of Lecture Hr	50	Exam Hours	03

Credits – 00

COURSE OBJECTIVES:

The objectives of this course help the students to

1. To provide basic information about Indian constitution.
2. To identify individual role and ethical responsibility towards society.
3. To understand human rights and its implications.

Unit - I	**Hours**
Introduction to the Constitution of India, The Making of the Constitution and Salient features of the Constitution. Preamble to the Indian Constitution Fundamental Rights & its limitations.	**10**
Unit - II	
Directive Principles of State Policy & Relevance of Directive Principles State Policy Fundamental Duties. Union Executives – President, Prime Minister Parliament Supreme Court of India.	**10**
Unit – III	
State Executives – Governor, Chief Minister, State Legislature High Court of State. Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th &91st Amendments.	**10**
Unit –IV	
Special Provision for SC & ST Special Provision for Women, Children & Backward Classes Emergency Provisions. Human Rights –Meaning and Definitions, Legislation Specific Themes in Human Rights- Working of National Human Rights Commission in India Powers and functions of Municipalities, Panchyats and Co - Operative Societies.	**10**
Unit – V	
Scope & Aims of Engineering Ethics, Responsibility of Engineers Impediments to Responsibility. Risks, Safety and liability of Engineers, Honesty, Integrity & Reliability in Engineering.	**10**

COURSE OUTCOMES:

On completion of the course student will

1. Have general knowledge and legal literacy and thereby to take up competitive examinations.
2. Understand state and central policies, fundamental duties.
3. Understand Electoral Process, special provisions.
4. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies, and
5. Understand Engineering ethics and responsibilities of Engineers
6. Understand Engineering Integrity & Reliability

Question paper pattern:

1 Question paper consists of 10 questions. 2 Each full question carrying 14 marks. 3 Each full question will have sub question covering all topics under a unit. 4 The student will have to answer 5 full questions selecting one full question from each unit.
TEXT BOOKS: 1. Durga Das Basu: **"Introduction to the Constitution on India",** (Students Edn.) Prentice – Hall EEE, 19th / 20th Edn., 2001 2. Charles E. Haries, Michael S Pritchard and Michael J. Robins **"Engineering Ethics"** Thompson Asia, 2003-08-05.
REFERENCE BOOKS: 1. M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002. 2. M.Govindarajan, Natarajan, V.S.Senthilkumar, **"Engineering Ethics",** Prentice –Hall of India Pvt. Ltd. New Delhi, 2004 3. Brij Kishore Sharma,**" Introduction to the Constitution of India"**, PHI Learning Pvt. Ltd., New Delhi, 2011. 4. Latest Publications of Indian Institute of Human Rights, New Delhi

TECHNICAL ENGLISH

SEMESTER II

Subject Code	21CMEGT2010	IA Marks	30
Number of Lecture Hours/ Week	03	Exam Marks	70
Total Number of Lecture Hours	50	Exams Hours	03

Credits -03

Course Objectives:

To enable the students to learn and apply fundamental principles in Technical English & Communication by focusing on:

1. Technical English Vocabulary
2. Writing Skills
3. Common Errors in Writing
4. Nature and Style of Sensible Technical Writing
5. Writing Technical Reports and Letters

Unit I	
Principles of Scientific Vocabulary • Principles of Scientific vocabulary: short and simple words-compact substitutes for wordy phrases- redundant words and expressions-Avoid hackneyed and stilted phrases, verbosity and incorrect use of words • The role of roots in word building, prefixes and suffixes, confusing words and expressions.	10 hours
Unit II	
Writing Skills • Distinguishing between academic and personal styles of writing • Use of clauses in technical phrases and sentences • Techniques of Sentence and paragraph writing • Measuring the clarity of a text through Fog Index or Clarity Index	10 hours
Unit III	
Common Errors in Writing • Subject-verb agreement and concord of nouns, pronouns and possessive adjectives • Common errors in the use of articles, prepositions, adjectives and adverbs • Punctuation • Technical Guidelines for Communication • Avoiding the pitfalls	10 hours

Unit IV

Nature and Style of Sensible Technical Writing • Academic Writing Process • Describing, processes and products • Defining, Classifying • Effective use of charts, graphs, and tables	10 hours

Unit V

Report writing and Letter writing • Writing Technical Reports, Précis writing ,Letter Writing &Essay writing	10 Hours

COURSE OUTCOMES

On Completion of the course student will acquire

1. Ability to understand Scientific vocabulary and use them confidently
2. Familiarity with the basic principles of writing clear sentences and paragraphs
3. Ability to write error free simple technical passages
4. Knowledge of writing different writing styles
5. Confidence to write letters and technical reports clearly and coherently

Question paper pattern:

1. Question paper consists of 10 questions.
2. Each full question carrying 14 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit.

Text Books

1. **Effective Technical Communication by Barun K Mitra**, Oxford University Publication

Non-detailed Text

1. **Karmayogi: A Biography of E Sreedharan by M S Ashokan**

Reference Books

1. *Communication Skills* by Sanjay Kumar & Pushpa Latha, OUP
2. Study Writing by Liz Hamp-Lyons and Ben Heasly, Cambridge University Press.
3. Remedial English Grammar by F T Wood, Macmillian 2007
4. *Practical English Usage* by Michael Swan Oxford University Press
5. *English Collocations in Use* by Michael McCarthy & Felicity O'Dell
6. *Effective Technical Communication* by Arsahf Rizvi,
7. *Essential English Grammar by Raymond Murphy, CUP, 2017*

Unit	Title	Text books/Reference Books
I	Principles of Scientific Vocabulary	Text Book 1/Reference Book 5
II	Writing Skills	Text Book 1Reference Book 2 Reference Book 6
III	Common Errors in Writing	Text Book 1,Reference Book 3 Reference Book 4,Reference Book 7
IV	Nature and Style of Sensible Technical Writing	Text Book 1,Reference Book 1 Reference Book 2
V	Report writing and Letter writing	Text Book 1,Reference Book 1 Reference Book 2

COURSE OUTCOMES TO PROGRAM OUTCOMES MAPPING:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
1	-	-	-	-	-	-	-	-	-	**2**	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	**2**	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	**2**	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	**2**	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	**2**	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	**2**	-	-	-	-	-

ENGINEERING MATHEMATICS-II

(Linear algebra, Laplace transforms & Numerical Methods)

Common to all the branches

SEMESTER II

Subject Code	21CMMAT2020	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Course objectives:

To enable students to apply the knowledge of Mathematics in various engineering

fields by making them to learn the following'

1. To develop the use of matrix algebra techniques that is needed by engineers for practical applications and solve system of linear equations
2. To find the inverse and power of a matrix by Cayley-Hamilton theorem and reduce the Quadratic form
3. To solve initial value problems by using Laplace transforms
4. To find the solution of algebraic/ transcendental equations and also interpolate the functions.
5. To apply different algorithms for approximating the solutions of ordinary differential equations with initial conditions to its analytical computations.

Unit -1	**Hours**
Solving systems of linear equations: Rank of a matrix by echelon form and normal form – Solving system of homogeneous and non homogeneous linear equations – Gauss Elimination method- Jacobi and Gauss-Seidel methods for solving system of equations numerically.	**10**
Unit -2	
Eigen values and Eigen vectors, Cayley–Hamilton theorem and Quadratic forms: Eigen values and Eigen vectors and properties- Cayley-Hamilton theorem (without proof) – Reduction to Diagonal form – Quadratic forms and nature of the quadratic forms – Reduction of quadratic form to canonical forms by orthogonal transformation, Diagonalisation and Lagrange's reduction	**10**
Unit – 3	
Laplace Transforms: Laplace transforms – Definition and Laplace transforms of some certain functions– Shifting theorems – Transforms of derivatives and integrals	**10**

– Unit step function –Dirac's delta function Periodic function – Inverse Laplace transforms– Convolution theorem (without proof). Applications: Solving ordinary differential equations (initial value problems) using Laplace transforms.	
Unit – 4	
Numerical Methods: Introduction - Method of false position - Newton-Raphson method (One Variable) Introduction– Errors in polynomial interpolation – Finite differences– Forward differences– Backward differences –Central differences – Relations between operators – Newton's forward and backward formulae for interpolation – Interpolation with unequal intervals – Lagrange's interpolation formula.	**10**
Unit – 5	
Numerical integration, Solution of ordinary differential equations with initial conditions: Trapezoidal rule - Simpson's 1/3rd and 3/8th rule - Solution of initial value problems by Taylor's series– Picard's method of successive approximations– Euler's method – Runge -Kutta method (second and fourth order).	**10**
Course outcomes: On completion of this course, students are able to, 1. Develop the use of matrix algebra techniques that is needed by engineers for practical applications and solve system of linear equations (L6) 2. Find the inverse and power of a matrix by Cayley-Hamilton theorem and reduce the Quadratic form (L3) 3. Solve initial value problems by using Laplace transforms (L3) 4. Find the solution of algebraic/ transcendental equations and also interpolate the functions(L3) 5. Apply different algorithms for approximating the solutions of ordinary differential equations with initial conditions to its analytical computations (L3).	
Question paper pattern: 5. Question paper consists of 10 questions. 6. Each full question carrying 14 marks. 7. Each full question will have sub question covering all topics under a unit. 8. The student will have to answer 5 full questions selecting one full question from each unit.	
Text Books: 1. B. S. Grewal," Higher Engineering Mathematics", Khanna publishers, 44th Edition, 2016. 2. Kreyszig, "Advanced Engineering Mathematics " - Wiley, 9th Edition, 2013. **3.** B.V.Ramana "Higher Engineering M athematics" Tata Mc Graw-Hill, 2006	
Reference Books:	

1. Dr.K.V.Nageswara Reddy and Dr.B.Rama Bhupal Reddy, "Engineering Mathematics, Volume II" Scitech Publications, 2017.
2. Steven C. Chapra, Applied Numerical Methods with MATLAB for Engineering and Science, Tata McGraw Hill Education, 4th Edition, 2018
3. M. K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publications, 3rd Edition, 2020.
4. Lawrence Turyn, Advanced Engineering Mathematics, CRC Press, 1st Edition 2014.

COURSE OUTCOMES TO PROGRAM OUTCOMES MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	3	-	-	-	-	-	-	-	-	-	-
2	3	3	-	-	-	-	-	-	-	-	-	-
3	3	3	-	-	-	-	-	-	-	-	-	-
4	3	3	-	-	-	-	-	-	-	-	-	-
5	3	3	-	-	-	-	-	-	-	-	-	-
Course	3	3	-	-	-	-	-	-	-	-	-	-

BASIC ELECTRICAL ENGINEERING

SEMESTER II

(Common to All)

Subject Code	21CMEET2030	IA Marks	30
Number of Lecture Hours/Week	3L + 1T	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits-03			

Course Objectives:

This course will enable student to

1. Understand basic electrical circuit operation.
2. Understand the concept of Alternating Voltage and Current.
3. Understand the operation of DC machines.
4. Understand the working of measuring instruments.
5. Understand the operation of different types of ac machines.
6. Understand the concept of Electrical Safety.

Unit -1	**Hours**
Basic Electrical Circuits: Basic definitions(Electric Charge, Current, Electro Magnet Force, Potential Difference; Electric Power and Energy) – types of network elements – Ohm's Law – Kirchhoff's Laws –series & parallel circuits - network theorems (Super position, Thevinen's, Norton's, Maximum power transfer theorems)	**10**
Unit -2	
AC Fundamentals & Basic Electromagnetic Laws: Study of AC Voltage and Current, RMS and Average Values, Three phase Star-Delta connections, Alternating Voltage applied to Pure Resistance, Inductance, Capacitance and their combinations, Concept of Power and Power Factor in AC Circuit. Concept of Magnetic Field, Magneto Motive Force (MMF), Permeability; Self and Mutual Induction, Basic Electromagnetic laws,	**10**
Unit – 3	
DC Machines: DC Machine -Principle of operation & construction – emf equation- torque equation - speed control methods – losses and efficiency – brake test. Applications of DC motors.	**10**
Unit – 4	
AC Machines: Single Phase Transformers - Construction and Operation-Principles - Classification - Applications-OC & SC test of single phase transformer-regulation & Efficiency. Three Phase Induction Motors: working principle- construction, speed- torque characteristics-losses and efficiency.	**10**
Unit – 5	
Electrical Safety: Electrical Shock and Precautions against it, Treatment of Electric Shock; Concept of Fuses and Their Classification, Selection and Application; Concept of Earthing.	**10**

Course Outcomes: The student should be able to

1. Understand basic electrical circuit operation.
2. Understand the concept of Alternating Voltage and Current.
3. Understand the operation of DC machines.
4. Understand the working of measuring instruments.
5. Understand the operation of different types of ac machines.
6. Understand the concept of Electrical Safety.

Question paper pattern:

1. Question paper consists of 10 questions.
2. Each full question carrying 14 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

i. Electrical Circuit Theory and Technology by John Bird, Routledge Taylor &Francis Group.

ii. Principles of Electrical Machines by V.K. Mehta & Rohit Mehta, S.Chand and Company Limited.

Reference Books:

i. Theory and Performance of Electrical Machines by J.B. Gupta, S.K.Kataria & Sons.
ii. A Textbook of Electrical Technology – Volume II: AC & DC Machines by B.L.Theraja & A.K. Theraja, S.Chand and Company Limited.
iii. Basic Electrical Engineering by Nagsarkar, Sukhija, Oxford Publications, 2nd edition.
iv. Basic Electrical Engineering by M.S.Naidu and S.Kamakshiah, TMH Publications
v. Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications, 2nd edition.
vi. Electrical Technology by Surinder Pal Bali, Pearson Publications.

COURSE-OUTCOMES-TO-PROGRAM-OUTCOMES-MAPPING:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	2	2	1									
CO2	2	2	1									
CO3	2	2	1									
CO4	2	2	1									
CO5	2	2	1									
CO6	2	2	1									
Overall Course	**2**	**2**	**1**									

PYTHON PROGRAMMING

Common to All

SEMESTER II

Subject Code	21CMCST2040	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite		Credits – 03	

The Objectives of Python Programming are:

- To learn about Python programming language syntax, semantics, and the runtime environment
- To be familiarized with general computer programming concepts like data types, conditional statements, loops and functions.
- To be familiarized with general coding techniques and object-oriented programming and Graphical User Interfaces.

Unit -1	**Hours**
Introduction:(TB1:22-30,TB2:1.1-1.4,TB2:1.21-1.33) Introduction Python, Program Development Cycle, Input, Processing, and Output, Displaying Output with the Print Function, Variables, Reading Input from the Keyboard, Operators. **Data Types, and Expression: (TB1:41-59)** Strings Assignment, and Comment, Numeric Data Types and Character Sets, Type conversions, Expressions, Using functions and Modules. **Decision Structures and Boolean Logic:(TB1:77-85)** if, if-else, if-else if-else Statements, Nested Decision Structures, Comparing Strings, Logical Operators, Boolean Variables.	08
Unit -2	
Control Statement:(TB1:65-72,TB1:86-91) Definite iteration for Loop Formatting Text for output, Selection if and if else Statement Conditional Iteration, The While Loop, Nested Loops. **Strings and Text Files:(TB1:103-125)** Accessing Character and Substring in Strings, Data Encryption, Strings and Number Systems, String Methods, Text Files.	10
Unit -3	
ListandDictionaries:(TB1:135-145,TB1:153-158) Lists,Tuples,Sets,Dictionaries. **Design with Function:(TB1:146-149, TB1:169-190)**Functions as Abstraction Mechanisms, Problem Solving with Top Down Design, Design with Recursive Functions, Case Study Gathering Information from a File System. **Modules**:**(TB2:8.1-8.5)**Modules, Standard Modules, Packages.	12
Unit – 4	
File Operations:(TB1:122-123) Reading config files in python, Writing log files in python, Understanding read functions, read(), readline() and readlines(), Understanding write functions, write() and write lines(). **Object Oriented Programming:(TB2:5.1-5.20, TB2:6.1-6.17)**Concept of class, object and instances, Constructor, class attributes and destructors, Inheritance. **Design with Classes:(TB1:294-301, TB1:309-330)** Objects and Classes, Data modeling Examples, Case Study an ATM.	12
Unit – 5	
Errors and Exceptions:(TB2:7.1-7.8) Syntax Errors, Exceptions, Handling Exceptions, Raising Exceptions, User-defined Exceptions, Defining Clean-up	8

Actions, Redefined Clean-up Actions**.**
Graphical User Interfaces:(TB1:245-288) The Behavior of Terminal Based Programs and GUI –Based Programs, Coding Simple GUI-Based Programs, Other Useful GUI Resources.

Course outcomes:

On completion of the course student will be able to

- Able to learn the fundamental concepts in the Python language
- Implementation of python iterative statements and strings
- Demonstrate python lists, dictionaries and functions
- Understand the concepts of modules and packages in python
- Complete coding challenges relating to object-oriented programming's essential concepts and techniques.
- Apply variety of error handling and GUI programming techniques

Question paper pattern:

1. Question paper consists of 10 questions.
2. Each full question carrying 14 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit.

Text Books

1. Fundamentals of Python First Programs, Kenneth.A.Lambert,Cengage.
2. Python Programming: A Modern Approach,Vamsi Kurama,Pearson.

ReferenceBooks:

1)Introduction to Python Programming ,Gowrishankar.S,VeenaA,CRCPress.

2)Introduction to Programming Using Python,Y.DanielLiang,Pearson.

E-Resources:

https://www.tutorialspoint.com/python3/python_tutorial.pdf

Course Outcomes to Program Outcomes mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	3
2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	3
3	2	2	3	-	2	-	-	-	-	-	-	-	-	-	3
4	3	2	3	-	3	-	-	-	-	-	-	-	-	-	2
5	3	3	3	-	2	-	-	-	-	-	-	-	-	-	2
6	3	2	3	-	3	-	-	-	-	-	-	-	-	-	3
Course	**3**	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**

NETWORK ANALYSIS			
Subject Code	21ETETT2050	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite		Credits – 03	

COURSE OBJECTIVES:

- To understand the basic concepts on RLC circuits.
- To know the behavior of the steady states and transients states in RLC circuits.
- To know the basic Laplace transforms techniques in periods' waveforms.
- To understand the two port network parameters.
- To understand the properties of LC networks and filters.

Unit -1	**Hours**
Fundamentals and Network Topology: Definitions of branch, node, tree, planar, non-planar graph, incidence matrix, basic tie set schedule, basic cut set schedule. Definitions of terms associated with periodic functions: Time period, Angular velocity and frequency, RMS value, Average value, Form factor and peak factor-problem solving, Phase angle, Phasor representation, Addition and subtraction of phasors, mathematical representation of sinusoidal quantities, explanation with relevant theory, problem solving. Principal of Duality with examples.	08
Unit -2	
Electric Circuits: Review of Kirchhoff's laws, Mesh analysis and Nodal analysis problem solving including dependent sources also. **Network Theorems:** Thevinin's, Norton's, Milliman's, Reciprocity, Compensation, Substitution, Superposition, Max Power Transfer, Tellegens-problem solving using dependent sources also.	10
Unit -3	
Steady State Analysis of A.C Circuits: Impedance concept, phase angle, series R-L, R-C, R-L- C circuits problem solving. Complex impedance and phasor notation for R-L, R-C, R-L-C problem solving using mesh and nodal analysis, Star-Delta conversion, problem solving. **Transients:** First order differential equations, Definition of time constants, R-L circuit, R-C circuit with DC excitation, Evaluating initial conditions procedure, second order differential equations, homogeneous, non-homogenous, problem solving using R-L-C elements with DC excitation and AC excitation, Response as related to s-plane rotation of roots. Solutions using Laplace transform method.	12
Unit – 4	
Resonance: Introduction, Definition of Q, Series resonance, Bandwidth of series resonance, Parallel resonance, Condition for maximum impedance, current in anti resonance, Bandwidth of parallel resonance, general case-resistance present in both branches, anti resonance at all frequencies. **Coupled Circuits:** Coupled Circuits: Self inductance, Mutual inductance, Coefficient of coupling, analysis of coupled circuits, Natural current, Dot rule of coupled circuits, Conductively coupled equivalent circuits- problem solving.	12
Unit – 5	
Two-port Networks: Relationship of two port networks, Z-parameters, Y-parameters, Transmission line parameters, h-parameters, Inverse h-parameters,	8

Inverse Transmission line parameters, Relationship between parameter sets, Parallel connection of two port networks, Cascading of two port networks, series connection of two port networks, problem solving including dependent sources also.	

Course outcomes:

On completion of the course student will be able to

1. Gain the knowledge on basic network elements.
2. Will analyze the RLC circuits' behavior in detailed.
3. Analyze the performance of periodic waveforms.
4. Gain the knowledge in characteristics of two port network parameters (Z,Y,ABCD,h&g).
5. Analyze the filter design concepts in real world applications.

Question paper pattern:

1. Question paper consists of 10 questions.
2. Each full question carrying 14 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Network Analysis – ME Van Valkenburg, Prentice Hall of India, 3rdEdition,2000.
2. Network Analysis by K.Satya Prasad and S Sivanagaraju,CengageLearning
3. Electric Circuit Analysis by Hayt andKimmarle,TMH

Reference Books:

1. Network lines and Fields by John. D. Ryder 2ndedition, Asiapublishinghouse.
2. Basic Circuit Analysis by DR Cunninghan, Jaico Publishers. 3.Network Analysis and Filter Design by Chadha,UmeshPublications.

Course Outcomes to Program Outcomes mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	3
2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	3
3	2	2	3	-	2	-	-	-	-	-	-	-	-	-	3
4	3	2	3	-	3	-	-	-	-	-	-	-	-	-	2
5	3	3	3	-	2	-	-	-	-	-	-	-	-	-	2
6	3	2	3	-	3	-	-	-	-	-	-	-	-	-	3
Course	**3**	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**

S.No.	Unit Name	Text Book/ Reference	Chapter No.
1.	Fundamentals and Network Topology	T2 &R1	1
2.	Electric Circuits and Network Theorems	T2&R1	2 &3
3.	Steady State Analysis of A.C Ckts &Transient	T2,T1,R2	4,5 &6
4.	Resonance and Coupled Circuits	T2,R2	6,7& 8
5.	Two-port Networks	T1	4 & 5

ENGLISH LANGUAGE COMMUNICATION SKILLS LAB

SEMESTER II

Subject Code	18CMEGL2060	IA Marks	15
Number of Practical Hr./week	02	Exam Marks	35
Total Number of Practical Hr	32	Exam Hours	03

Credits – 01

Objectives: To enable the students to learn communication skills of Listening, Speaking, Reading and Writing by focusing on:

- Listening Comprehension
- Pronunciation
- Functional English in formal and Informal Situations
- Interpersonal Communication Skills
- Presentation Skills

List of Experiments

UNIT I: Listening Comprehension

UNIT II: Pronunciation , Stress, Intonation & Rhythm

UNIT III: Common Everyday Situations: Conversations & Dialogues, Communication at Workplace

UNIT IV: Interpersonal Communication Skills- Group discussions and debates

UNIT V: Formal Presentations

Outcomes:

By the end of the course the students will be able to acquire basic Proficiency in English by practicing the following:

- Listening Comprehension
- Pronunciation
- Dialogues
- Interpersonal Communication Skills
- Presentation Skills
- Discussions and Debates

Learning Resources:

- Interact – English Lab Manual for Undergraduate Students by Orient BlackSwan
- Ted Talks, Interviews with Achievers and select movies
- Toastmaster's speeches and table topics
- Book Reviews and movie reviews
- Exercises in Spoken English Parts: I-III, CIEFL, Hyderabad.
- Oxford Guide to Effective Writing and Speaking by John Seely
- https://www.ted.com/talk

Course Outcomes Vs Program Outcomes Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	-	-	-	-	-	-	-	-	-	2	-	-
2	-	-	-	-	-	-	-	-	-	3	-	-
3	-	-	-	-	-	-	-	-	-	3	-	-
4	-	-	-	-	-	-	-	-	-	2	-	-
5	-	-	-	-	-	-	-	-	-	3	-	-
6	-	-	-	-	-	-	-	-	-	2	-	-

BASIC ELECTRICAL ENGINEERING LABORATORY

(Common to All)

SEMESTER II

Subject Code	21CMEEL2070	IA Marks	15
Number of Lecture Hours/Week	3P	Exam Marks	35
Total Number of Lecture Hours	36	Exam Hours	03

Credits-1.5

Course Objectives:

This course will enable the student to

1. Verify the Kirchhoff's laws, network theorems for a given circuit.
2. Analyze the performance of DC shunt generator.
3. Control the speed of DC motor.
4. Predetermine the efficiency DC machine.
5. Analyze performance of three phase induction motor.
6. Determine the regulation of an alternators.

List of Experiments(Any ten experiments must be conducted)

1. Verification of Kirchoff's laws.
2. Verification of Thevenin's Theorem.
3. Verification of Norton's Theorem.
4. Verification of Superposition theorem.
5. Verification of Maximum Power Transfer Theorem.
6. Speed control of D.C. shunt motor.
7. Brake test on DC shunt motor.
8. Calibration of wattmeter.
9. OC & SC tests on single-phase transformer.
10. Brake test on 1-phase Induction motor.
11. Brake test on 3-phase Induction motor.
12. Study experiment on Ear thing.

COURSE OUTCOMES:

On completion of the course student will be able to:

1. Verify the Kirchoff's laws.
2. Verify network theorems for a given circuit.
3. Control the speed of DC motor.
4. Analyze performance of single phase induction motor
5. Analyze performance of three phase induction motor.
6. Identify different types of earthling's

Question paper pattern:

Ten questions are given, and student should choose one question (blind option), which carries 50 marks in total.

a. 15 marks are allotted for procedure including circuit diagrams and model graphs.
b. 15 marks for conduction of the experiment.
c. 10 marks for results and conclusions.
d. 10 marks for viva voce

COURSE-OUTCOMES-TO-PROGRAM-OUTCOMES-MAPPING:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			2												
CO2			2												
CO3			2												
CO4			2												
CO5			2												
CO6			2												
Overall Course			**2**												

ENGINEERING WORKSHOP LAB SEMESTER II			
Subject Code	21ETMEL2080	IA Marks	15
Number of Lecture Hours/Week	L(0)+T(0)+P(3)	Exam Marks	35
Total Number of Lecture Hours	36	Exam Hours	3
Credits – 1.5			

Course objectives: On completion of the course students should be able to

1. Learn basic use of hand tools along with the techniques and methods applicable to the carpentry trade
2. Learn basic use of hand tools along with the techniques and methods applicable to the fitting trade
3. Learn basic use of hand tools along with the techniques and methods applicable to the forging trade
4. Learn basic use of hand tools along with the techniques and methods applicable to the casting trade
5. Learn basic use of hand tools along with the techniques and methods applicable to the welding trade

EXPERIMENTS

1. Preparation of T Lap joint using carpentry.
2. Preparation of Cross Lap joint using carpentry.
3. Preparation of Square fit using mild steel specimen.
4. Preparation of V fit using mild steel specimen.
5. Conversion of round rod to square rod by forging operation.
6. Preparation of *S* hooks by forging operation.
7. Preparation of green sand mould for a single piece pattern
8. Preparation of green sand mould for a split piece pattern
9. Preparation of a Butt joint using arc welding
10. Preparation of a Lap joint using arc Welding

ADDITIONAL EXPERIMENTS

1. Preparation of electrical wiring connections using wiring (one lamp controlled by one switch)

Course outcomes: On successful completion of this course, the students will be able to

1. Perform the joinery work of wooden pieces using carpentry.
2. Perform the joinery work of metallic pieces using fitting.
3. Produce the required shaped metallic products using black smithy.
4. Make the green sand moulds using different patterns
5. Fabricate different components using welding.

Question paper pattern:

Ten questions are given, and student should choose one question (blind option), which carries 50 marks in total.

a. 15 marks are allotted for procedure including circuit diagrams and model graphs.
b. 15 marks for conduction of the experiment.
c. 10 marks for results and conclusions.
d. 10 marks for viva voce.

COs vs POs MAPPING (HIGH: 3; MEDIUM: 2; LOW: 1)

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2								2					
CO2	2								2				2	
CO3	2								2				2	
CO4	2								2				2	
CO5	2								2					
CO6	1								1				1	
Course	**2**								**2**				**2**	

ENVIRONMENTAL SCIENCE

SEMESTER II

Subject Code	21CMCHN2090	IA Marks	30
Number of Lecture Hours/Week	2	Exam Marks	70
Total Number of Lecture Hours	32	Exam Hours	03

Credits – 00

COURSE OBJECTIVES:

The objectives of this course, help the students to

1. Acquire knowledge on global environmental challenges.
2. Learn different types of natural resources
3. Create awareness on biodiversity and ecology.
4. Gain scientific knowledge on environmental pollution
5. Acquire knowledge on water conservation methods and environmental legislation

Unit -1	**Hours**
MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES **Environment -** Definition, Introduction - Scope and Importance - Global environmental challenges, global warming & climate change - Acid rains, ozone layer depletion - Role of Information Technology in Environment and human health.	**6**
Unit -2	
NATURAL RESOURCES Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use, deforestation - Timber extraction – Mining, dams and other effects on forest and tribal people Water resources – Floods, drought, , dams – benefits and problems Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. Food resources: Effects of modern agriculture - fertilizer-pesticide problems, water logging, eutrophication, biological magnification and salinity. Energy resources: Renewable and non-renewable energy resources	**6**

Role of an individual in conservation of natural resources.	
Unit – 3	
ECOSYSTEM AND BIODIVERSITY **Ecosystem** - Concept of an ecosystem. - Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem - Food chains, food webs and ecological pyramids. - Introduction, types, characteristic features, structure and function of the Forest and grassland ecosystem. **Biodiversity** - Introduction - Definition: genetic, species and ecosystem diversity. – Value of biodiversity: consumptive use, productive use, social, ethical and optional values - Hot-spots of biodiversity - Threats to biodiversity: habitat loss - Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.	**8**
Unit – 4	
ENVIRONMENTAL POLLUTION Definition, Cause, effects and control measures of : a. Air pollution b. Water pollution c. Soil pollution d. Noise pollution e. Nuclear hazards Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution.	**6**
Unit – 5	
SOCIAL ISSUES AND THE ENVIRONMENT Urban problems related to energy -Water conservation, rain water harvesting, Resettlement and rehabilitation of people its problems and concerns. Environment Protection Act - Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act .	**6**
COURSE OUTCOMES:	

On completion of the course student will be able to

1. Obtain knowledge on global warming & climate change - Acid rains, ozone layer depletion.
2. Preserve several natural resources
3. Summarize the concept of ecosystem
4. Control different types of pollution
5. Understand social issues and environmental legislation

Question paper pattern:

1. Question paper consists of 10 questions.
2. Each full question carrying 14 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit.

TEXT BOOKS:

1. E. Bharucha (2003), "Environmental Studies", University Publishing Company, New Delhi.
2. J.G. Henry and G.W. Heinke (2004), "Environmental Science and Engineering", Second Edition, Prentice Hall of India, New Delhi.
3. G.M. Masters (2004)" Introduction to Environmental Engineering and Science", Second Edition, Prentice Hall of India, New Delhi

REFERENCE BOOKS:

1. Text Book of Environmental Studies by Deeksha Dave & P. Udaya Bhaskar, Cengage Learning.
2. Environmental Studies by K.V.S.G. Murali Krishna, VGS Publishers, Vijayawada.
3. Environmental Studies, P.N. Palaniswamy, P. Manikandan, A. Geeta and K. Manjula Rani, Pearson Education, Chennai.

COURSE OUTCOMES TO PROGRAM OUTCOMES MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
5	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Course	2	3	2	-	-	-	2	-	-	-	-	-	-	-	-

MATHEMATICS-III

(Vector Calculus and Complex analysis)

(Syllabus for the Academic Year 2021 -2022)

Common to CE, EEE, ME, ECE and ECT

SEMESTER - II/I

Subject Code	21CMMAT3010/20	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:

- To Interpret the physical meaning of different operators such as gradient, curl and divergence.
- To Estimate the work done against a field, verify integral theorems.
- To apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic
- To find the differentiation and integration of complex functions used in engineering problems.
- To make use of the Cauchy residue theorem to evaluate certain integrals.

Unit -1	
Vector Differentiation: Gradient– Directional derivative – Divergence – Curl - Scalar Potential .	**Hours – 08**
Unit -2	
Vector Integration: Line integral - Work done – Area - Surface and volume integrals – Vector integral theorems: Greens, Stokes and Gauss Divergence theorems (without proof) and problems on above theorems.	**Hours – 10**
Unit – 3	
Function of a complex variable Introduction –continuity –differentiability- analyticity – properties – Cauchy – Riemann equations in Cartesian and polar coordinates. Harmonic and conjugate harmonic functions – Milne – Thompson method.	**Hours – 10**
Unit – 4	
Integration and series expansions Complex integration: Line integral – Cauchy's integral theorem, Cauchy's in integral formula, generalized integral formula (all without proofs) Radius of convergence – expansion in Taylor's series, Maclaurin's series and Laurent series.	**Hours – 10**
Unit – 5	
Singularities and Residue Theorem Zeros of an analytic function, Singularity, Isolated singularity, Removable singularity, Essential singularity, pole of order m, simple pole, Residues, Residue theorem, Calculation of residues, Residue at a pole of order m**,** Evaluation of real definite integrals: Integration around the unit circle**,** Integration around semi circle.	**Hours – 10**

Course outcomes:

On completion of this course, students are able to

1. Interpret the physical meaning of different operators such as gradient , curl and divergence(L5)
2. Estimate the work done against a field, and verify integral theorems (L5)
3. apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic (L3)
4. find the differentiation and integration of complex functions used in engineering problems(L3)
5. make use of the Cauchy residue theorem to evaluate certain integrals (L3)

Question paper pattern:

Question paper consists of 10 questions.

9. Each full question carrying 14 marks.
10. Each full question will have sub question covering all topics under a unit.
11. The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. B. V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. Srimantha Pal, S C Bhunia, Engineering Mathematics, Oxford University Press.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 9th edition,
4. N.P.Bali and Manish Goyal, "A text book of Engineering mathematics", Laxmi publications, 7th Edition.
5. H.K. Dass and Er. RajnishVerma, "Higher Engineerig Mathematics", S.Chand publishing, 1st edition, 2011.

Course Structure for II B.Tech ECT Under the Regulations of SITE-21							
Semester -III							
S.No	**Course Code**	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
1	BS	21ECMAT3010	Engineering Mathematics - III	3	0	0	3
2	BS	21ETETT3020	Probability Theory & Stochastic Processes	3	0	0	3
3	PC	21ETETT3030	Semiconductor Devices	3	0	0	3
4	PC	21ETETT3040	Digital System Design	3	0	0	3
5	PC	21ETETT3050	Signals & Systems	3	0	0	3
6	PC	21ETETL3060	Semiconductor Devices Lab	0	0	3	1.5
7	PC	21ETETL3070	Digital System Design Lab	0	0	3	1.5
8	PC	21ETETL3080	Electrical circuits Lab	0	0	3	1.5
9	SOC	21ETETS3090	Skill Oriented Course –I (Data Science Using Python) **OR** (MATLAB FOR Engineers)	1	0	2	2
TOTAL							**21.5**

Course Structure for II B.Tech ECT Under the Regulations of SITE-21

Semester -IV

S.No	Course Code	Subject Code	Course	L	T	P	C
1	PC	21ETETT4010	Management Science	3	0	0	3
2	PC	21ETETT4020	EM Waves & Transmission Lines	3	0	0	3
3	PC	21ETETT4030	Principles of Communication Theory	3	0	0	3
4	PC	21ETETT4040	Electronic Circuit Analysis	3	0	0	3
5	HS	21CMMST4050	Control Systems	3	0	0	3
6	PC	21ETETL4060	Principles of Communication Lab	0	0	3	1.5
7	PC	21ETETL4070	Electronic Circuit Analysis Lab	0	0	3	1.5
8	PC	21ETETL4080	Signals and systems Lab	0	0	3	1.5
9	SOC	21ETETS4090	Skill Oriented Course -2 (Internet of Things (IOT)) **OR** (PCB Designing)	1	0	2	2
10	MC	21ETETN40A0	Pulse and Digital Circuits	2	0	0	0
Total							**21.5**
11		21ETETHXXX 21ETETMXXX	Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also	4	0	0	4

PROBABILITY THEORY & STOCHASTIC PROCESSES Common to ECE & ECT SEMESTER III			
Subject Code	21ECECT3020, 21ETETT3020	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite	Engineering Mathematics	**Credits – 03**	

Course Objectives:

This course will enable students

1. To understand the concepts of Probability Theory and Random Variables.
2. To apply statistical operations and transformations on one Random Variable.
3. To extend the concept of one random variable to multiple random variables and Apply statistical operations and transformations on multiple Random Variables.
4. To characterize the random processes in the time domain.
5. To characterize the random processes in the frequency domain and analyze the LTI systems with random inputs.

Unit -1	**Hours**
Review of Probability Theory: Introduction, Review of Probability Theory, Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete, Continuous and Mixed Random Variables, Distribution and Density functions, Properties, Poisson, Gaussian, Rician and Rayleigh Distributions.	**8**
Unit -2	
Operation on One Random Variable – Expectations: Introduction, Expected Value of a Random Variable, Function of a Random Variable, Moments about the Origin, Central Moments, Variance and Skew, Chebychev's Inequality, Characteristic Function, Moment Generating Function, Transformations of a Random Variable: Monotonic Transformations for a Continuous Random Variable, Non monotonic Transformations of Continuous Random Variable. Transformation of a Discrete Random Variable.	**10**
Unit – 3	
Multiple Random Variables: Vector Random Variables, Joint Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables, Central Limit Theorem: Unequal Distribution, Equal Distributions. **Operations on Multiple Random Variables**: Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables: Two Random Variables case, N Random Variables case, Properties, Transformations of Multiple Random Variables.	**10**
Unit – 4	
Random Processes – Temporal Characteristics: The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, Concept of Stationarity and Statistical Independence. First-Order Stationary Processes, Second-order and Wide-Sense Stationarity, N^{th}-order and Strict-Sense Stationarity, Time Averages and Ergodicity, Autocorrelation Function and its Properties, Cross-Correlation	**10**

Function and its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process.	
Unit – 5	
Random Processes – Spectral Characteristics: The Power Density Spectrum: Properties,Relationship between Power Density Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Density Spectrum and Cross-Correlation Function. **Linear Systems With Random Inputs:** Random Signal Response of Linear Systems: SystemResponse – Convolution, Mean and Mean-squared Value of System Response, Autocorrelation Function of Response, Cross-Correlation Functions of Input and Output, Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectra of Input and Output .	**10**
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Understand the concepts of Probability Theory and Random Variables.
2. Apply statistical operations and transformations on one Random Variable.
3. Extend the concept of one random variable to multiple random variables and Apply statistical operations and transformations on multiple Random Variables.
4. Characterize the random processes in the time domain.
5. Characterize the random processes in the frequency domain and analyze the LTI systems with random inputs.

Text Books:

1. Peyton Z. Peebles, Probability, "Random Variables & Random Signal Principles", 4th Edition, TMH, 2001.
2. Papoulis and S.Unnikrisha, "Probability, Random Variables and Stochastic Processes", 4th Edition, PHI, 2002.

Reference Books:

1. Henry Stark and John W. Woods, "Probability and Random Processes with Applications to Signal Processing", 3rd Edition, Pearson Education.
2. Gardener W.A, "Introduction to Random Processes with Applications to Signals and Systems", 2nd Edition, McGraw-Hill.

Web References:

1. https://nptel.ac.in/courses/117105085/
2. https://ocw.mit.edu/courses/mathematics/18-440-probability-and-random-variables-spring-2014/

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	-	-	-	-	-	-	-	-	-	-	3	-
2	3	2	-	-	-	-	-	-	-	-	-	-	-	1	-
3	3	2	-	-	-	-	-	-	-	-	-	-	-	1	-
4	3	2	-	-	-	-	-	-	-	-	-	-	-	1	-
5	3	2	-	-	-	-	-	-	-	-	-	-	-	3	-
6	3	1	-	-	-	-	-	-	-	-	-	-	-	2	-
Course	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**

S.No.	Unit Name	Text Book / Reference	Chapter No.
1	Review of Probability Theory & The Random Variable	T1	1 & 2
		T2	1,2 & 4
		R1	1 & 2
		R2	1 & 2
2	Operation on One Random Variable – Expectations	T1	3
		T2	5
		R1	3 & 4
3	Multiple Random Variables	T1	4 & 5
		T2	6
		R2	4
4	Random Processes – Temporal Characteristics	T1	6
		T2	9,12 & 14
5	Random Processes – Spectral Characteristics & Linear Systems With Random Inputs	T1	7 & 8

SEMI CONDCUTOR DEVICES
Common to ECE & ECT
SEMESTER III

Subject Code	21ECECT3030, 21ETETT3030	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Engineering Physics	Credits – 03	

Course Objectives:

This course will enable students to

- The basic concepts of semiconductor physics are to be reviewed.
- Study the physical phenomena such as conduction, transport mechanism and electrical characteristics of PN Junction diodes.
- Basic principle and operation of different semiconductor devices.
- The application of diodes as rectifiers with their operation and characteristics with and without filters are discussed.
- The principal of working and operation of different Transistors and their characteristics are explained.
- The need of transistor biasing and its significance is explained.

Unit -1	**Hours**
Semi-Conductor Physics : Energy band diagram of Insulators, Semi-conductors and conductors, Intrinsic and extrinsic semiconductors, electrons and holes in intrinsic semi-conductors and extrinsic semi-conductors, Carrier transport: diffusion current, drift current, mobility and resistivity; charge densities in semiconductors, Poisson and continuity equations, law of junction, Fermi Dirac function, Fermi level in intrinsic and extrinsic Semiconductors, Hall effect.	09
Unit -2	
Junction Diode Characteristics: Open circuited p-n junction, Biased p-n junction, p-n junction diode, current components in PN junction Diode, diode equation, V-I Characteristics, temperature dependence on V-I characteristics, static and dynamic resistance, transition and diffusion capacitance, energy band diagram of PN junction Diode, Breakdown mechanisms, Construction and operation of Zener Diode, Varactor diode and Tunnel Diode, Zener diode as a voltage regulator.	10
Unit -3	
Transistor Characteristics: Bipolar Junction transistor, transistor current components, transistor equation, transistor configurations, common Base, common Emitter and common Collector configurations, Ebers-Moll model of a transistor, punch through/ reach through, typical transistor junction voltage values, FET types, construction, operation, characteristics, parameters, MOSFET-types, construction, operation, characteristics, Construction and operation of SCR, UJT and IGBT.	11
Unit – 4	
Building blocks of regulated power supply: Block diagram of regulated power supply, half wave rectifier, full wave rectifier, bridge rectifier, rectifier circuits-operation, input and output waveforms, different parameters of rectifiers, Inductor filter, Capacitor filter, L- section filter, Π- section filter, Multiple L- section and Multiple Π section filter ,comparison of various filter circuits, series and shunt voltage regulators.	11
Unit – 5	

Transistor Biasing and Thermal Stabilization : Need for biasing, operating point, load line analysis, BJT biasing- methods, basic stability, fixed bias, collector to base bias, self-bias, Stabilization against variations in V_{BE}, I_{co}, and β, Stability factors, (S, S' , S''), Compensation Techniques, Thermal runaway, Thermal stability. FET Biasing- methods and stabilization.	09

Course outcomes:

On completion of the course student will be able to

1. Understand the basic concepts of semiconductor physics.
2. Understand the different diodes and its behavior.
3. Understand the construction, principle of operation of Bipolar junction Transistor and their V-I characteristics in different configurations.
4. Understand the construction, principle of operation and characteristics of FET, UJT and SCR.
5. Know the construction, working principle of rectifiers with and without filters with relevant expressions and necessary comparisons.
6. Know the need of transistor biasing, various biasing techniques for BJT and FET and stabilization concepts with necessary expressions.

Text Books:

1. Jacob Millman, C. Halkies, C.D.Parikh, "Integrated Electronics", Tata Mc-Graw Hill, 2009.
2. G. Streetman and S. K. Banerjee, "Solid State Electronic Devices", 2nd edition, Pearson, 2014.

Reference Books:

1. Robert L Boyelstad, LovisNashelsky, "Electronic Devices & Theory", 10th edition
2. David A Bell, "Electronic Devices and Circuits", 5th Edition, Oxford Publications
3. J. Millman, C. Halkias, "Electronic Devices and Circuits", 3rd Edition, Tata Mc-Graw Hill.
4. Salivahanan, Kumar, Vallavaraj, "Electronic Devices and Circuits", 2nd Edition, Tata Mc-Graw Hill.

Course Outcomes to Program Outcomes mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
2	3	2	-	-	-	-	-	-	-	-	-	-	2	-	2
3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	2
4	3	2	-	-	-	-	-	-	-	-	-	-	2	-	2
5	2	1	1	-	-	-	-	-	-	-	-	-	1	-	-
6	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
Course	3	2	1	-	-	-	-	-	-	-	-	-	1	-	1

S.No.	Unit Name	Text Book/ Reference	Chapter No.
1.	Semi-Conductor Physics	T1	2
		T2	3
		R4	4
2.	Junction Diode Characteristics	T1	3
3.	Transistor Characteristics	T1	5,10,18
		T2	6,7
		R3	7,12
4.	Building blocks of regulated power supply	T1	4
		R1	2
5.	Transistor Biasing and Thermal Stabilization	T1	9
		R2	5

DIGITAL SYSTEM DESIGN

Common to ECE & ECT
SEMESTER III

Subject Code	21ECECT3040, 21ETETT3040	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	---	**Credits – 03**	

Course Objectives:

This course will enable students to

- Learn the basic concepts of number systems and their conversions
- Learn the Boolean algebra and digital logic minimization techniques
- Understand the VHDLprogramming for the design and implementation of combinational logic circuits
- Design and analyze Sequential logic circuits
- Design various digital systems with the help of FSM using HDL

Unit -1	**Hours**
Digital Fundamentals : Analog Vs Digital; Merits of Digital System; Number systems; Base conversions; Number representations: Binary, Integer and Floating point; Complements of numbers; Weighted and Unweighted codes; Boolean algebra; Logic gates; Canonical and Standard forms; Minimization and realization of switching functions using Boolean theorems, NAND – NAND, NOR-NOR Implementations.	08
Unit -2	
Combinational Logic Design-I: K-Map (up to 5 variables), Design of Half adder, full adder, half subtractor, full subtractor, applications of full adders; 4-bit adder-subtractor circuit, BCD adder circuit, Excess 3 adder circuit and carry look-ahead adder circuit, Design code converts using Karnaugh method and draw the complete circuit diagrams. **VHDL Coding styles:** Lexical Conventions, Basic Architecture, Operators, Gate Level Modelling, Data Flow Modelling and Behavioral level Modelling of Adders and code converters	10
Unit -3	
Combinational Logic Design - II: Design of encoder, decoder, multiplexer and de-multiplexers, Implementation of higher order circuits using lower order circuits. Realization of Boolean functions using decoders and multiplexers. Design of Priority encoder, 4-bit digital comparator and Seven segment decoder. **INTRODUCTION OF PLD's :** PROM, PAL, PLA -Basics structures, realization of Boolean functions, Programming table Gate Level Modelling, Data Flow Modeling and Behavioral level Modelling of decoders, encoders, multiplexers and de-multiplexers using VHDL	12
Unit – 4	
Sequential Logic Design: Operation of NAND & NOR Latches and flip-flops; truth tables and excitation tables of RS flip-flop, JK flipflop, T flip-flop, D flip-flop with reset and clear terminals. Conversion of flip- flops. Design of ripple counters, design of synchronous counters, Johnson counter, ring counter. Design of registers - shift register, universal shift, register.	10

Gate Level Modeling and Behavioral level Modeling of counters and registers using VHDL	
Unit – 5	
Finite State Machines, Logic Families: State diagram, state assignment, state minimization, Design of Mealy and Moore FSM - Sequence Detection. Behavioral level Modeling of Mealy and Moore FSM using VHDL **Logic Families:** Characteristic parameters, Transistor-Transistor logic, TTL subfamilies, CMOS logic family, Implementation of Boolean function using CMOS logic	10
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Understand the basic number systems and conversions.
2. Apply the Boolean algebra to optimize the logic functions using K-maps and to understand the basic concepts of VHDL.
3. To design and analyze combinational logic circuits, PLDs
4. To design and analyze sequential logic circuits.
5. To design combinational and sequential logic circuits using mealy and more machines

Text Books:

1. Morris Mano, Michael D Ciletti , "Digital Design" , 4thEdition, PEA
2. John F. Wakerly, "Digital Design Principles & Practices", 3rdEdition PHI/ Pearson Education Asia, 2005.
3. C.H. Roth Jr and L.L. Kinney, "Fundamentals of Logic Design", 7th edition, Cengage Learning, 2014.

Reference Books:

1. W R.P. Jain, "Modern Digital Electronics", Tata McGraw-Hill, 4th edition, 2008.
2. C.H. Roth Jr, "Digital System Design using VHDL", Indian Edition, Thomson Books, 2006.
3. Stephen Brown, ZvonkocVranesic, "Fundamentals of Digital Logic with VHDL Design", TMH, 2nd Edition., IEEE Press, 2004.

Simulation Books

1. R.S.Sandige, M.L.Sandige, "Fundamentals of Digital and Computer Design with VHDL", TMH, First edition, 2012.
2. J Baskar, "VHDL Primer", Prentice Hall, 3rd edition, 2002.

SIGNALS & SYSTEMS Common to ECE & ECT SEMESTER III			
Subject Code	21ECECT3050, 21ETETT3050	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite	Engineering Mathematics-III	**Credits – 03**	

Course Objectives:

This course will enable students to:

- Know the concepts of signals and systems and perform operations on LTI systems.
- Analyze frequency domain representation of signals and systems using transforms.
- Learn the process of sampling and various sampling techniques.

Unit -1	**Hours**
Introduction: Introduction to Signals and Systems, Singularity functions and related functions-Exponential and Sinusoidal signals. Operations on Signals, Classification of Signals, Classification of Systems. Analogy between vectors and signals, Orthogonal signal space, Signal approximation using Orthogonal functions, Mean square error, Closed or complete set of Orthogonal functions, Orthogonality in complex functions.	**10**
Unit -2	
Fourier Series: Fourier Series representation of continuous time periodic signals, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series Representations, Properties of Fourier series, Relation between Trigonometric and Exponential Fourier series. **Fourier Transform**: Complex Fourier spectrum, Deriving Fourier transform from Fourier series, Fourier transform of standard signals, Properties of Fourier transforms Fourier transform of periodic signals, Introduction to Hilbert Transform.	**12**
Unit – 3	
Analysis of Linear Systems: Introduction**, I**mpulse response, Response of a linear system, Linear Time Invariant (LTI) systems. Concept of Convolution in time domain and frequency domain, Graphical representation of Convolution, Transfer function of a LTI system. **Correlation:** Cross-correlation and Auto-correlation of functions, Properties of correlation function, Energy density spectrum, Parseval's theorem, Power density spectrum, Relation between auto correlation function and energy/power spectral density function. Relation between Convolution and Correlation. Detection of periodic signals in the presence of noise by Correlation.	**10**
Unit – 4	
Sampling Theorem: Representation of Band limited CT signal by its samples: The Sampling theorem, Impulse sampling, Natural and Flat-top Sampling, Reconstruction of signal from its samples, effect of under sampling –Aliasing, Introduction to Band Pass sampling. Review of Laplace Transforms, Properties of Laplace Transforms, Relation	**8**

between LT and FT of a signal.	
Unit – 5	
Z-Transforms: Discrete time Complex Exponential and Sinusoidal signals, Periodicity properties of discrete time Complex Exponential signal. Concept of Z-Transform of a discrete time sequence. Region of convergence (ROC) of Z-Transform and Properties of ROC for various classes of signals. Properties of Z-Transforms. Inverse Z-Transform. Distinction between Laplace, Fourier and Z-Transforms.	**8**
Total	**48**

Course outcomes:

On completion of the course student will be able to

1. Illustrate various signals and systems and their properties.
2. Make use of Fourier analysis for frequency domain representation of signals
3. Solve the response of LTI system through Convolution and Correlation.
4. Construct Sampling theorem for signal conversion.
5. Apply Z-Transform for the analysis of discrete-time signals.

Text Books:

1. A.V. Oppenheim, A.S. Willsky and S.H. Nawab, "Signals and Systems", 2nd Edition, PHI, 2009.
2. B.P. Lathi, "Signal Processing & Linear Systems", 1st Edition, Oxford University Press, 2006.
3. A. Anand Kumar, "Signals and Systems", 3rd Edition, PHI Publications, 2013.

Reference Books

1. Simon Haykin and Van Veen, "Signals & Systems", 2nd Edition, John Wiley India, 2011.
2. M. J. Roberts, "Analysis using Transform methods and MATLAB", 1st Edition, TMH, 2005.

Web References:

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-003-signals-and-systems-fall-2011/lecture-videos/
2. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/
3. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/
4. https://nptel.ac.in/courses/117104074/

SEMI CONDUCTOR DEVICES LAB

Common to ECE & ECT

SEMESTER III

Subject Code	21ECECL3060, 21ETETL3060	Internal Marks	15
Number of Lecture Hours/Week	03	External Marks	35
Total Number of Hours	36	Exam Hours	03

Credits – 1.5

Course Objectives:

This course will enable students to

- Identification and testing various passive components and active devices.
- Study the operation of multimeter, function generator, regulated power supply and CRO.
- Introduce the operation of diodes and transistors.
- Perform soldering and DE soldering of different components and wires.

Unit -1	**Hours**
List of Experiments: 1. Identification and testing of various components. 2. Study the operation of multimeter, function generator, regulated power supply and Cathode Ray Oscilloscope. 3. PN junction diode characteristics. 4. Zener Diode Characteristics. 5. Half-wave Rectifier with and without filter. 6. Full-wave Rectifier with and without filter. 7. Common Emitter configuration: Input and Output characteristics. 8. Common source configuration: Drain and Transfer characteristics. 9. Transistor Biasing. 10. Soldering Practice. 11. Design of Printed Circuits Board for Regulated Power supply. 12. Design of Printed Circuits Board for CE Amplifier.	**36**

Course outcomes:

On completion of the course student will be able to

1. Identify different components.
2. Know the operation of multimeter, function generator, regulated power supply and CRO.
3. Analyze the characteristics of Semiconductor devices and circuits.
4. Design printed circuit boards for different circuits.

DIGITAL SYSTEM DESIGN LAB

Common to ECE & ECT

SEMESTER III

Subject Code	21ECECL3070, 21ETETL3070	Internal Marks	15
Number of Lecture Hours/Week	03	External Marks	35
Total Number of Hours	36	Exam Hours	03

Credits – 1.5

Course Objectives:

This course will enable students to

- Design various combinational circuits using logic gates.
- Design various sequential circuits using logic gates.
- Understand the use of VHDL in Digital systems design.

List of Experiments:	**Hours**
1. Realization of Logic Gates. 2. Design of code converters 3. Adders 4. Subtractors 5. Multiplexers. 6. Encoders 7. Decoders 8. D Flip-Flop. 9. Synchronous and Asynchronous counters 10. Shift registers. 11SRAM 12 Sequence Detector 13. ALU Design	**36**

Course outcomes:

On completion of the course student will be able to

1. Design of Logic Gates and code converters
2. Design and analysis of basic arithmetic logic circuits.
3. Design and analysis of combinational logic circuits
4. Design and analysis of Sequential logic circuits
5. Design of memory elements
6. Design of complex logic circuits using Finite State Machines

ELECTRICAL CIRCUITS LAB

Common to ECE & ECT

SEMESTER III

Subject Code	21ECECL3080, 21ETETL3080	Internal Marks	15
Number of Lecture Hours/Week	03	External Marks	35
Total Number of Hours	36	Exam Hours	03

Credits – 1.5

Course Objectives:

This course will enable students to

- Understand the concepts of design and analysis of Electrical circuits.
- Analyze the electrical circuits using various circuit analysis techniques
- Determine the transient response of R-L-C Networks
- Analyze two port networks and determine filter characteristics

The students are required to design the electrical circuits to verify the laws, theorems, two port parameters, time response of AC circuits and have to experimentally find the results. Experimental results should be verified with theoretical values.	**Hours**
List of Experiments: **Part-A: Computation of two port network parameters and transients** 1. Two port network parameters – Z-Y Parameters and analytical verification. 2. Two port network parameters – Hybrid & ABCD parameters, Analytical verification. 3. Transient response of RL & RC Networks for DC and AC Inputs 4. Transient response of RLC Circuit for DC and AC inputs. **Part-B: Simulation of electrical networks using PSPICE** 5. Introduction to PSPICE and verification of Kirchhoff's laws for basic electrical networks. 6. Simulation of DC Electrical circuits and verification using Kirchhoff's laws 7. Simulation of AC Electrical circuits and verification using Kirchhoff's laws 8. Verification of Thevenin's and Norton's equivalent circuits using PSPICE. Verification on DC with Resistive loads 9. Verification of Thevenin's and Norton's equivalent circuits using PSPICE. Verification on AC with Reactive loads 10. Transient Response of RLC Circuits for DC and AC Inputs 11. Determination of Two port network parameters 12. Low pass and High Pass Filter characteristics	**36**

Course outcomes:

On completion of the course student will be able to

1. Analyze complex DC and AC linear circuits.
2. Apply concepts of electrical circuits across engineering.
3. Analyze the given electrical network by using PSPICE Simulation tool.

SKILL ORIENTED COURSE-I **Data Science using Python** SEMESTER III			
Subject Code	21ETETS3090	Internal Marks	0
Number of Lecture Hours/Week	02	External Marks	50
Total Number of Practical Hours/Week	32	Exam Hours	03
Pre-requisite	Technical English	Credits – 02	

Course Objectives:

The main objective of the course is to inculcate the basic understanding of Data Science and it's practical implementation using Python. on.

Course Outcomes:	**Teaching Hours**
On the completion of this laboratory course, the students will be able to Upon successful completion of the course, the student will be able to: • Perform various operations on numpy arrays. • Importing data from different file formats using pandas. • Draw different types of charts using matplotlib.	**32**

	List of Experiments :
1	Creating a NumPy Array a. Basic ndarray b. Array of zeros c. Array of ones d. Random numbers in ndarray e. An array of your choice f. Imatrix in NumPy g. Evenly spaced ndarray
2	The Shape and Reshaping of NumPy Array a. Dimensions of NumPy array b. Shape of NumPy array c. Size of NumPy array d. Reshaping a NumPy array e. Flattening a NumPy array f. Transpose of a NumPy array
3	Expanding and Squeezing a NumPy Array a. Expanding a NumPy array b. Squeezing a NumPy array c. Sorting in NumPy Arrays
4	Indexing and Slicing of NumPy Array a. Slicing 1-D NumPy arrays b. Slicing 2-D NumPy arrays c. Slicing 3-D NumPy arrays d. Negative slicing of NumPy arrays
5	Stacking and Concatenating Numpy Arrays a. Stacking ndarrays b. Concatenating ndarrays c. Broadcasting in Numpy Array
6	Perform following operations using pandas a. Creating dataframe b. concat() c. Setting conditions

	d. Adding a new column
7	Perform following operations using pandas a. Filling NaN with string b. Sorting based on column values c. groupby()
8	Read the following file formats using pandas a. Text files b. CSV files c. Excel files d. JSON files
9	Read the following file formats a. Pickle files b. Image files using PIL c. Multiple files using Glob d. Importing data from database
10	Demonstrate web scraping using python
11	Perform following preprocessing techniques on loan prediction dataset a. Feature Scaling b. Feature Standardization c. Label Encoding d. One Hot Encoding
12	Perform following visualizations using matplotlib a. Bar Graph b. Pie Chart c. Box Plot d. Histogram e. Line Chart and Subplots f. Scatter Plot

Web References:

1. https://www.analyticsvidhya.com/blog/2020/04/the-ultimate-numpy-tutorial-for-data-science-beginners/
2. https://www.analyticsvidhya.com/blog/2021/07/data-science-with-pandas-2-minutes-guide-to-key-concepts/
3. https://www.analyticsvidhya.com/blog/2020/04/how-to-read-common-file-formats-python/
4. https://www.analyticsvidhya.com/blog/2016/07/practical-guide-data-preprocessing-python-scikit-learn/

SKILL ORIENTED COURSE-I
MATLAB FOR Engineers
SEMESTER III

Subject Code	18ETETS3090	Internal Marks	0
Number of Lecture Hours/Week	02	External Marks	50
Total Number of Practical Hours/Week	32	Exam Hours	03
Pre-requisite	Programming Skills	Credits – 02	

Course Objectives:

- To learn features of MATLAB as a programming tool.
- To promote new teaching model that will help to develop programming skills and technique to solve mathematical problems.
- To understand MATLAB graphic feature and its applications.
- To use MATLAB as a simulation tool.

Course Outcomes:
On the completion of this laboratory course, the students will be able to
1. Understand MATLAB environment , variables and arrays
2. Understand MATLAB Functions includes user defined and built-in functions
3. Use graphics , 2D, 3D Plotting and handling graphics
4. Programme using MATLAB – conditional statements, programming and Debugging, applications.
5. Understand mathematical computing with MATLAB

Teaching Hours 32

List of experiments

1	**Introduction to MATLAB** a. The MATLAB Environment b. MATLAB Basics – Variables, Numbers, Operators, Expressions, Input and output c. Vectors, Arrays – Matrices
2	**MATLAB Functions** a. Built-in Functions b. User defined Functions
3	**Graphics with MATLAB** a. Files and File Management – Import/Export b. Basic 2D, 3D plots c. Graphic handling
4	**Programming with MATLAB** a. Conditional Statements, Loops b. MATLAB Programs – Programming and Debugging. c. Applications of MATLAB Programming
5	**Mathematical Computing with MATLAB** a. Algebraic equations b. Basic Symbolic Calculus and Differential equations c. Numerical Techniques and Transforms

Reference Books:

1. "A Guide to MATLAB - for Beginners and Experienced Users", 2nd Ed., Brian R. Hunt, Ronald L.
Lipsman, Jonathan M. Rosenberg, Cambridge University Press, (2006).
2. "Essentials of MATLAB Programming", 2nd Ed., Stephen J. Chapman, Cengage Learning, (2009).
3. "MATLAB Demystified", David McMahon, The McGraw-Hill Companies, (2007).
4. "MATLAB® for Engineers", 3rd Ed., Holly Moore, Pearson Education, Inc., (2012).
5. "Engineering computation with MATLAB", 2nd Ed., David M. Smith, Pearson Education, Inc., (2010).

MANAGEMENT SCIENCE
(Common to ECE,CSE,ECT,IT& EEE)
SEMESTER IV

Subject Code	21CMMST4010	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Course objectives:
This course will enable the students to

- Understand the concepts of Management its nature & importance, Management theories and organization principles.
- Analyze the Work study, SQC, inventory management and its techniques.
- Learn various concepts like PERT, CPM and Project crashing and recent trends in management.

Unit -I	**Hours**
Introduction to Management: Concept –nature and importance of Management – Functions of Management – Evaluation of Management thought- Theories of Motivation – Decision making process-Designing organization structure- Principles of organization - Types of organization structure.	**10**
Unit –II	
Operations Management: Principles and Types of Layouts – Work study- Statistical Quality Control- Control charts (P-chart, R-chart, and C chart). Simple problems- Material Management: Need for Inventory control- EOQ, ABC analysis (simple problems) and Types of ABC analysis (HML, SDE, VED, and FSN analysis).	**10**
Unit-III	
Functional Management & **Strategic Management**: **Functional Management**: Concept of HRM, HRD and PMIR- Functions of HRM - Marketing Management- Functions of Marketing, Marketing strategies based on product Life Cycle, Channels of distributions. **Strategic Management**: Vision, Mission, Goals, Strategy – Elements of Corporate Planning Process – Environmental Scanning – SWOT analysis- Steps in Strategy Formulation and Implementation, Generic Strategy alternatives	**12**
Unit –IV	
Project Management: **(PERT/CPM):** Development of Network – Difference between PERT and CPM Identifying Critical Path- Probability- Project Crashing (Simple Problems).	**10**
Unit-V	
Contemporary Management Practices: Basic concepts of MIS, MRP, Justin- Time (JIT) system, Total Quality Management (TQM), Six sigma , Supply Chain Management, Enterprise Resource Planning (ERP), Business Process outsourcing (BPO), Business process Re-engineering and Bench Marking, Balanced Score Card.	**08**

Course outcomes:
On completion of the course student will be able to:

1. Execute the functions of Management, Principles of Management & Leadership styles.
2. Examine Statistical Quality Control Techniques, Methods of inspection, the concept of Inventory Management and Control

3. Predict the Customer Behaviour and Employees Contribution towards success of Organization.
4. Identify different Strategies for the Development of the Organization.
5. Analyze Project Management Techniques like CPM, PERT and Crashing.
6. Apply various contemporary issues in Management Practices like TQM, Business Process Reengineering and BPO etc.

Question paper pattern:

Section A:

1. This section contains ten one or two line answer question carrying 1 mark each.
2. Two questions from each unit should present.

Section B:

1. This Section will have 10 questions, 2 from each unit
2. Each full question carry 12 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit

Text Books:

1. Dr. A. R. Aryasri – Management Science, TMH 2011.
2. Dr. P.G.Ramanujam,Dr. B.V.R.Naidu and Prof. P.V.Rama Sastry: Management Science, Himalaya Publishing House 2013.

Reference Books:

1. Koontz & Weihrich: 'Essentials of Management' TMH 2011.
2. Seth & Rastogi: Global Management Systems, Cengage Learning, Delhi, 2011.
3. Robbins: Organizational Behaviors, Pearson Publications, 2011

Web References:

1. https://www.managementstudyguide.com/management_principles.htm
2. https://businessjargons.com/strategic-management.html

Course Outcomes to Program Outcomes mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
2	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
4	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
6	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Course	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**-**

S.No.	Unit Name	Text Book Reference	Chapter No.
1	Introduction to Management	T1	1 & 3
		T2	1
2	Operations Management	T1	7,8,10&15
		T2	2
3	Functional Management & Strategic Management	T1	11,12 &14
		T2	3 & 5
4	Project Management: (PERT/CPM)	T1	16 & 17
		T2	4
5	Contemporary Management Practices	T1	20
		T2	8

ELECTROMAGNETIC WAVES AND TRANSMISSION LINES
Common to ECE & ECT
SEMESTER IV

Subject Code	21ECECT4020, 21ETETT4020	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Engineering Physics	Credits – 03	

Course Objectives:
This course will enable students to

- To gain conceptual and basic mathematical understanding of electrical and magnetic fields in free space and in materials with the help of Maxwell equations
- To understand wave propagation in lossless and in lossy media
- To introduce the various types of transmission lines and to discuss the losses associated
- To provide thorough understanding about impedance transformation and matching.
- To give insight about the usage of Smith chart in problem solving

Unit -1	**Hours**
TIME VARYING FIELDS AND MAXWELL'S EQUATIONS: Review of vector analysis and coordinate systems, Faraday's Law – Transformer and Motional Electromotive Forces – Displacement current – Generalized forms of Maxwell's equation in final forms, Electromagnetic boundary conditions.	9
Unit -2	
PROPAGATION OF UNIFORM PLANE WAVES: The wave equation-uniform plane waves, Plane waves in lossless media, Plane waves in lossy media (low-loss dielectrics and good conductors), Group velocity, Electromagnetic power flow and Poynting vector	9
Unit -3	
REFLECTION AND REFRACTION OF PLANE WAVES: Reflection and refraction of plane waves at plane boundaries under normal and oblique incidence on the surface of perfect dielectric, perfect conductor, Wave impedance. **TRANSMISSION LINE THEORY**: Transmission Line Model- Line of Cascaded T sections, General theory of Transmission lines, Transmission line equations at radio frequencies, Primary and secondary constants, The infinite line - Input and transfer impedance, Waveform distortion, Distortion-less lines, methods of loading	14
Unit – 4	
HIGH FREQUENCY TRANSMISSION LINES: Input impedance, Open and short circuited lines, wavelength, velocity of propagation, Reflection coefficient - calculation of current, voltage and power delivered, Standing Wave Ratio, Reflection losses on unmatched line.	9
Unit – 5	
IMPEDANCE MATCHING IN HIGH FREQUENCY LINES: Impedance matching: Quarter-wave line and applications, Smith chart – Smith circle equations, Determination of Load impedance, input impedance, Reflection coefficient, VSWR, V_{min} and V_{max} using Smith chart Half-wave line, Impedance matching by stubs - Single stub and double stub matching, Single stub matching using Smith chart.	9

Course outcomes:

On completion of the course student will be able to

1. Demonstrate knowledge and understanding of fundamental electromagnetic laws and concepts
2. Display an understanding of the effect of materials on electric and magnetic fields
3. Understand the EM wave propagation in a medium and through boundaries
4. Analyze the various types of transmission lines and to discuss the losses associated.
5. Comprehend the working of transmission line at radio frequencies
6. Analyze the problems in RF line and stub matching using Smith chart

Text Books:

1. D.K. Cheng, "Field and Wave Electro Magnetics", Pearson (India), 2 nd Edition, 1989.
2. John D Ryder, "Networks lines and fields", Prentice Hall of India, 2005

Reference Books:

1. W.H. Hayt and J.A. Buck, "Engineering electro magnetics", McGraw-Hill (India), 7 th Edition, 2006
2. E.C.Jordan and K.G. Balmain, “Electromagnetic Waves and Radiating Systems”, PHI, 2011.
3. Mathew.N.O.Sadiku, “Elements of Electromagnetics”, Oxford University Press, 6 th Edition, 2015.
4. Kraus, Fleisch, “Electromagnetics with Applications”, McGraw-Hill, 5 th Edition, 2010.
5. R. K. Shevgaonkar, “Electromagnetic Waves”, Tata McGraw Hill Publications, 2006
6. UmeshSinha, Transmission Lines and Networks: Networks, Filters & Transmission Lines, SathyaPrakash, 2010.

Course Outcomes to Program Outcomes mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2			2										
2		2	1	2											
3		3	3	3									1		
4	2	1	1	1		1					2	2	2		
5	2	3	2			1					1	1	2		
6	3	3	3	3		1					1	1	2		
Course	2	3	2	2	1	1					1	1	1		

S.No.	Unit Name	Text Book/ Reference	Chapter No.
1.	Time varying fields and Maxwell's equations	T1	5
		R2	4
2.	Propagation of uniform plane waves	T1	6
		R2	5
3.	Reflection and Refraction of plane waves	T1	6
		R2	6
4.	Transmission line theory	T2	3
		R6	6
5.	High frequency transmission lines	T2	9
		R6	7
6.	Impedance matching in high frequency lines	T2	9
		R3	6
		R4	5

PRINCIPLES OF COMMUNICATION THEORY

Common to ECE & ECT

IV SEMESTER

Subject Code	21ECECT4030, 21ETETT4030	Internal	30
Number of Lecture Hours/Week	03	External	70
Total Number of Lecture Hours	50	Exam	03
Pre-requisite	Signals & Systems	Credits – 03	

Course Objectives:

The student will be able to

- Understand the concept of modulation and learn continuous wave modulation and pulse modulation techniques.
- Understand Modulation & demodulation techniques of DSB, SSB &VSB
- Understand Modulation & demodulation techniques of FM
- To acquire knowledge to analyze the noise performance of analog modulation techniques.
- To understand the pulse modulation techniques.

Unit -1	**Hours**
Amplitude Modulation: Introduction to communication system, Need for modulation, Amplitude Modulation, Definition, Time domain and frequency domain description, single tone modulation, power relations in AM waves, Generation of AM waves, square law Modulator, Switching modulator, Detection of AM Waves; Square law detector, Envelope detector.	**10**
Unit -2	
DSB & SSB Modulation: Generation of DSBSC Waves, Balanced Modulators, Ring Modulator, Coherent detection of DSB-SC Modulated waves, COSTAS Loop, and Phase discrimination method Frequency discrimination for generating AM SSB Modulated waves, Demodulation of SSB Waves, Vestigial side band modulation, Design /Demonstrate the use of digital formatting in Multiplexers, Vocoders and Video transmission.	**10**
Unit – 3	
Angle Modulation: Introduction, Mathematical analysis of FM and PM, Modulation index for FM and PM, Frequency spectrum and bandwidth of FM, Narrow band and wide band FM, Direct, FM generation, Detection of FM Waves: Balanced Frequency discriminator, Phase locked loop, Comparison of AM, FM and PM. **NOISE:** Review of noise and noise sources, noise figure, Noise in Analog communication Systems, Noise in AM System, Noise in Angle Modulation Systems, Threshold effect in Angle Modulation System, Pre-emphasis & de-emphasis	**10**
Unit – 4	
PULSE ANALOG MODULATION: Introduction, Digitize Analog Sources The Low Pass Sampling Process Pulse Amplitude Modulation, Pulse-Position Modulation, Generation of PPM Waves, Detection of PPM Waves. **Multiplexing:** frequency division multiplexing, Time division multiplexing, wavelength division multiplexing and comparison.	**10**

Unit – 5	
PULSE DIGITAL MODULATION : The Quantization Random Process, Quantization Noise, Pulse-Code Modulation: Sampling, Quantization, Encoding, Regeneration, Decoding, Filtering, Differential PCM, Application examples- , Video + MPEG , Vocoders.	**8**

Course outcomes:

After going through this course the student will be able to

1. Understand the concept of modulation and amplitude modulation.
2. Differentiate various schemes of amplitude modulation and demodulation techniques.
3. Understand the fundamentals of angle modulation and demodulation techniques.
4. Analyze noise characteristics of various analog modulation methods.
5. Analyze the concept of pulse modulation schemes.
6. Design /Demonstrate the use of digital formatting in Multiplexers, Vocoders and Video transmission.

Text Books:

1. Simon Haykin, **"Principles of Communication Systems"**, 2nd Ed, John Wiley.
2. Modern Digital and Analog Communication Systems –B.P. Lathi, Zhi Ding, Hari Mohan Gupta, Oxford University Press, 4th Edition, 2017

References Books:

1. B.P. Lathi, **"Communication Systems"**, BS Publication, 2006.
2. Proakis J. G. and Salehi M., **"Communication Systems Engineering"**, Pearson Education, 2002.
3. H. Taub and D. Schilling, **"Principles of Communication Systems"**, TMH, 2003

Web References:

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-02-introduction-to-eecs-ii-digital-communication-systems-fall-2012/lecture-videos/
2. https://nptel.ac.in/courses/117102059/
3. https://www.youtube.com/watch?v=TPm0XSPxld8

Course Outcomes to Program Outcomes mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
2	3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
3	3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
4	3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
5	3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
6	3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
Course	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	**3**	-

S.No	Unit Name	Text Book / Reference	Chapter No.
1	Amplitude Modulation	T1	3
		R1	3
		R2	3
2	DSB & SSB Modulation	T1	3
		R1	3
		R2	3
3	Angle Modulation	T1	4
		R1	4
	Noise	T1	5
		R3	9
4	Pulse Analog Modulation	T1	6
		R1	5
5	Pulse Digital Modulation	T1	7
		R1	6

ELECTRONIC CIRCUIT ANALYSIS Common to ECE & ECT SEMESTER IV			
Subject Code	21ECECT4040, 21ETETT4040	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Electronic Devices	**Credits – 03**	

Course Objectives:

This course will enable the students to:

- Understand analysis of small signal BJT and FET amplifier circuits
- Understand the small signal high frequency amplifiers and the effect of Cascading on single stage amplifiers.
- Understand the concept of feedback on amplifiers,
- Understand the principle of oscillator circuits.
- Derive the efficiency of different Power amplifiers
- Understand the concept of tuned amplifiers

Unit -1	**Hours**
Small Signal Low Frequency Transistor Amplifier Models: **BJT:** Two port network, Transistor hybrid model,h-parameters, conversion of h-parameters, generalized analysis of transistor amplifier model using h-parameters, Analysis of CB, CE and CC amplifiers, Comparison of transistor amplifiers. **FET:** Small signal model of a MOSFET, Analysis of CG, CS and CD amplifiers, comparison of FET amplifiers.	**8**
Unit -2	
Small Signal High Frequency Transistor Amplifier models: **BJT:** Transistor at high frequencies: Hybrid- π CE transistor model, Hybrid π conductances, Hybrid π capacitances, validity of hybrid π model, CE short circuit current gain, current gain with resistive load, cut-off frequencies, single stage CE transistor amplifier response and gain bandwidth product. **FET:** Analysis of common Source and common drain Amplifier circuits at high frequencies	**12**
Unit – 3	
Feedback Amplifiers: Classification of Amplifiers, Feedback concept, feedback topologies, General Characteristics of negative feedback amplifiers, Method of analysis of feedback amplifiers **Oscillators:** Condition for oscillations, RC-phase shift and Wien bridge oscillators with BJT and analysis, General form of oscillator circuit, Hartley and Colpitts oscillators with BJT and analysis.	**20**
Unit-4	
Power Amplifiers: Transformer coupled Class A power Amplifier and its efficiency, Class B amplifier and its efficiency, Class AB amplifier, Complementary symmetry push pull amplifier, Class-C power amplifier, Thermal stability and Heat sinks.	**10**
Unit-5	

Tuned Amplifiers : Introduction, Q-Factor, small signal tuned amplifier, capacitance single tuned amplifier, double tuned amplifiers, effect of cascading single tuned amplifiers on band width, effect of cascading double tuned amplifiers on band width, staggered tuned amplifiers, stability of tuned amplifiers, wideband amplifiers	**10**

Course outcomes:

On completion of the course student will be able to:

1. **Perform the analysis of small signal amplifier circuits using BJT and FET**
2. Design small signal high frequency amplifiers and estimate the effects of cascading
3. Design different types of feedback amplifier circuits
4. Design a reliable amplifier and oscillator circuits
5. Design a power amplifier with the required efficiency
6. **Design the tuned amplifiers and the effect of cascading**

Text Books:

1. Microelectronic Circuits - A.S. Sedra and K.C. Smith, 5th edition
2. Integrated Electronics- Jacob Millman, C. Halkies, Tata McGraw Hill Electronic

Reference Books:

1. Electronic Devices and Circuits -David A. Bell, 5th Edition Oxford University press
2. Electronic Devices and Circuits Theory – Robert L. Boylestad and Louis Nashelsky, Pearson/Prentice Hall, Tenth Edition.

Course Outcomes to Program Outcomes mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
4	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-
5	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-
Course	**3**	**2**	**1**	-	-	-	-	-	-	-	-	-	-	-	-

S.No.	Unit Name	Text Book Reference	Chapter No.
1	Small Signal Low Frequency Transistor Amplifier Models	T1	3
2	Small Signal High Frequency Transistor Amplifier models	T1	3 & 4
3	Feedback Amplifiers & Oscillators	T1	7 & 11
4	Power Amplifiers	T1	12
5	Tuned Amplifiers	T1	10

CONTROL SYSTEMS

Common to ECE & ECT

SEMESTER IV

Subject Code	21ECECT4050,21ETETT4050	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Mathematics-III	Credits – 03	

Course Objectives:

This course will enable the students to:

- Understand concepts of the mathematical modeling, feedback control and stability analysis in Time and Frequency domains.
- Analyze the system with state variable analysis techniques.

Unit -1	**Hours**
Introduction: System, Control System, Open Loop Control System, Closed loop Control System, Different Examples, Effects of Feedback, Feedback Characteristics and its advantages. **Mathematical models of Physical Systems:** Differential equations of physical systems, Transfer functions of Electrical, mechanical translational and rotational systems. Block diagram Algebra, Signal flow graph	**12**
Unit -2	
Controller Components: DC Servomotor (Armature Controlled and Field Controlled) with necessary derivation for transfer function, AC Servomotor and its transfer function, AC Tachometer, Potentiometer, Synchros. **Time Response Analysis:** Standard test Signals, Time response of first and second order systems, steady state errors and error constants, Design specifications of second order systems, controllers and Compensators	**10**
Unit – 3	
Concepts of Stability and Algebraic Criteria: The concept of Stability, Necessary Conditions for Stability, Routh Hurwitz Stability Criterion, Relative stability analysis **The Root Locus Technique:** Introduction, The Root Locus concepts, Construction of Root Loci, Effect of adding poles and zeros to a system	**10**
Unit – 4	
Frequency response analysis: Introduction, Correlation between time and frequency response, Polar Plots, Bode Plots, Nyquist Stability Criterion, Performance specifications in frequency-domain.	**10**
Unit – 5	
State Variable Analysis and Design: Introduction, Concepts of State, State Variables and State models, State models for linear continuous-time systems, Solution of state equations and Concepts of Controllability and Observability	**8**

Course outcomes:

On completion of the course student will be able to:

1. Characterise a control system and effects of feedback
2. Develop mathematical model of the physical systems.
3. Apply time response analysis on first and second order systems
4. Analyse the system stability using Routh Hurwitz and Root locus techniques
5. Analyse the system stability using frequency response analysis
6. Apply state variable analysis to continuous time systems and obtain the relationship between state variable representation and transfer functions.

Text Books:

1. I.J.Nagarath and M.Gopal, **"Control Systems"**, New Age International Publishers, 5th Edition, 2014
2. Katsuhiko Ogata, **"Modern Control Engineering"**, Pearson, 4th Edition, 2012

Reference Books:

1. Ambikapathy, **"Control Systems"**, Khanna Book Publishing Co. (P) Ltd., Delhi
2. Anand Kumar, **"Control Systems",** 2nd Edition, PHI learning PVT. Ltd,2014

Web References:

1. https://nptel.ac.in/courses/108101037/
2. http://www.ee.surrey.ac.uk/Projects/CAL/control/index.htm

Course Outcomes to Program Outcomes mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	-	-	-	-	-	-	-	-	-	-	3	-
2	3	2	-	-	-	-	-	-	-	-	-	-	-	2	-
3	3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
4	3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
5	3	2	2	-	-	-	-	-	-	-	-	-	-	2	-
6	3	2	2	-	-	-	-	-	-	-	-	-	-	2	-
Course	**3**	**2**	**1**	-	-	-	-	-	-	-	-	-	-	**2**	-

Text Book /Reference:

S.No.	Unit Name	Text Book /Reference	Chapter No.
1	Introduction and Mathematical models of Physical Systems	T1	1,2 & 3
		T2	1 & 3
		R1	1
		R2	1,2 & 3
2	Controller Components and Time Response Analysis	T1	4 & 5
		T2	5 & 7
		R1	2
		R2	4
3	Concepts of Stability and Algebraic Criteria and The Root Locus Technique	T1	6 & 7
		T2	6

		R1	3
4	Frequency response analysis	T1	8 & 9
		T2	8
		R2	7 & 8
5	State Variable Analysis and Design	T1	12
		T2	11
		R2	10

PRINCIPLES OF COMMUNICATION LAB

Common to ECE & ECT

SEMESTER IV

Subject Code	21ECECL4060, 21ETETL4060	Internal Marks	15
Number of Lecture Hours/Week	03	External Marks	35
Total Number of Hours	36	Exam Hours	03

Credits – 1.5

Course Objectives:

This course will enable students to

- Perform the continuous wave modulation and demodulation techniques
- Verify Sampling Theorem
- Simulate modulation Techniques.

List of Experiments:	**Hours**
1. Amplitude Modulation - Modulation & Demodulation. 2. AM – DSBSC - Modulation & Demodulation. 3. Frequency Modulation & Demodulation. 4. Diode Detector. 5. Pre-emphasis & De-emphasis 6. AGC Circuits. 7. Verification of Sampling Theorem 8. Pulse Amplitude Modulation & Demodulation 9. PWM, PPM–Modulation & Demodulation 10. PLLIC-565 as FM demodulator 11. Pulse Code Modulation and Demodulation 12. Communication link simulation	**36**

Course outcomes:

On completion of the course student will be able to

1. Infer the modulation and demodulation techniques for continuous wave.
2. Apply the sampling theorem.
3. Simulate modulation Techniques.

ELECTRONIC CIRCUIT ANALYSIS LAB Common to ECE & ECT SEMESTER IV			
Subject Code	21ECECL4070, 21ETETL4070	Internal Marks	15
Number of Lecture Hours/Week	03	External Marks	35
Total Number of Lecture Hours	36	Exam Hours	03
Credits – 1.5			

Course objectives:

The objective of the course is to make students to understand the concepts of Basic Amplifiers, Oscillators, Feedback amplifiers

For the following amplifier circuits, Frequency response and frequency of oscillations needs to be executed both in hardware and Multisim software.	**Hours**
1. BJT CE Amplifier 2. Emitter follower-CC Amplifier 3. FET CS Amplifier 4. Two Stage RC Coupled Amplifier 5. Voltage-Series Feedback Amplifier 6. Current-Shunt Feedback Amplifier 7. RC Phase Shift Oscillator 8. Wien Bridge Oscillator 9. Hartley and Colpitts Oscillator 10. Class A Series-fed Power Amplifier 11. Complementary Symmetry Class B Push-Pull Power Amplifier 12. Single Tuned Voltage Amplifier	**36 Hours**

Course outcomes:

After completing this course, students will be able to:

1. Design CE amplifier and analyze frequency response at low, mid and high frequencies
2. Design two stage amplifier and analyze frequency response at low, mid and high frequencies
3. Design feedback amplifier and analyze its frequency response
4. Design different oscillator circuits and evaluate its frequency of oscillation
5. Design different Power amplifiers and evaluate the efficiency
6. Design tuned amplifier and evaluate the resonant frequency

Hardware/Software Requirements:

Equipment required

1. Regulated Power supplies
2. Analog/Digital Storage Oscilloscopes
3. Analog/Digital Function Generators
4. Digital Multimeters
5. Decade Résistance Boxes/Rheostats
6. Decade Capacitance Boxes
7. Ammeters (Analog or Digital)
8. Voltmeters (Analog or Digital)
9. Active & Passive Electronic Components

Software:

1. Multisim/ Equivalent Industrial Standard Licensed simulation software tool.
2. Computer Systems with required specifications.

SIGNALS AND SYSTEMS LAB

Common to ECE & ECT

SEMESTER IV

Subject Code	21ECECL4080, 21ETETL4080	Internal Marks	15
Number of Lecture Hours/Week	03	External Marks	35
Total Number of Hours	36	Exam Hours	03
Credits – 1.5			

Course Objectives:

This course will enable students to

1. Generate fundamental Continuous time and discrete time signals.
2. Analyze the continuous time signals using Fourier Series and Fourier Transform.
3. Extend the properties of systems to LTI Systems.
4. Verify the sampling theorem.
5. Generation and standard operations on Random signals.

The programs shall be implemented in MATLAB software and student has to perform at least TEN Experiments.	**Hours**
List of Experiments: 1. Introduction to MATLAB and structure of a MATLAB program. 2. Generation of Continuous Time and Discrete Time signals. 3. Perform standard operations on signals. 4. Check the properties of Systems. 5. Exponential Fourier series representation of a periodic Fullwave rectified signal. 6. Determine Fourier Transform and Inverse Fourier Transform of a CT signal. 7. Perform Linear convolution between two signals. 8. Determine Autocorrelation and Cross correlation between signals. 9. Verification of the Sampling theorem. 10. Generate a uniformly distributed random sequence in the range (0,1) and compute it's Mean and Variance. Also plot the Histogram. 11. Generate a discrete time sequence of length N with i.i.d uniformly distributed random numbers in the interval (-0.5,-0.5) and compute the autocorrelation of the sequence. 12. Calculate Probability Distribution and Probability Density functions of a Random variable.	**36**

Course outcomes:

1. Experiment with Generation of fundamental signals.
2. Analyze the fundamental signals in frequency domain.
3. Inspect the system properties for a LTI system
4. Construct the Sampling theorem.
5. Construct Random signals and compute various parameters related to random signals

SKILL ORIENTED COURSE-II
PCB Designing
SEMESTER IV

Subject Code	21ETETS4090	Internal Marks	0
Number of Lecture Hours/Week	02	External Marks	50
Total Number of Practical Hours/Week	32	Exam Hours	03
Pre-requisite	Technical English	Credits – 02	

Course Outcomes:

1. Determine appropriate components to make circuits.(L3) 2. Interpret test results and measurements on electric circuits.(L2) 3. Analyze the fabrication processes of printed circuit boards.(L4) 4. Apply the software and hardware for PCB Design.(L3) 5. Evaluate an electronic printed circuit board for a specific application using industry standard software.(L5)	**Teaching Hours 36**

Course Contents

List of experiments:

1. Study on types of PCB layers, through Hole and SMD Components.
2. Schematic Creation and simulation of an electronic circuit
3. Mapping Components of an electronic circuit
4. Set Parameters for PCB Design.
5. Laying Tracks on PCB.
6. Create PCB Layout of an Electronic Circuit.
7. Create Device Model and simulation.
8. Create PCB layout of an amplifier design.
9. Create PCB layout of an Astable Multivibrator using IC's.
10. Create PCB layout of a Voltage Regulator using IC's.
11. Create PCB layout of a Galvanic isolation circuit.
12. Printing on PCB.
13. Etching and Drilling of PCB.
14. Soldering PCB.
15. Testing of an electronic Circuit-1 on PCB.
16. Testing of an electronic Circuit-2 on PCB.

Note: Any TWELVE of the experiments are to be conducted

SKILL ORIENTED COURSE-II
INTERNET OF THINGS (IOT)
SEMESTER IV

Subject Code	21ETETS4090	Internal Marks	0
Number of Lecture Hours/Week	02	External Marks	50
Total Number of Practical Hours/Week	32	Exam Hours	03
Pre-requisite	• Computational Thinking with'C' • Digital Logic Design	Credits – 02	

Laboratory objectives

- To develop Embedded C language program skills.
- Providing the basic knowledge of interfacing various peripherals to Arduino Uno.
- To Develop Real Time Small Scale Embedded Applications.

Laboratory Outcomes

1. Understand the concepts of ArduinoUnoand different types of I/O Devices.
2. Construct interfacing circuits for different Applications
3. Develop Embedded C codes for different applications using Arduino
4. Develop Real time applications using Arduino.

Teaching Hours 36

Course Contents

Part-A (Minimum Any 6 Experiments)

1. Write an Embedded C Program to interface the following with Arduino Uno
   a. LED
   b. RGB LED
2. Write an Embedded C Program to interface Push Button with Arduino Uno.
3. Write an Embedded C Program to Interface LCD with Arduino Uno.
4. Write an Embedded C Program to Interface Seven Segment Display with ArduinoUno
5. Write an Embedded C Program to Interface DC Motor and Servo Motor with Arduino Uno.
6. Write an Embedded C Program to Interface Keypad with Arduino Uno.
7. Write an Embedded C Program to interface the fallowing with Arduino Uno
   a. IR Sensor
   b. Temperature Sensor
   c. Ultrasonic Sensor

Part-B (Minimum Any 4 Experiments)

1. Study and Implement RFID using Arduino Uno.
2. Develop an Application to Interface GSM with Arduino and transmit the message "WELCOME TO SASI" to the number specified.
3. Develop an Application to Interface GPS with Arduino and Identify Latitude and Longitude of SITE.
4. Design an Application to develop touchless doorbell using Arduino
5. Design an Application to monitor temperature and humidity of a city and store in Thingspeak cloud using Bluetooth and Arduino.
6. Design an Application to detect depth and height of the pothole and hump to aid drivers and store in Thing speak cloud using Bluetooth and Arduino.

PULSE & DIGITAL CIRCUITS Common to ECE & ECT SEMESTER IV			
Subject Code	21ECECN40A0, 21ETETN40A0	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Semiconductor Devices	Credits -- 0	

Course Objectives:

This course will enable students to

- Understand Wave shaping circuits.
- Analyze switching characteristics of electronic devices.
- Design multivibrators and time base generators.

Unit -1	**Hours**
Linear Wave Shaping: High pass, low pass RC circuits, their response for sinusoidal, step, pulse, square, ramp and exponential inputs. RC network as differentiator and integrator; Attenuators , its applications in CRO probe, RL and RLC circuits and their response for step input, Ringing circuit.	10
Unit -2	
Non-Linear Wave Shaping: Diode clippers, Transistor clippers, clipping at two independent levels, Transfer characteristics of clippers, Emitter coupled clipper; Clamping operation, clamping circuits using diode with different inputs, Clamping circuit theorem, practical clamping circuits, effect of diode characteristics on clamping voltage, Transfer characteristics of clampers.	12
Unit – 3	
Switching Characteristics of Devices: Diode as a switch, piecewise linear diode characteristics, Design and analysis of Transistor as a switch, Break down voltage consideration of transistor, saturation parameters of Transistor and their variation with temperature, Design of transistor switch, transistor switching times. Bistable Multivibrator: Analysis And Design of Fixed Bias, Self Bias Bistable Multi Vibrator, Collector Catching Diodes, Commutating Capacitors, Triggering of Binary Circuits, Emitter Coupled Bistable Multivibrator (Schmitt Trigger).	12
Unit – 4	
Monostable Multivibrator: Analysis and Design of Collector Coupled Monostable Multi vibrator, Triggering of Monostable Multivibrator, Applications of Monostable Multivibrator. Astable Multivibrator: Analysis and Design of Collector Coupled Astable Multivibrator, Application of Astable Multivibrator as a Voltage to Frequency Converter.	9
Unit – 5	
Voltage Time Base Generators: General features of a time base signal, Methods of generating time base waveform Exponential Sweep Circuits, Negative Resistance Switches, basic principles in Miller and Bootstrap time base	7

generators, Transistor Miller time base generator, Transistor Bootstrap time base generator.	

Course outcomes:

On completion of the course, student will be able to

1. Analyze linear wave shaping circuits with different inputs.
2. Design Non linear wave shaping circuits.
3. Design switching circuits.
4. Analyze different Multivibrators
5. Design different multivibrators
6. Understand different types of time base generators

Text Books:

1. A. Anand Kumar, "Pulse and Digital Circuits", PHI, 2005

Reference Books:

2. J. Millman and H. Taub, Mothiki S Prakash Rao, "Pulse, Digital and Switching Waveforms", McGraw-Hill, Second Edition, 2007.
3. Venkata Rao,K,Ramasudha K, Manmadha Rao,G, "Pulse & Digital Circuits", Pearson,2010
4. J. Millman and H. Taub, Pulse, "Digital and Switching Waveforms", McGrawHill

Web References:

1. http://www.iitg.ac.in/apvajpeyi/ph218/Lec-18.pdf
2. http://www.nptelvideos.in/2012/12/digital-circuits-and-systems.html
3. http://www.allaboutcircuits.com/video-lectures/

Course Outcomes to Program Outcomes mapping:

CO	PO1	PO2	PO3	P04	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	-	-	-	-	-	-	-	-	-	-	-	1
2	3	3	3	-	-	-	-	-	-	-	-	-	-	-	1
3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	2
4	3	3	2	-	-	-	-	-	-	-	-	-	-	-	2
5	3	3	3	-	-	-	-	-	-	-	-	-	-	-	2
6	3	3	1	-	-	-	-	-	-	-	-	-	-	-	-
Cours e	3	3	3	-	-	-	-	-	-	-	-	-	-	-	2

Text Book/Reference:

S.No	Unit Name	Text Book/Reference	Chapter No
1	Linear Wave Shaping	T1	1
		R1	2

2	Non-Linear Wave Shaping	T1	2
		R1	5,6
3	Switching Characteristics of Devices, Bistable Multivibrator	T1	3,4
		R2	6
4	Monostable Multivibrator & Astable Multivibrator	T1	4
		R2	7,8
5	Voltage Time Base Generators	T1	5
		R3	14,15

Semester -V						
S.No	**Subject Code**	**Name of the subject**	**L**	**T**	**P**	**C**
1	21ETETT5010	Digital Modulation and Coding	3	0	0	3
2	21ETETT5020	Microelectronics & VLSI Design	3	0	0	3
3	21ETETT5030	Linear IC Applications	3	0	0	3
4	21ETETP504X	Professional Elective-1	3	0	0	3
5	21ETXXO505X	Open Elective - 1	3	0	0	3
6	21ETETL5060	Digital Modulation and Coding Lab	0	0	3	1.5
7	21ETETL5070	Linear IC Applications Lab	0	0	3	1.5
8	21CMAHS5080	Skill advanced course/ soft skill course-3* (Soft Skills & Aptitude Builder-1).	1	0	2	2
10	21CMMSN5090	Biology for Engineers	2	0	0	0
11	21ETETR70A0	Summer Internship - 2 Months (Mandatory) after second year (to be evaluated during V semester	0	0	3	1.5
Total Semester Credits						**21.5**
12		Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)	4	0	0	4

Professional Elective-1

S.No	**Subject Code**	**Name of the subject**	**L**	**T**	**P**	**C**
1	21ETETP504A	Computer Organization and Microprocessors	3	0	0	3
2	21ETETP504B	Radiation Systems	3	0	0	3
3	21ETETP504C	System Design through Verilog	3	0	0	3

Open Elective-I

Candidate should select the subject from list of subjects offered by other departments

Course Structure for III B.Tech ECT Under the Regulations of SITE-21						
Semester -VI						
S.No	**Subject Code**	**Name of the subject**	**L**	**T**	**P**	**C**
1	21ETETT6010	Digital Signal Processing	3	0	0	3
2	21ETETT6020	Data Communications and Networking	3	0	0	3
3	21ETETT6030	Microcontrollers and Applications	3	0	0	3
4	21ETETP604X	Professional Elective-II	3	0	0	3
5	21ETXXO605X	Open Elective - II	3	0	0	3
6	21ETETL6060	Digital Signal Processing Lab	0	0	3	1.5
7	21ETETL6070	VLSI Design Lab	0	0	3	1.5
8	21ETETL6080	Microcontroller and Applications Lab	0	0	3	1.5
9	21ETETS6090	Skill advanced course/ soft skill course-4* Soft Skills and Aptitude Builder-2	1	0	2	2
10	21ETETN60A0	Essential of Indian Traditional Knowledge	2	0	0	0
		Total Semester Credits				**21.5**
11	H/M	Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)	4	0	0	4

Professional Elective-2

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ETETP604A	Spread Spectrum Techniques	3	0	0	3
2	21ETETP604B	Advanced VLSI Design	3	0	0	3
3	21ETETP604C	Microwave Engineering	3	0	0	3

Open Elective-II

Candidate should select the subject from list of subjects offered by other departments

Course Structure for IV B.Tech ECT Under the Regulations of SITE-21

Semester -VII						
S.No	**Subject Code**	**Name of the subject**	**L**	**T**	**P**	**C**
1	21ETETP701X	Professional Elective -III	3	0	0	3
2	21ETETP702X	Professional Elective -IV	3	0	0	3
3	21ETETP703X	Professional Elective -V	3	0	0	3
4	21ETXXO704X	Open Elective - III	3	0	0	3
5	21ETXXO705X	Open Elective - IV	3	0	0	3
6	21ETXXO706X	Open Elective - V	3	0	0	3
7	21CMAHS7070	Skill advanced course/ soft skill course	1	0	2	2
8	21ETETR7080	Summer Internship 2 months after Third year (To be evaluated during VII sem)	3	0	0	3
Total Semester Credits						**23**
9		Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)	4	0	0	4

Professional Elective-III

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ETETP701A	Digital Image Processing	3	0	0	3
2	21ETETP701B	Telecommunications and Switching Networks	3	0	0	3
3	21ETETP701C	CAD Tools for VLSI	3	0	0	3

Professional Elective-IV

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ETETP702A	Bio-Medical Signal Processing	3	0	0	3
2	21ETETP702B	Global Position Systems	3	0	0	3
3	21ETETP702C	Optical Communication	3	0	0	3

Professional Elective-V

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ETETP703A	RF System Design	3	0	0	3
2	21ETETP703B	Internet of Things	3	0	0	3
3	21ETETP703C	Radar and Satellite Communications	3	0	0	3

Open Elective-III

Candidate should select the subject from list of subjects offered by other departments

Open Elective-IV

Candidate should select the subject from list of subjects offered by other departments

Open Elective-V

Candidate should select the subject from list of subjects offered by other departments

Course Structure for IV B.Tech ECT Under the Regulations of SITE-21						
Semester -VIII						
S.No	**Subject Code**	**Name of the subject**	**L**	**T**	**P**	**C**
1	XXXXXX	Project work, seminar and internship in industry	0	0	24	12
					Total Semester Credits	**12**

DIGITAL MODULATION AND CODING SEMESTER V			
Subject Code	21ETETT5010	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Principles of Communication Theory	**Credits – 03**	

Course Objectives:

This course will enable students to:

- Interpret various digital modulation techniques and able to analyze various systems for their performance in terms of probability of error.
- Illustrate the concepts of information theory and need for source coding.
- Explain Block codes, cyclic codes and convolution codes.

Unit -1	**Hours**
DIGITAL MODULATION TECHNIQUES: Introduction to digital communication: Elements of digital communication systems, advantages of digital communication systems, Digital modulation techniques: ASK, FSK, PSK, DPSK, QPSK, M-ary PSK, M-ary ASK, M-ary FSK.	**10**
Unit -2	
DATA TRANSMISSION : Base band signal receiver, probability of error, the optimum filter, matched filter, probability of error using matched filter, coherent reception, non-coherent detection of FSK, calculation of error probability of ASK, BPSK.	**10**
Unit – 3	
INFORMATION THEORY: Discrete messages, concept of amount of information and its properties. Average information, Entropy and its properties. Information rate **SOURCE CODING:** Introductions, Advantages, Shannon's theorem, Shanon-Fano coding, Huffman coding, efficiency calculations, channel capacity of discrete and analog Channels, capacity of a Gaussian channel, bandwidth –S/N trade off.	**12**
Unit – 4	
LINEAR BLOCK CODES: Introduction, Matrix description of Linear Block codes, Error detection and error correction capabilities of Linear block codes, Hamming codes, Binary cyclic codes.	**9**
Unit – 5	
CONVOLUTION CODES: Introduction, convolution codes- time domain approach, transform domain approach. Graphical approach: state, tree and trellis diagram, decoding using Viterbi algorithm.	**9**
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Demonstrate various Digital Modulation Techniques.
2. Solve the probability of error in the data transmission.
3. Illustrate various source coding techniques.
4. Interpret the Linear Block codes.

5. Demonstrate the Convolution Codes.

Text Books:

1. Digital communications - Simon Haykin, John Wiley,2005
2. Digital and Analog Communication Systems - Sam Shanmugam, John Wiley,2005

Reference Books:

1. Principles of Communication Systems – H. Taub and D. Schilling, TMH,2003
2. Digital Communications – John Proakis, TMH, 1983. Communication Systems Analog&Digital – Singh &Sapre, TMH,2004.
3. Modern Digital and Analog Communication Systems – B.P.Lathi, Zhi Ding, Hari Mohan Gupta, Oxford University Press,4 th Edition,2017
4. Analog & Digital Communication - Dr. Sanjay Sharma, S.K. Kataria& Sons, 3rd Edition.

Web References:

1. https://nptel.ac.in/courses/117101051
2. https://archive.nptel.ac.in/courses/108/101/108101113/
3. https://archive.nptel.ac.in/courses/117/105/117105144/
4. https://archive.nptel.ac.in/courses/108/102/108102120/

MICROELECTRONICS AND VLSI DESIGN

SEMESTER V

Subject Code	21ETETT5020	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite	Digital System Design	**Credits – 03**	

Course Objectives:

This course will enable students to

1. Know about IC technology and MOS transistor characteristics.
2. Demonstrate IC design process.
3. Estimate parametric of CMOS circuits.
4. Understand gate level design and physical design.
5. Know subsystem design.

Unit -1	**Hours**
Introduction: Introduction: Basic steps of IC fabrication, PMOS, NMOS, CMOS & BiCMOS, Basic Electrical Properties of MOS and BiCMOS Circuits: Working of MOS transistors – Threshold voltage; MOS design equations: Ids – Vds relationships, Threshold Voltage, Body effect, Channel length modulation, gm, gds, Figure of merit ω0 ; Pass transistor, NMOS Inverter, CMOS Inverter analysis and design, Various pull ups loads, Bi-CMOS Inverters.	10
Unit -2	
VLSI Circuit Design Processes: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, 2 um Double Metal, Double Poly. CMOS/BiCMOS Rules, 1.2 um Double Metal, Single Poly. CMOS Rules.	9
Unit -3	
Basic Circuit Concepts: Sheet resistance, Rs concept applied to MOS transistors and inverters, Resistance estimation, Area capacitance of layers, Standard unit of capacitance, Capacitance estimation, Wiring capacitances, Delay unit and Inverter delays, Driving large capacitance loads, Propagation Delay, Wiring Capacitances. Scaling of MOS circuits, Limitations of Scaling.	10
Unit – 4	
Gate level Design: Introduction to MOS transistor switches – Basic gate using switches, Working polar transistor Resistors and Capacitors. Logic gates and other complex gates, Switch logic, Alternate gate circuits. **Physical Design:** Floor-Planning, Placement, Routing, Power delay estimation, Clock and Power routing.	10
Unit – 5	
Subsystem Design: Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators and Counters. **VLSI Design Styles:** Full-custom, Standard Cells, Gate-arrays, FPGAs, CPLDs and Design Approach for Full-custom and Semi-custom devices.	9
Total	**48**

Course outcomes:

On completion of the course student will be able to

1. Interpret the basic electrical properties of MOS and BiCMOS circuits.
2. Illustrate the intricacies of VLSI Circuit design processes.
3. Develop the parametric for CMOS Circuits.
4. Explain the VLSI design methodologies.
5. Construct various subsystems.

LINEAR IC APPLICATIONS SEMESTER V			
Subject Code	21ETETT5030	IA Marks	30
Number of Lecture Hours/ Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exams Hours	03
Pre-requisite	Semiconductor Devices	**Credits – 03**	

Course Objectives:

This course will enable the students to

6. Understand the basic operation and performance parameters of differential amplifiers.
7. Understand the measuring techniques and performance parameters of op-amp.
8. Learn linear and non-linear applications of operational amplifiers.
9. Understand and design active filters using op-amps and applications of IC555 timer and PLL .
10. Learn the internal structure and operation of various DACs and ADCs.

Unit I	
DIFFERENTIAL AMPLIFIERS: Differential Amplifier-DC and AC Analysis of Dual Input Balanced Output Configuration, Properties of Other Differential Amplifier Configuration: Dual Input Unbalanced Output, Single Ended Input Balanced and Unbalanced Output, DC Coupling and Cascaded Differential Amplifier Stages, Level Translator.	9
Unit II	
CHARACTERISTICS OF OP-AMPS: Integrated Circuits Types, Classification, Package Types and Temperature Ranges, Power Supplies, Op-amp Block Diagram, Ideal and Practical Op-amp Specifications, 741 Op-amp & its Features, Op-Amp Parameters and Measurement, DC and AC Characteristics: Input and Output Offset Voltages and Currents, Slew Rate, CMRR, PSRR, Drift, Frequency Compensation Techniques.	10
Unit III	
LINEAR APPLICATIONS OF OP-AMPS: Inverting and Non-inverting Amplifier, Integrator and Differentiator, Difference Amplifier, Instrumentation Amplifier, AC Amplifier, V to I, I to V Converters. **NON-LINEARAPPLICATIONS OF OP-AMPS:** Comparators, Multivibrators, Function Generators: Triangular and Square Wave Generators, Log and Anti-log Amplifiers, Precision Rectifiers.	10
Unit IV	
ACTIVE FILTERS: Design and Analysis of Butterworth Active filters: 1^{st} order, 2^{nd} order LPF, HPF, Band Pass, Band Reject and All Pass Filters, Sample & Hold Circuits. **TIMERS AND PHASE LOCKED LOOPS:** IC 555 Timer Functional Diagram, Monostable and Astable Operations and Applications, Schmitt Trigger, Phase Locked Loop (PLL), 565 PLL, Frequency Multiplication and Frequency Translation using PLL, Applications of VCO(566).	10
Unit V	
DIGITAL TO ANALOG AND ANALOG TO DIGITAL CONVERTERS: Basic DAC Techniques, Weighted Resistor DAC, R-2R Ladder DAC, Inverted R-2R DAC, IC1408 DAC, Parallel Comparator type ADC, Counter type ADC, Successive	9

Approximation and Dual Slope ADC, DAC and ADC Specifications, Specifications of AD574 (12 bit ADC).	
Total	**48**

Course Outcomes

On Completion of the course, student will be able to

6. Illustrate basic operation and performance parameters of differential amplifiers.
7. Demonstrate the performance parameters of operational amplifier.
8. Develop linear and non-linear applications of operational amplifier.
9. Build different active filters, timer and PLL applications.
10. Construct various DAC and ADC circuits.

Text Books

2. Linear Integrated Circuits by D. Roy Choudhury, NewAgeInternational(p) Ltd,4th Edition, 2015.
3. Op-Amps and Linear ICs by Ramakanth A.Gayakwad,PHI, 1987.

Reference Books

8. Operational Amplifiers and Linear Integrated Circuits by Sanjay Sharma, S K Kataria & Sons, 2ndEdition, 2010.
9. Operational Amplifiers and Linear ICs by David A Bell, Oxford Uni. Press, 3rdEdition.

Professional Elective-1

S.No	Subject Code	Name of the subject	L	T	P	C
1	21ETETP504A	Computer Organization and Microprocessors	3	0	0	3
2	21ETETP504B	Radiation Systems	3	0	0	3
3	21ETETP504C	System Design through Verilog	3	0	0	3

COMPUTER ORGANIZATION & MICROPROCESSORS

(Professional Elective – I)

SEMESTER V

Subject Code	21ETETP504A	Internal Marks	30
Number of Lecture Hours /Week	3	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite	Digital System Design	**Credits – 03**	

Course Objectives:

This course will enable the students to:

- Understand the concepts of basic structure of Computers, machine instructions, programs and memory and I/O devices.
- Understand the concepts of parallel processing and pipelining.
- Understand architectures concepts of 8086 and advanced Micro processors.
- Apply programming concepts of 8086 Micro processors.
- Apply interfacing of Micro processors with memory and other peripherals.

Unit -1	**Hours**
Basic Structure of Computers: Computer Types, Functional UNIT, Basic Operational Concepts, Bus, Structures, Software, Performance, Multiprocessors and Multi Computers, Data Representation. Register Transfer Language and Micro Operations: Register Transfer Language, Register Transfer Bus and Memory Transfers, Arithmetic Micro Operations, Logic Micro Operations, Shift Micro Operations, Arithmetic Logic Shift Unit, Instruction Codes, Computer Registers Computer Instructions - Instruction Cycle. Memory - Reference Instructions, I/p-O/p and Interrupt, STACK Organization, Instruction Formats, Addressing Modes, DATA Transfer and Manipulation, Program Control, Reduced Instruction Set Computer.	**10**
Unit -2	
Input-Output Organization: Peripheral Devices, I/p-O/p Interface, Asynchronous Data Transfer Modes, Priority Interrupt, Direct Memory Access, I/p-O/p Processor (IOP), Serial Communication; Introduction to Peripheral Components, Interconnect (PCI) Bus, Introduction to Standard Serial Communication Protocols like RS232, USB, IEEE1394.	**9**

The Memory System: Basic Concepts of Semiconductor RAM Memories, Read-Only Memories, Cache Memories Performance Considerations, Virtual Memories secondary Storage, Introduction to RAID.	
Unit – 3	
Processing Unit: Fundamental Concepts: Register Transfers, Performing An Arithmetic Or Logic Operation, Fetching A Word From Memory, Execution of Complete Instruction, Hardwired Control. **Micro programmed Control**: Microinstructions, Micro program Sequencing, Wide Branch Addressing Microinstructions with next –Address Field. Concept of parallel processing, Pipelining, Forms of parallel processing, interconnect network.	**8**
Unit – 4	
Micro processors Architecture: Introduction to 8-bit Processors, Features, Pin Description, 8086 Microprocessor Family, 8086 Internal Architecture, Interrupts, Minimum Mode and Maximum Mode Configuration of 8086. Advanced processor Architectures- 286, 386,486.	**8**
Unit – 5	
8086 Programming: Instruction set, Addressing Modes, Assembler Directives, Writing Simple Programs with an Assembler, Assembly Language Program Development Tools.	**8**
Total	**48**

Course outcomes:

On completion of the course student will be able to:

1. Demonstrate the fundamental organisation of a computer system.
2. Summarize memory and I/O devices
3. Interpret parallel processing, Pipelining and parallel processing concepts.
4. Learn architectures concepts of 8086 and advanced Micro processors.
5. Analyze the programming concepts of 8086 Microprocessor.

Text Books:

1. Carl Hamacher, Zones Vranesic, Safea Zaky, "Computer Organization", 5th Edition, McGraw Hill.
2. John P. Hayes, "Computer Architecture and Organization", 3rd Edition,
3. A. K. Ray, K. M. Bhurchandi, "Advanced Microprocessors and Peripherals", 2nd Edition, Tata McGraw Hill Education Private Limited.

Reference Books:

1. William Stallings, "Computer Organization and Architecture", 6th Edition.
2. Andrew S. Tanenbaum, "Structured Computer Organization", 4th Edition PHI/Pearson.
3. Douglas V Hall, SSSP Rao, "Microprocessors and Interfacing – Programming and Hard ware", 3rd Edition, Tata McGraw Hill Education Private Limited.
4. R. S. Gaonkar, "Microprocessor Architecture: Programming and Applications with the 8085/8080A", Penram International Publishing, 1996

RADIATION SYSTEMS

(Professional Elective – I)

SEMESTER V

Subject Code	21ETETP504B	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:

This course will enable students to:

- To give insight into the radiation phenomena.
- To give a thorough understanding of the radiation characteristics of different types of antennas
- To create awareness about the different types of propagation of radio waves at different frequencies

Unit -1	**Hours**
FUNDAMENTALS OF RADIATION- Antenna parameters - Radiation pattern, Gain, Directivity, Effective aperture, Main lobe and side lobes, Antenna Beam width, Beam efficiency, Bandwidth, Antenna height, Friss transmission formula, Impedance matching: BALUNS, Polarization mismatch, Antenna temperature, half wave dipole and folded dipole, Antenna polarization.	**10**
Unit -2	
ANTENNA ARRAYS - Two element array, N-element linear array, Pattern multiplication, Broadside and end fire array, Array synthesis: Binomial array, Adolph-Tschebyscheff array, Phased array antenna, Yagi-Uda array.	**8**
Unit – 3	
APERTURE ANTENNAS - Huygens' principle, Babinet's principle, Types of Horn antennas, radiation from rectangular aperture, design considerations, Radiation from sectoral and pyramidal horns, parabolic reflector antennas and feeding techniques, microstrip patch antenna .	**11**
Unit – 4	
MODERN ANTENNAS - Phased array antennas, Smart antennas – switched beam and adaptive arrays, UWB antennas, RFID Antennas, Wearable antennas, Reconfigurable antennas, Dielectric resonator antennas, bandwidth enhancement techniques, gain enhancement techniques.	**10**
Unit – 5	

ANTENNA MEASURMENTS - Required equipment in antenna measurement, Antenna measurement range, Measurements: Gain measurement , Directivity measurement , Measurement of phase of an antenna, Measurement of Antenna efficiency and polarization.	**9**

Course outcomes:

On completion of this course, students are able to

1. Comprehend and appreciate the significance and role of this course in the present contemporary world.
2. Understand the fundamentals of the antenna by gaining technical knowledge regarding antenna parameters.
3. Have insight into the radiation phenomena.
4. Have a thorough understanding of the radiation characteristics of different types of Antennas.
5. Identify the different types of propagation of radio waves at various frequencies.

Text Books:

1. John D Kraus, “Antennas for all Applications”, Mc Graw Hill, 5 th Edition, 2005.
2. R.E.Collin, “Antennas and Radio wave propagation”, Mc Graw Hill, 1985.

References:

1. Constantine.A.Balanis, "Antenna Theory Analysis and Design", Wiley student edition,3rd Edition, 2009.
2. Edward C.Jordan and Keith G.Balmain, "Electromagnetic Waves and Radiating Systems", Prentice Hall of India, 2006.
3. S. Drabowitch, "Modern Antennas", Springer Publications, 2 nd Edition, 2007.
4. Robert S.Elliott, "Antenna theory and Design", Wiley student edition, 2010.
5. H.Sizun, "Radio Wave Propagation for Telecommunication Applications", First Indian Reprint, Springer Publications, 2007.

SYSTEM DESIGN THROUGH VERILOG

(Professional Elective – I)

SEMESTER V

Subject Code	21ECECT504C	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre requisite	Digital System Design	**Credits – 03**	

Course Objectives:

Enable the students to

1. Understand basic language constructs of Verilog HDL
2. Design the digital circuits using Verilog HDL
3. Verifying and synthesizing the digital circuits using CAD tools
4. Design simple digital systems based on digital abstractions.

Unit -1	**Hours**
Introduction to Verilog HDL: Verilog as HDL, HDL Design flow, Levels of Design Description, Simulation and Synthesis, Functional Verification **Language Constructs**: Introduction, Module, Keywords, Identifiers, White Space, Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Operators.	**10**
Unit -2	
Gate Level Modeling: Introduction, Gate Primitives, Illustrative Examples, Tri-State Gates, Array of Instances of Primitives, Design of Flip-flops with Gate Primitives, Delays, Strengths and Contention Resolution, Net Types, Switch Level Modeling – CMOS Switches.	**10**
Unit – 3	
Data flow Modeling: Introduction, Continuous Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators. **Behavioral Modeling:** Introduction, Types of Assignments, Initial Construct, Always Construct, Examples, Assignments with Delays, Blocking and Non-blocking Assignments, The case statement, if and if-else constructs, for loop, while loop, forever loop, wait construct.	**10**
Unit – 4	
Implementation of Combinational Circuits: Verilog implementation of combinational logic circuits- Full Adders, Full Subtractors, encoders, decoders, multiplexers and magnitude comparators.	**9**
Unit – 5	
Implementation of Sequential Circuits: - Verilog implementation of sequential logic circuits- latches, Flip-flops, Shift registers, Synchronous counters, Design and analysis of clocked sequential circuits- Sequence detector.	**9**
Total	**50**

Course outcomes:

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

1. Understand Verilog HDL fundamentals.

2. Construct various syntaxes in Gate level modeling.
3. Construct various syntaxes in data flow and behavioral modeling.
4. Examine various combinational circuits.
5. Examine various sequential circuits.

Text Books:

1. Design through Verilog HDL – T.R. Padmanabhan and B. Bala Tripura Sundari, WSE, IEEE Press, 2004.
2. Verilog HDL - Digital Design and Modelling– Joseph. Cavanagh, CRS Press, 2007.

Reference Books:

1. A Verilog Primier – J. Bhasker, BSP, 2003.
2. HDL Design by Palnitkar.

DIGITAL MODULATION AND CODING LAB

SEMESTER V

Subject Code	21ETETL5060	Internal Marks	15
Number of Lecture Hours/Week	02	External Marks	35
Total Number of Hours	36	Exam Hours	03

Credits – 1.5

Course Objectives:

This course will enable students to

- Know Multiplexing Scheme
- Know the Digital Modulation Schemes
- Know the Analog to Digital Conversion Techniques.

List of Experiments:	
Students have to perform a minimum of 10 Experiments using MATLAB programming or MATLAB Simulink. 13. Time Division Multiplexing 14. Differential Pulse Code Modulation 15. Amplitude Shift Keying 16. Frequency Shift Keying 17. Phase Shift Keying 18. Differential Phase Sift Keying 19. Quadrature Phase Shift Keying (QPSK) 20. Implementation of Source Coding Techniques – Huffman Coding, 21. Implementation of Source Coding Techniques – Shannon – Fano coding 22. Linear Block Code – Encoder and Decoder 23. Binary Cyclic Code – Encoder and Decoder 24. Single bit error detection and correction using Hamming code 25. Convolution Code - Encoder and Decoder	**36**

Course outcomes:

On completion of the course student will be able to:

1. Illustrate Multiplexing schemes.
2. Analyze different Digital Modulation & Demodulation schemes.
3. Evaluate various Source & Channel Coding Techniques.
4. Demonstrate the Analog to Digital Conversion techniques.
5. Make an effective report based on experiments.

LINEAR IC APPLICATIONS LAB

SEMESTER V

Subject Code	21ETETL5070	IA Marks	15
Number of Lecture Hours/ Week	03	Exam Marks	35
Total Number of Lecture Hours	36	Exams Hours	03

Credits -1.5

Course Objectives:

This lab will enable the students to

1. Study basic parameters and specifications of various ICs related to Linear ICs.
2. Analyze basic application of IC 741.
3. Understand various filters and timer.
4. Understand the operation of PLL and VCO.
5. Learn the operation of DAC.

List of Experiments:	**Hours**
Conduct any ten experiments using Multisim software. 1. Study of IC 741, IC 555, IC 565 and IC 566 and their functioning, parameters and Specifications. 2. Adder, Subtractor and Comparator using IC 741. 3. Integrator and Differentiator using IC 741. 4. Function Generator using IC 741. 5. Low Pass and High Pass Filters (first order) using IC 741. 6. Monostable Multivibrator using IC 555. 7. Astable Multivibrator using IC 555. 8. Schmitt Trigger Circuits using IC 741 and IC 555. 9. IC 565 PLL Applications. 10. IC 566 VCO Applications. 11. 4-bit DAC using Op-amps. 12. Voltage Regulator using IC 723.	36

Course Outcomes:

On Completion of the lab, student will be able to

1. Understand specifications of Linear ICs.
2. Construct various applications using IC 741.
3. Design various filters and timer based applications.
4. Construct various applications of PLL and VCO.
5. Make an effective report based on experiments.

Course Structure for III B.Tech ECT Under the Regulations of SITE-21						
Semester -VI						
S.No	**Subject Code**	**Name of the subject**	**L**	**T**	**P**	**C**
1	21ETETT6010	Digital Signal Processing	3	0	0	3
2	21ETETT6020	Data Communications and Networking	3	0	0	3
3	21ETETT6030	Microcontrollers and Applications	3	0	0	3
4	21ETETP604X	Professional Elective-II	3	0	0	3
5	21ETXXO605X	Open Elective - II	3	0	0	3
6	21ETETL6060	Digital Signal Processing Lab	0	0	3	1.5
7	21ETETL6070	VLSI Design Lab	0	0	3	1.5
8	21ETETL6080	Microcontroller and Applications Lab	0	0	3	1.5
9	21ETETS6090	Skill advanced course/ soft skill course-4* Soft Skills and Aptitude Builder-2	1	0	2	2
10	21ETETN60A0	Essential of Indian Traditional Knowledge	2	0	0	0
Total Semester Credits						**21.5**
11	H/M	Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)	4	0	0	4

Professional Elective-II

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ETETP604A	Spread Spectrum Techniques	3	0	0	3
2	21ETETP604B	Advanced VLSI Design	3	0	0	3
3	21ETETP604C	Microwave Engineering	3	0	0	3

Open Elective-II

Candidate should select the subject from list of subjects offered by other departments

DIGITAL SIGNAL PROCESSING
SEMESTER VI

Subject Code	21ETETT6010	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Signals and Systems	Credits – 03	

Course Objectives:

This course will enable students to

1. Analyze the Discrete time signals.
2. Compute DFT of a signal using different FFT algorithms.
3. Learn the IIR and FIR filter design procedures.
4. Understand the need of Multirate signal Processing.
5. Understand the basics of DSP Processors.

Unit -1	**Hours**
Introduction: Introduction to Digital Signal Processing: Discrete-time signals, Classification of Discrete-time systems, Stability of LTI systems, Response of LTI systems to arbitrary inputs. Solution of linear constant coefficient difference equations. Frequency domain representation of discrete-time signals and systems. Review of Z-transforms, Solution of difference equations using Z-transforms, System function.	10
Unit -2	
Discrete Fourier Series & Fourier Transforms: Discrete Fourier Series: DFS representation of periodic sequences Properties of DFS. Discrete Fourier transforms: Properties of DFT, Linear filtering methods based on DFT, Fast Fourier transforms (FFT) - Radix-2 decimation in time and decimation in frequency FFT Algorithms, Inverse FFT.	10
Unit -3	
Design of IIR Digital Filters& Realizations: Analog filter approximations – Butter worth and Chebyshev, Design of IIR Digital filters from analog filters, Design Examples, Analog and Digital frequency transformations. Basic structures of IIR systems, Transposed forms. **Design of FIR Digital Filters & Realizations:** Characteristics of FIR Digital Filters, Frequency response. Design of FIR Digital Filters using Window Techniques and Frequency Sampling technique, Comparison of IIR & FIR filters, Basic structures of FIR systems, Lattice structures.	12
Unit – 4	
Multirate Digital Signal Processing: Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Implementation of sampling rate conversion. Applications of Multirate signal processing: Sub-band Coding of Speech Signals.	10
Unit – 5	
DSP Processors: Introduction to programmable DSPs: Multiplier and Multiplier Accumulator, Modified bus structures and memory access schemes in P-DSPs, Multiple Access Memory, Multi-ported memory, VLIW architecture, Pipelining, Special addressing modes, On-Chip Peripherals.	8
Total	**50**

Course outcomes:

On completion of the course, student will be able to

1. Illustrate the Discrete-time signals and systems.
2. Apply the FFT algorithm for solving the DFT of a given signal.
3. Construct a Digital IIR and FIR filter for the given specifications.
4. Apply Multirate signal Processing concepts in various applications.
5. Apply the signal processing concepts on DSP Processor.

Text Books:

1. John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing, Principles, Algorithms, and Applications, Pearson Education, 2007.
2. A.V. Oppenheim and R.W. Schaffer, Discrete Time Signal Processing, PHI, 3rd Edition, 2010.
3. Venkataraman, Bhaskar, Digital Signal Processors, Architecture, Programming and Applications, TATA McGraw Hill, 2002.

Reference Books:

1. A Anand Kumar, Digital Signal Processing, PHI.
2. Robert J. Schilling, Sandra L. Harris, Fundamentals of Digital Signal Processing using MATLAB, Thomson, 2007.

DATA COMMUNICATION AND NETWORKING SEMESTER VI			
Subject Code	21ETETT6020	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
			Credits – 03

Course Objectives:

This course will enable students to

- Understand the concept of data communications and network connection.
- Design and analyze the operation of data link layer.
- Understand the routing protocols in the Network Layer.
- Understand the operation of transport layer and IP.
- The application layer and Principles of Networking Applications.

Unit -1	**Hours**
Introduction to Data Communications: Components, Data Representation, Data Flow, types of networks, Network Topologies, Network Models, Categories of Networks Interconnection of Networks, Network Models, Layered Tasks, OSI model, Layers in OSI model, TCP/IP Protocol Suite, Wireless Links and Network Characteristics, WiFi: 802.11 Wireless LANs -The 802.11 Architecture.	10
Unit -2	
Data Link Layer: Links, Access Networks, and LANs- Introduction to the Link Layer, The Services Provided by the Link Layer, Types of errors, Redundancy, Parity Checks, Check summing Methods, Cyclic Redundancy Check (CRC) , Framing, Flow Control and Error Control protocols , Noisy less Channels and Noisy Channels, HDLC, Multiple Access Protocols, Random Access ,ALOHA, Controlled access.	10
Unit -3	
The Network Layer: Introduction, Forwarding and Routing, Network Service Models, Virtual Circuit and Datagram Networks-Virtual-Circuit Networks, Datagram Networks, Origins of VC and Datagram Networks, Inside a Router-Input Processing, Switching, Output Processing, Queuing, The Routing Control Plane, Internet protocols:IPv4 and IPv6 protocols.	10
Unit – 4	
Transport Layer: Introduction and Transport Layer Services: Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet, Multiplexing and De-multiplexing, Connectionless Transport: UDP, Connection oriented Transport: TCP.	10
Unit – 5	
Application Layer: Principles of Networking Applications, File Transfer Protocol, Electronic Mail, The web and HTTPs, DNS.	8
Total	**48**

Course Outcomes:

1. Able to understand the knowledge of data communications and its networking.
2. Able to design and analyze various error detection techniques.
3. Able to demonstrate the mechanism of routing the data in network layer.
4. Able to design the transport layer protocol.
5. Able to understand the application layer.

Text Books:

1. Computer Networking A Top-Down Approach – Kurose James F, Keith W, 6thEdition , Pearson,2017.
2. Data Communications and Networking Behrouz A.Forouzan4th Edition McGraw Hill Education, 2017.

Reference Books:

1. Data communication and Networks - Bhusan Trivedi, Oxford university press, 2016.
2. Computer Networks -- Andrew S Tanenbaum, 4th Edition, Pearson Education, 2003.
3. Understanding Communications and Networks, 3 rd Edition, W.A.Shay, Cengage Learning, 2003.

MICROCONTROLLERS AND APPLICATIONS SEMESTER VI			
Subject Code	21ETETT6030	Internal Marks	30
Number of Lecture Hours/Week	3	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
			Credits – 03

Course Objective:

This course will enable students to:

- Understand internal architecture and functional description of 8051 microcontroller.
- Learn the programming models of 8051 Microcontroller using embedded C.
- Interpret the concept of 8051 microcontroller internal architecture like Timer/Counter, I/O ports interfacing.
- Discuss the operational aspects of advanced controlling boards.

Unit -1	Hours
Intel 8051 Microcontroller Architecture: Introduction to Microcontrollers (8051): Microprocessors & Microcontrollers Comparison, Overview of 8051 Microcontroller, Internal Block Diagram of 8051, Pin Diagram of 8051, Memory Organization, Internal RAM Memory Structure, External Memory interfacing.	8
Unit -2	
Intel 8051 Interfacing and Programming: **8051 Interfacing-** Input/output ports and circuits, counters/timers, serial data input/output, Interrupts. Instruction syntax, addressing modes with examples **8051 Programming Concepts-**Assembler directives, Classification of Instructions and basic 8051 Assembly Language Programs using Data Transfer and arithmetic Instructions.	10
Unit – 3	
8051 I/O Interfacing: Introduction to Embedded C. LEDs & switches interfacing, keypad interfacing, Seven Segment Display interfacing, ADC & DAC interfacing, 2x16 LCD interfacing stepper motor interfacing, serial port interfacing, high power devices. Embedded C programming for above interfacings.	10
Unit – 4	
Introduction to Arduino: Functional Block diagram of Arduino, Architecture, Pin functions, Arduino IDE, writing, saving, compiling and uploading sketches, Arduino Shields and Libraries. General Hardware Interfacing- LED's, Switches, Seven segment display, Relay's, LCD, Buzzer, POT, Introduction to sensors and actuators, Digital and Analog Sensors, and other basic electronic components interfacing with ARDUINO and programming.	10
Unit – 5	
Introduction to On board Computing Boards: Introduction to Raspberry Pi board, Board preparation and installation procedures of OS, Configuration and updating of OS. Basic Commands in Raspberry Pi OS, Bash command line operation. **Raspberry Pi GPIO operations:** Communication with devices through the pins of the Raspberry Pi, RPi. GPIO library, Python functions, setting up the pins, General purpose IO pins, Protocol Pins, GPIO Access- Simple interfacings	10

like LED, Buzzer, Switch, Display, matric keyboard and seven segment display etc.	
Total	**48**

Course outcomes:

On completion of the course student will be able to

1. Understand the internal operations of 8051microcontroller
2. Apply the programming model of 8051 Microcontroller using embedded C.
3. Apply the interfacing concepts of 8051 with I/O ports and other peripherals.
4. Demonstrate the real world solutions with 8051 Microcontroller.
5. Discuss the operational aspects of advanced Processors.
6. Interpret the operational view of on board computers.

Text Books:

1. The 8051 Microcontroller and Embedded Systems Using Assembly and C by Muhammad Ali Mazidi, Rolinmckinlay Janice GillispieMazidi, Pearson, Second Edition.
2. Programming and Interfacing with Arduino by Yogesh Misra, CRC Press, ISBN: 9781000431681, 1000431681.
3. Exploring Raspberry Pi-Interfacing to the Real World with Embedded LinuxBy Derek Molloy · 2016, ISBN: 9781119188681, 1119188687.

Reference Books:

1. Kenneth J. Ayala, The 8051 Microcontroller, Penram International Publishing, 1996.
2. Raspberry PI 3: a Comprehensive Beginner's Guide From a to Z Simple Steps by Darryl Barton · 2016, ISBN: 9781540328199, 1540328198.
3. Programming Arduino Getting Started with Sketches by Simon Monk · 2011, McGraw-Hill Education, ISBN:9780071784238, 0071784233.

Professional Elective-II

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ETETP604A	Spread Spectrum Techniques	3	0	0	3
2	21ETETP604B	Advanced VLSI Design	3	0	0	3
3	21ETETP604C	Microwave Engineering	3	0	0	3

SPREAD SPECTRUM TECHNIQUES (Professional Elective-II) SEMESTER VI			
Subject Code	21ETETP604A	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

This course will enable students to:

- Understand the concept of Spread Spectrum and study various types of Spread spectrum sequences and their generation.
- Understand the principles of Code Division Multiple Access (CDMA) and use of Spread spectrum concept in CDMA.
- Understand various Code tracing loops for optimum tracking of wideband signals viz Spread spectrum signals.
- Understand the procedure for synchronization of receiver for receiving the Spread spectrum signal.
- Study the performance of spread spectrum systems in Jamming environment, systems with Forward Error Correction and Multiuser detection in CDMA cellular radio.

Unit -1	**Hours**
Introduction to Spread Spectrum Systems: Fundamental Concepts of Spread Spectrum Systems, Pseudo Noise Sequences, Direct Sequence Spread Spectrum, Frequency Hop Spread Spectrum, Hybrid Direct Sequence Frequency Hop Spread Spectrum, Code Division Multiple Access. Binary Shift Register Sequences for Spread Spectrum Systems: Introduction, Definitions, Mathematical Background and Sequence Generator Fundamentals, Maximal Length Sequences, Gold Codes.	8
Unit -2	
Code Tracking Loops: Introduction, Optimum Tracking of Wideband Signals, Base Band Delay-Lock Tracking Loop, Tau-Dither Non- Coherent Tracking Loop, Double Dither Non-Coherent Tracking Loop.	8
Unit – 3	
Initial Synchronization of the Receiver Spreading Code: Introduction, Problem Definition and the Optimum Synchronizer, Serial Search Synchronization Techniques, Synchronization using a Matched Filter, Synchronization by Estimated the Received Spreading Code.	11
Unit – 4	
Cellular Code Division Multiple Access (CDMA) Principles: Introduction, Wide Band Mobile Channel, The Cellular CDMA System, Single User Receiver in a Multi User Channel, CDMA System Capacity. Multi-User Detection in CDMA Cellular Radio: Optimal Multi-User Detection, Linear Suboptimal Detectors, Interference Combat Detection Schemes, Interference Cancellation Techniques.	11
Unit – 5	

Performance of Spread Spectrum Systems in Jamming Environments: Spread Spectrum Communication System Model, Performance of Spread Spectrum Systems without Coding. Performance of Spread Spectrum Systems with Forward Error Correction: Elementary Block Coding Concepts, Optimum Decoding Rule, Calculation of Error Probability, Elementary Convolution Coding Concepts, Viterbi Algorithm, Decoding and Bit-Error Rate.	10
Total	**48**

Course outcomes:

On completion of this course, students are able to

1. Understand Spread spectrum techniques and various codes used in SST.
2. Explain code tracking loops and significance.
3. Explain the concept of Synchronization of the receiver Spreading Code.
4. Explain the Synchronization of Received Spreading Code.
5. Understand the Interference Combat Detection Schemes, Interference Cancellation Techniques.
6. Analyze the performance of Spread spectrum systems in Jamming environment and systems with Forward Error Correction.

Text Books:

1. Rodger E Ziemer, Roger L. Peterson and David E Borth - "Introduction to Spread Spectrum Communication- Pearson, 1st Edition, 1995.
2. Mosa Ali Abu-Rgheff – "Introduction to CDMA Wireless Communications." Elsevier Publications, 2008.

References:

1. George R. Cooper, Clare D. Mc Gillem - "Modern Communication and SpreadSpectrum," McGraw Hill, 1986.
2. Andrew j. Viterbi - "CDMA: Principles of spread spectrum communication," Pearson Education, 1st Edition, 1995.

ADVANCED VLSI DESIGN
(Professional Elective-II)
SEMESTER VI

Subject Code	21ETETP604B	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite	Microelectronics and VLSI Design	Credits – 03	

Course Objectives:
This course will enable students to
- To study the fundamental concepts in low power CMOS VLSI design.
- To learn about different FPGA designs and implementation.
- Calculate yield and test vectors for IC design.
- To study the fundamental concepts of VLSI Interconnects.

Unit -1	**Hours**
Low-Power CMOS VLSI Design: Sources of power dissipation, static power dissipation, active power dissipation, designing of low power, circuit techniques for leakage power reduction.	8
Unit -2	
FPGA Design: FPGA design flow, Basic FPGA architecture, FPGA Technologies, FPGA families- Altera Flex 8000FPGA, Altera Flex 10FPGA, Xilinx XC4000 series FPGA, Xilinx Spartan XL FPGA, Xilinx Spartan II FPGAs, Xilinx Vertex FPGA.	10
Unit -3	
Design for Manufacturability: Introduction, Process Variations, Basic Concepts and Definitions, Design of Experiments and Performance Modelling, Parametric Yield Estimation and Yield Maximization, Worst-Case Analysis.	10
Unit – 4	
Design for Testability: Introduction, Fault Types and Models, Controllability and Observability Ad Hoc Testable Design Techniques, Scan-Based Techniques, Built-In Self-Test (BIST) Techniques, Current Monitoring IDDQ Test.	10
Unit – 5	
Introduction to VLSI Interconnects: Distributed RC interconnect model, Elmore delay, Elmore delay in interconnects, Elmore delay in RC tree and branched interconnects, Equivalent circuit of RC interconnect, Scaling Effects, Delay mitigation in RC interconnects, RC interconnect simulation session, Inductive effects in interconnects.	10
Total	**48**

Course outcomes:
On completion of the course student will be able to
1. Understand fundamental concepts in low power CMOS VLSI design.
2. Examine commercial architectures of FPGA.
3. Understand design for Manufacturability.
4. Understand design for Testability.
5. Understand the concepts of VLSI Interconnects.

Text Books:
1. Kamran Eshraghian, Douglas and A. Pucknell and Sholeh Eshraghian, Essentials of VLSI Circuits and Systems, Prentice-Hall of India Private Limited, 2005.

2. Sung-Mo Kang, Yusuf Leblebic, CMOS Digital Integrated Circuits Analysis & Design McGraw-Hill Higher Education, 2002.

Reference Books:

1. Introduction to VLSI Design by Eugene D. Fabricius, McGraw Hill International Editions, 1990.
2. Modern VLSI Design System on chip by Wayne Wolf, Pearson Education, 2002.

MICROWAVE ENGINEERING
(Professional Elective-II)
SEMESTER-VI

Subject Code	21ETETP604C	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	EM Waves and Transmission Lines	Credits – 03	

Course Objectives:

This course will enable students to

1. Understand the concepts of Rectangular waveguides, micro strip lines, and cavity resonators
2. Analyze the passive components for microwave systems and obtain the characteristics of these components
3. Analyze microwave O-type vacuum tubes
4. Understand the generation & amplification of the microwave signals and obtain the characteristics of O & M Type Tubes.
5. Understand the microwave measurement process

Unit -1	**Hours**
Introduction to microwaves: History, Microwave Spectrum and Bands, Applications of Microwaves. **Rectangular Waveguides**: Introduction, TE/TM mode analysis, Dominant and Degenerate Modes, Sketches of TE and TM mode fields in the cross-section, Mode Characteristics – Phase and Group Velocities, Wavelengths and Impedance Relations,Power Transmission and Power Losses in Rectangular Guide, Impossibility of TEM mode. Related Problems. **Microstrip Lines**– Introduction, Zo Relations, Effective Dielectric Constant, Losses, Q factor.	12
Unit -2	
Microwave Passive Components: Coupling Mechanisms – Probe, Loop, Aperture types. Waveguide Attenuators – Resistive Card, Rotary Vane types; Waveguide Phase Shifters – Dielectric, Rotary Vane types, Scattering Matrix– Significance, Formulation and Properties, S-Matrix Calculations for – 2 port Junction, E-plane and H-plane Tees, Magic Tee, Hybrid Ring; Directional Couplers – 2Hole, Bethe Hole types, Ferrite Components– Faraday Rotation, S-Matrix Calculations for Gyrator, Isolator, Circulator, Related Problems.	10
Unit -3	
Microwave Tubes: Limitations and Losses of conventional tubes at microwave frequencies, Re-entrant Cavities, Microwave tubes – O type and M type classifications, O-type tubes :2 Cavity Klystrons – Structure, Velocity Modulation Process and Applegate Diagram, Bunching Process and Small Signal Theory –, Applications. **Reflex Klystrons** – Structure, Applegate Diagram and Principle of working Electronic Admittance; Oscillating Modes and output Characteristics, Electronic and Mechanical Tuning, Applications,	10
Unit – 4	
Helix TWTs: Significance, Types and Characteristics of Slow Wave Structures; Structure of TWT and Suppression of Oscillations, **M-Type Tubes :** Introduction, Cross-field effects, Magnetrons – Different Types, 8-Cavity Cylindrical Travelling Wave Magnetron – Hull Cut-off Condition,	8

Modes of Resonance and PI-Mode Operation, Separation of PI-Mode, o/p characteristics	
Unit – 5	
Microwave Solid State Devices: Introduction, Classification, Applications. TEDs – Introduction, Gunn Diode – Principle, RWH Theory, Characteristics, Basic Modes of Operation, Oscillation Modes. **Microwave Measurements:** Description of Microwave Bench – Different Blocks and their Features, Precautions; Microwave Power Measurement – Bolometer Method. Measurement of Attenuation, Frequency, Q- factor, Phase shift, VSWR, Impedance Measurement	10
Total	**50**

Course outcomes:

On completion of the course, student will be able to

1. To understand microwave transmission lines
2. To analyze various microwave passive components with their working
3. To analyze various microwave O-type tubes
4. To analyze various M Type microwave vacuum tubes
5. To study the importance of microwave measurements

Text Books:

1. Samuel Y. Liao, Microwave Devices and Circuits, Pearson, 1990
2. M. Kulkarni, Microwave and Radar Engineering, Umesh Publications, 2009

Reference Books:

1. Annapurna Das and Sisir K. Das, "Microwave Engineering", 3rd Edition, Tata McGraw-Hill Education, 2000
2. G S N Raju, Microwave Engineering, I K International Publishing House Pvt. Ltd, 2013

DIGITAL SIGNAL PROCESSING LAB SEMESTER VI			
Subject Code	21ETETL6060	Internal Marks	15
Number of Lecture Hours/Week	03	External Marks	35
Total Number of Hours	36	Exam Hours	03
Credits – 1.5			

Course Objectives:

This course will enable students to

1. Generate the fundamental discrete-time signals.
2. Perform Convolution and DFT operation
3. Design Infinite Impulse Response filters.
4. Design Finite Impulse Response filters.
5. Understand the concept of Noise removal in a signal.

List of Experiments: students has to perform any 10 experiments	**Hours**
1. Generation of discrete-time signals for discrete signals 2. To verify the Linear Convolution for discrete signals a. Using MATLAB b. Using Code Composer Studio (CCS) 3. To verify the Circular Convolution for discrete signals a. Using MATLAB b. Using Code Composer Studio (CCS) 4. To verify the autocorrelation between two discrete signals 5. To verify Discrete Fourier Transform (DFT) and Inverse Discrete Fourier Transform (IDFT) a. Using MATLAB b. Using Code Composer Studio (CCS) 6. Determination of the power spectrum of a discrete signal 7. Frequency Response of IIR low pass Butterworth Filter 8. Frequency Response of IIR High pass Butterworth Filter 9. Frequency Response of IIR Low pass Chebyshev Filter 10. Frequency Response of IIR high pass Chebyshev Filter 11. Frequency Response of FIR low pass Filter using Rectangle Window 12. Frequency Response of FIR high pass Filter using Rectangle Window 13. Implementation of the Decimation Process 14. Implementation of Interpolation Process	**36**

Course outcomes:

On completion of the course, students will be able to

1. Illustrate the fundamental discrete-time signals
2. Experiment with the properties of an LTI system
3. Construct a Digital IIR filter for the given specifications.
4. Construct a Digital FIR filter for the given specifications.
5. Apply basic building blocks of Multi-rate signal processing.

VLSI Design LAB SEMESTER VI			
Subject Code	21ETETL6070	IA Marks	15
Number of Lecture Hours/ Week	03	Exam Marks	35
Total Number of Lecture Hours	36	Exams Hours	03
			Credits -1.5

Course Objectives:

This lab will enable the students to

6. Design CMOS logic circuits.
7. Simulate combinational and sequential CMOS circuits.
8. Analyze layouts for combinational CMOS circuits.
9. Analyze of layouts for sequential CMOS circuits.
10. Perform DRC and LVS for CMOS circuits.

List of Experiments:	Hours
Conduct any ten experiments using Mentor Graphics/Cadence/Synopsis software. 13. Design and Implementation of an Inverter. 14. Design and Implementation of a NAND Gate. 15. Design and Implementation of an NOR Gate. 16. Design and Implementation of Full Adder. 17. Design and Implementation of 4-bit Ripple Carry Adder. 18. Design and Implementation of Multiplexer using Transmission Gate. 19. Design and Implementation of Decoder. 20. Design and Implementation of D Flip-flop. 21. Design and Implementation 4-bit Register. 22. Design and Implementation asynchronous counter. 23. Design and Implementation of static RAM cell. 24. Design and Implementation of Sequence Detector.	**36**

Course Outcomes:

On Completion of the lab, student will be able to

6. Design CMOS logic circuits
7. Design and simulate Combinational and Sequential CMOS circuits.
8. Generate and verify layouts for combinational CMOS circuits.
9. Generate and verify layouts for sequential CMOS circuits.
10. Design and analyze DRC and LVS for CMOS.

Microcontroller and Applications Lab
SEMESTER VI

Subject Code	18ETETL6080	Internal Marks	15
Number of Lecture Hours/Week	03	External Marks	35
Total Number of Hours	36	Exam Hours	03
			Credits -1.5

Course Objectives:

This course will enable students to

1. To learn the basic input and output interfacing concepts with 8051 microcontroller.
2. Understand the concepts of Arduino Uno, Raspberry Pi Board and different types of I/O Devices.
3. To develop Embedded C language program skills.
4. To develop Python language program skills.
5. Providing the basic knowledge of interfacing various peripherals to Raspberry Pi

List of Experiments:	**Hours**
Part-A (Minimum of 3 Experiments has to be performed)	
1. Write a Embedded C program and verify different timer mode operations for LEDs Interfacing with 8051 2. Write a Embedded C program for displaying digits in 2 digit seven segment display interface with 8051 3. Stepper motor interfacing with 8051 for clockwise and anticlockwise rotation. 4. External ADC and Temperature control interface to 8051 using LM35 sensor 5. Implement Serial Communication Implementation between system and 8051	
Part-B (Perform all Experiments)	
1. Introduction and history of Arduino, types of Arduino boards, Install the Arduino Desktop IDE, Installing Libraries, functions and components of Arduino programming. 2. Introduction to Raspberry Pi Board, identification of components and software required, download and installation procedures of necessary software images in the memory card and booting of Raspberry Pi board.	
Part-C (Perform any 3 Experiments)	
1.Write an Embedded C program to glow LEDs using push switch with Arduino Uno Board. 2.Write an Embedded C program to display "Hello World" message on I2C LCD interfacing with Arduino Uno Board. 3.Write an Embedded C Program to control speed and direction of a stepper motor with Arduino Uno 4.Write an Embedded C Program to control speed and direction of a DC motor with Arduino Uno. 5.Write an Embedded C Program to implement real time clock using RTC modules with Arduino Uno and I2C LCD.	
Part- D (Minimum of 2 Experiments has to be performed)	
1. Write a Python program to interface LED, Switch and buzzer with Raspbery Pi Board. 2. Write a Python code to interface camera with Raspberry Pi board.	**36**

3. Write a Python code to read following sensor data and display the data in TFT screen. a) DHT11/22, b). Light Sensor (TEMT6000). 4. Write a Python code to read soil moisture and DS18B20sensor interfacing with raspberry Pi board and display in TFT screen.	

Course outcomes:

On completion of the course student will be able to

1. Illustrate the interfacing concepts of various components with 8051 microcontroller board.
2. Understand the concepts of Arduino Uno and different types of I/O Devices.
3. Develop Embedded C programs for different applications using Arduino Uno
4. Construct interfacing circuits for different Applications using Raspberry Pi
5. Compile, design and test various hardware components with raspberry Pi using Python Language

Course Structure for IV B.Tech ECT Under the Regulations of SITE-21						
Semester -VII						
S.No	**Subject Code**	**Name of the subject**	**L**	**T**	**P**	**C**
1	21ETETP701X	Professional Elective -III	3	0	0	3
2	21ETETP702X	Professional Elective -IV	3	0	0	3
3	21ETETP703X	Professional Elective -V	3	0	0	3
4	21ETXXO704X	Open Elective - III	3	0	0	3
5	21ETXXO705X	Open Elective - IV	3	0	0	3
6	21ETXXO706X	Open Elective - V	3	0	0	3
7	21CMAHS7070	Skill advanced course/ soft skill course	1	0	2	2
8	21ETETR7080	Summer Internship 2 months after Third year (To be evaluated during VII sem)	3	0	0	3
Total Semester Credits						**23**
9		Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)	4	0	0	4

Professional Elective-III

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ETETP701A	Digital Image Processing	3	0	0	3
2	21ETETP701B	Telecommunications and Switching Networks	3	0	0	3
3	21ETETP701C	CAD Tools for VLSI	3	0	0	3

Professional Elective-IV

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ETETP702A	Bio-Medical Signal Processing	3	0	0	3
2	21ETETP702B	Global Position Systems	3	0	0	3
3	21ETETP702C	Optical Communication	3	0	0	3

Professional Elective-V

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ETETP703A	RF System Design	3	0	0	3
2	21ETETP703B	Internet of Things	3	0	0	3
3	21ETETP703C	Radar and Satellite Communications	3	0	0	3

Open Elective-III

Candidate should select the subject from list of subjects offered by other departments

Open Elective-IV

Candidate should select the subject from list of subjects offered by other departments

Open Elective-V

Candidate should select the subject from list of subjects offered by other departments

DIGITAL IMAGE PROCESSING (Professional Elective-III) SEMESTER VII			
Subject Code	21ETETP701A	**Internal Marks**	30
Number of Lecture Hours/Week	03	**External Marks**	70
Total Number of Hours	50	**Exam Hours**	03
Prerequisite	SS & DSP		**Credits – 3**

Course Objectives:

This course will enable students to

1. Familiarize with basic concepts of digital image processing and image transforms.
2. Make use of filtering in spatial and frequency domains.
3. Inference the images using wavelets and to discuss various compression models.
4. Outline the color models and explain the Morphological image processing concepts on grayscale images.
5. Choose various segmentation algorithms on digital images

Unit-1	**Hours**
Introduction: The origins of Digital Image Processing, Fundamental steps in Digital Image Processing, Components of an image processing system, Image sensing and acquisition, Image sampling and quantization, Some basic relationships between pixels. **Image Transforms:** Need for image transforms, 2-D Discrete Fourier transform (DFT) and its properties, Walsh transform, Hadamard transform, Haar transform, Discrete cosine transform, PCA and SVD.	**12**
Unit-2	
Intensity Transformations and Spatial Filtering: Background, some basic intensity transformation functions, Histogram processing, Fundamentals of spatial filtering, smoothing spatial filters, Sharpening spatial filters. **Filtering in the Frequency Domain:** The basics of filtering in the frequency domain, Image smoothing using frequency domain filters, Image Sharpening using frequency domain filters, Selective filtering.	**10**
Unit-3	
Wavelets and Multiresolution Processing: Image pyramids, Sub-band coding, Multiresolution expansions, Wavelet transforms in one dimensions & two dimensions, Wavelet coding. **Image Compression:** Fundamentals, Basic compression methods: Huffman coding, Arithmetic coding, LZW coding, Run-length coding, Block transform coding, Predictive coding.	**10**
Unit-4	
Color Image Processing: Color fundamentals, Color models, Pseudo color Image Processing. **Morphological Image Processing:** Preliminaries, Erosion and Dilation, Opening and Closing, Basic morphological algorithms.	**8**
Unit-5	
Image segmentation: Fundamentals, Point, Line and Edge detection, Thresholding, Region-based Segmentation.	**10**

Case studies on digital image processing: Feature Detection, Face Recognition, Image Cryptography.	
Total	**50**

Course outcomes:

On completion of the course, students will be able to

1. Interpret the fundamentals of digital image processing and apply various transforms on digital images.
2. Apply filtering concepts in spatial and frequency domains
3. Analyze digital images using compression algorithms
4. Classify the color models and interpret the Morphological image processing concepts to grayscale images.
5. Apply various segmentation algorithms on digital images

Text Books:

1. R. C. Gonzalez and R. E. Woods, **"**Digital Image Processing", 3rd edition, Prentice Hall, 2008
2. Jayaraman, S. Esakkirajan, and T. Veerakumar," Digital Image Processing", Tata McGraw-HillEducation, 2011.

Reference Books:

1. Anil K.Jain, **"**Fundamentals of Digital Image Processing", Prentice Hall of India, 7thEdition, Indian Reprint, 1989
2. B.Chanda, D.Dutta Majumder, "Digital Image Processing and Analysis", PHI, 2009

Telecommunications and Switching Networks (Professional Elective –III) SEMESTER VII			
Subject Code	21ETETP701B	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
			Credits – 03

Course Objectives:

This course will enable the students to:

- To provide students with a balanced blend of theoretical and practical aspects regarding Telecommunication Switching System.
- To expose through the evolution of switching systems from manual and Electro mechanical systems to stored-program-controlled digital systems.
- To provide knowledge to the students regarding design and performance analysis of various switching systems.
- To train the students about basic Telephone Networks structures and traffic Engineering concepts.
- To inculcate students on various internet concepts like OSI reference model, LAN, WAN, WAN, Repeaters, bridges, routers ,gateways ,data communication networks and ISDN.

Unit -1	**Hours**
Telecommunication Switching Systems: Introduction, Elements of switching systems, switching network configuration, Rotary switches, Uniselector, Two motion selector, Trunking principle ,principles of cross bar switching, Crossbar Switch Configuration, Cross point Technology, Crossbar Exchange Organization.	9
Unit -2	
Electronic Space Division Switching: Stored Program Control, Centralized SPC, Distributed SPC, Software Architecture, Application Software, Enhanced services, Two Stage Networks, Three-Stage Networks, n-Stage Networks. Time Division Switching: Basic Time Division Space Switching, Basic Time Division Time Switching, Time Multiplexed Space Switching, Time Multiplexed Time Switching, Combination Switching, Three Stage Combination Switching, n - Stage Combinational Switching.	10
Unit – 3	
Telecommunications Traffic: Introduction, The Unit of Traffic, Congestion; Traffic Measurement, A Mathematical Model, Lost-Call Systems-Theory, Traffic Performance, Loss Systems in Tandem, Use of Traffic Tables. **Queuing Systems**: The Second Erlang Distribution, Probability of Delay, Finite Queue Capacity, Some Other Useful Results, Systems with a Single Server, Queues in Tandem, Delay Tables, Applications of Delay Formulae.	10
Unit – 4	

Telephone Networks: Subscriber loop systems, switching hierarchy and routing, transmission plan, transmission systems, numbering plan, charging plan, Signaling techniques: In channel signaling, common channel signaling, Cellular mobile telephony. **Data Networks:** Data transmission in PSTNs, Switching techniques for data transmission, data communication architecture, link to link layers, end to end layers, satellite based data networks, LAN, MAN, Internetworking.	10
Unit – 5	
Integrated Services Digital Network (ISDN): Introduction, motivation, new services, Network and protocol architecture, Transmission channels, User-Network interfaces, functional grouping, reference points, signaling, numbering, addressing, BISDN. DSL Technology: ADSL, Cable Modem, Traditional Cable Networks, HFC Networks, Sharing, CM & CMTS and DOCSIS. SONET: Devices, Frame, Frame Transmission, Synchronous Transport Signals, and STS I, Virtual Tributaries, and Higher rate of service.	9
Total	**48**

Course outcomes:

On completion of the course student will be able to:

1. Students will be able to analyze different switching methodologies.
2. Students will be able to differentiate between signaling methods used in Telecommunication Networks.
3. Students will be able to understand queuing systems and models.
4. Students will exhibit a good knowledge on data communication networks and ISDN and be able to differentiate LAN, MAN, WAN.
5. Students will demonstrate an ability to work on various Telecommunication Network concepts.
6. Students will demonstrate knowledge on modern telecommunication concepts like DSL & SONET.

Text Books:

1. Tele communication switching system and networks – Thyagarajan Viswanath, PHI, 2000.
2. J. E Flood, "Telecommunications Switching and Traffic Networks," Pearson Education, 2006.
3. Data Communication & Networking - B.A. Forouzan, TMH, 4th Edition, 2004.

Reference Books:

1. Digital telephony - J. Bellamy, John Wiley, 2nd edition, 2001.
2. Data Communications & Networks - Achyut. S. Godbole, TMH, 2004.
3. Principles of Communication Systems – H. Taub & D. Schilling, TMH, 2nd Edition, 2003.
4. An Engineering approach to computer networking - S. Keshav, Addison W.

Professional Elective-IV

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ETETP702A	Bio-Medical Signal Processing	3	0	0	3
2	21ETETP702B	Global Position Systems	3	0	0	3
3	21ETETP702C	Optical Communication	3	0	0	3

CAD Tools for VLSI
(Professional Elective –IV)
SEMESTER VII

Subject Code	21ETETP701C	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 3

Course Objectives:
This course will enable the students to:

- Hardware software co-design.
- Synthesis tools and VHDL modeling for digital circuits.
- Computational complexity issues in testing the circuits.
- Simulation for various design circuits.

Unit -1	**Hours**
Introduction: VLSI design methodologies and supporting CAD environment Schematic editors: Parsing: Reading files, describing data formats, Graphics & Plotting Layout. Layout Editor- Turning plotter into an editor.	10
Unit -2	
Layout Language and Analysis: Layout language- Parameterized cells, PLA generators, Introduction to Silicon compiler, Data path. Compiler, Placement & routing, Floor planning. Layout Analysis-Design rules, Object based DRC, Edge based layout operations. Module generators.	9
Unit – 3	
Simulation Algorithms: Types of simulation, Behavioral simulator, logic simulator, functional simulator & Circuit simulator. Introduction and significance of Compiled code and Event-driven simulation algorithms.	10
Unit – 4	
Optimization Algorithms: Greedy methods, simulated annealing, genetic algorithm and neural models.	9
Unit – 5	
Testing ICs: Fault simulation, Aids for test generation and testing. Computational complexity issues: Big Oh and big omega terms. **Recent topics in CAD-VLSI:** Array compilers, hardware software co-design, high-level synthesis tools and VHDL modeling.	10
Total	**48**

Course outcomes:
On completion of the course student will be able to

1. Understand VLSI design methodologies and supporting CAD environment and also understand the Plotting Layout, Layout Editor.
2. Design the layouts in VLSI.
3. Understand Simulation techniques for various design circuits.
4. Explain Optimization Algorithms for the design circuits.
5. Analyze the Computational complexity issues in testing the circuits.

Text Books:

1. Stephen Trimberger," Introduction to CAD for VLSI", Kluwer Academic

publisher, 2002
2. Naveed Shervani, "Algorithms for VLSI physical design Automation", Kluwer Academic Publisher, Second edition.

Reference Books:

1. Gaynor E. Taylor, G. Russell, "Algorithmic and Knowledge Based CAD for VLSI", Peter peregrinus ltd. London.
2. Gerez, "Algorithms VLSI Design Automation", John Wiley & Sons.

Biomedical Signal Processing
(Professional Elective –IV)

SEMESTER VII			
Subject Code	21ETETP702A	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
			Credits – 3

Course Objectives:

This course will enable the students to:

- Describe the Detection of biomedical signals in noise
- Analyze the Spectral analysis of heart rate variability - interaction with other physiological signals
- Understand the categorization of EEG activity - recording techniques - EEG applications
- Analyze the stochastic models – Non-linear modeling of EEG

Unit -1	**Hours**
Introduction To Biomedical Signals - Examples of Biomedical signals - ECG, EEG, EMG etc., Tasks in Biomedical Signal Processing - Computer Aided Diagnosis. Origin of bio potentials - Review of linear systems - Fourier Transform and Time Frequency Analysis (Wavelet) of biomedical signals- Processing of Random &Stochastic signals – spectral estimation – Properties and effects of noise in biomedical instruments - Filtering in biomedical instruments.	**10**
Unit -2	
Concurrent, Coupled and Correlated Processes - Illustration with case studies – Adaptive and optimal filtering - Modeling of Biomedical signals - Detection of biomedical signals in noise -removal of artifacts of one signal embedded in another -Maternal-Fetal ECG - Muscle-contraction interference. Event detection – case studies with ECG & EEG - Independent Component Analysis - Cocktail party problem applied to EEG signals - Classification of biomedical signals	**10**
Unit – 3	
Cardio Vascular Applications: Basic ECG - Electrical Activity of the heart- ECG data acquisition – ECG parameters & their estimation - Use of multi-scale analysis for ECG parameters estimation - Noise &Artifacts- **ECG Signal Processing:** Baseline Wandering, Power line interference, Muscle noise filtering – QRS detection -Arrhythmia analysis	**10**
Unit – 4	
Data Compression: Lossless &Lossy- Heart Rate Variability – Time Domain measures - Heart Rhythm representation - Spectral analysis of heart rate variability - interaction with other physiological signals	**9**
Unit – 5	
Neurological Applications: The electroencephalogram - EEG rhythms & waveform - categorization of EEG activity - recording techniques - EEG applications- Epilepsy, sleep disorders, brain computer interface. Modeling EEG- linear, **Stochastic models** – Non-linear modeling of EEG - artifacts in EEG & their characteristics and processing – Model based spectral analysis - EEG segmentation - Joint Time-Frequency analysis – correlation analysis of EEG channels - coherence analysis of EEG channels.	**9**
Course outcomes:	

On completion of the course student will be able to

1. Understand the need of biomedical signals
2. Describe the Detection of biomedical signals in noise
3. Understand ECG, ECG parameters estimation
4. Analyze the Spectral analysis of heart rate variability - interaction with other physiological signals
5. Understand the categorization of EEG activity - recording techniques - EEG applications
6. Analyze the stochastic models – Non-linear modeling of EEG

Text Books:

1. D.C.Reddy ,"Biomedical Signal Processing: Principles and techniques" ,Tata McGraw Hill, New Delhi
2. Willis J Tompkins , Biomedical Signal Processing -, ED, Prentice – Hall

Reference Books:

1. Biomedical Signal Processing, MetinAkay, Academic Press
2. Biomedical Signal Processing: Volume 2: Compression and Automatic Recognition, ArnonCohen, CRC Press
3. Biomedical Signal Processing: Advances in Theory, Algorithms and Applications, Ganesh Naik, Springer

Global Positioning Systems
(Professional Elective –IV)
SEMESTER VII

Subject Code	21ETETP702B	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
			Credits – 3

Course Objectives:

This course will enable the students to:

- To introduce fundamental blocks of global positioning system
- To analysis on signal characteristics of GPS
- Explore to the GPS Design analysis
- Illustrate about differential GPS
- Introduce about applications of GPS

Unit -1	**Hours**
Introduction: Basic concept, system architecture, GPS and GLONASS Overview, Satellite Navigation, Time and GPS, User position and velocity calculations, GPS, Satellite Constellation, Operation Segment, User receiving Equipment, Space Segment Phased development, GPS aided Geo-augmented navigation (GAGAN) architecture.	**10**
Unit -2	
Signal Characteristics: GPS signal components, purpose, properties and power level, signal acquisition and tracking , Navigation information extraction, pseudo range estimation, frequency estimation, GPS satellite position calculation, Signal structure, anti spoofing (AS), selective availability, Difference between GPS and GALILEO satellite construction.	**9**
Unit – 3	
GPS Receivers & Data Errors: Receiver Architecture, receiver design options, Antenna design, GPS error sources, SA errors, propagation errors, ionosphere error, troposphere error, multipath, ionosphere error, estimation using dual frequency GPS receiver. **Multipath Mitigation:** Methods of multipath mitigation, Ephemeris data errors, clock errors.	**10**
Unit – 4	
Differential GPS: Introduction, LADGPS, WADGPS, Wide Area Augmentation systems , GEO Uplink subsystem , GEO downlink systems , Geo Orbit determination , Geometric analysis , covariance analysis , GPS /INS Integration Architectures	**9**
Unit – 5	
GPS Applications: GPS in surveying, Mapping and Geographical Information System, Precision approach Aircraft landing system, Military and Space application, and intelligent transportation system. GPS orbital parameters, description of receiver independent exchange format (RINEX) , Observation data and navigation message data parameters, GPS position determination, least squares method	**10**

Course outcomes:

On completion of the course student will be able to

1. Explain about fundamental blocks of global positioning system
2. signal characteristics of GPS are analyzed
3. Explore to the GPS Design analysis.
4. Illustrate about differential GPS
5. Explain and trained towards applications of GPS

Text Books:

1. Mohinder S.Grewal, Lawrence R.Weill, Angus P.Andrews, "Global positioning systems, Inertial Navigation and Integration", Wiley 2007.

Reference Books:

1. E.D.Kaplan, Christopher J. Hegarty, "Understanding GPS Principles and

Applications", Artech House Boston 2005.

OPTICALCOMMUNICATIONS

(Professional Elective-IV**)**

SEMESTER-VII

Subject Code	21ETETP702C	Internal Marks	30
Number of Lecture Hours/Week	3	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits– 03

CourseObjectives:

This course will enable students to:

- Familiarize with basic concepts and theory of optical communication.
- Understand the signal loss with their computation and dispersion mechanism occurring in optical fiber cable.
- Analyze the operation of LEDs, laser diodes, and PIN photo detectors.
- Understand the different types of fiber connectors.
- Understand the performance of optical systems.

Unit-1	**Hours**
Over view of optical fiber communication-Historical development, The general system, advantages of optical fiber communications. Optical fiber wave guides-Introduction, Ray theory transmission, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays, cylindrical fibers-Modes, V-number, Mode coupling, Step Index fibers, Graded Index fibers, Single mode fibers-Cutoff wavelength, Mode Field Diameter, Effective Refractive Index, Exercise problems.	**11**
Unit-2	
Signal distortion in optical fibers: - Signal distortion in optical fibers-Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses, Information capacity determination, Group delay, Types of Dispersion: Material dispersion, Wave-guide dispersion, Polarization-Mode dispersion, Inter modal dispersion, Pulse broadening in Graded index fiber, Exercise problems.	**10**
Unit–3	
Optical Sources -LEDs, Structures, Materials, Quantum efficiency, Power, Modulation, Power bandwidth product. Injection Laser Diodes-Modes, Threshold conditions, External quantum efficiency, and Laser diode rate equations, Resonant frequencies, Reliability of LED & ILD. Optical detectors-Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors, Exercise problems.	**12**
Unit–4	
OpticalfiberConnectors-Connectortypes,Singlemodefiberconnectors,Connector return loss, Fiber Splicing- Splicing techniques, Splicing single mode fibers, Fiber alignment and joint loss-Multimode fiber joints, single mode fiber joints.	**8**
Unit–5	
Optical system design-Point-to-point links- component choice and considerations, Link power budget, Rise time budget with examples, Line coding in Optical links, WDM, Necessity, Principles, Measurement of Attenuation and Dispersion, Eye pattern.	**9**
Total	**50**

Courseoutcomes:

Oncompletionofthecoursestudentwill beableto

1. Understandbasicconceptsofopticalfibers
2. Analyzedifferentlossesoccursinopticalfibersand
3. UnderstandtheoperationofLEDs,laser diodes,andPINphotodetectors
4. Illustratedifferenttypesofopticalconnectors
5. Analyze opticalsystemdesign.

TextBooks:

1. Optical Fiber Communications – Gerd Keiser, Mc Graw-Hill International edition,3rdEdition,2000.
2. OpticalFiber Communications–JohnM. Senior,PHI, 2ndEdition, 2002.

ReferenceBooks:

1. FiberOpticCommunications– D.K.Mynbaev,S.C.GuptaandLowellL.Scheiner,PearsonEducation,2005.
2. Text Book on Optical Fiber Communication and its Applications – S.C.Gupta, PHI,2005.
3. Fiber Optic Communication Systems – Govind P. Agarwal, John Wiley, 3rd Edition,2004.
4. Fiber Optic Communications – Joseph C. Palais, 4th Edition, Pearson Education,2004.

Professional Elective-V

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ETETP703A	RF System Design	3	0	0	3
2	21ETETP703B	Internet of Things	3	0	0	3
3	21ETETP703C	Radar and Satellite Communications	3	0	0	3

RF System Design

(Professional Elective- V**)**

SEMESTER VII

Subject Code	21ETETT703A	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course objectives:

This course will enable the students to

- Acquire the importance of RF Issues and various considerations for design
- Understand the filter design in RF range
- Understand the active components and applications
- Design RF Amplifiers
- Analyze the characteristics of RF Amplifiers
- Analyze High frequency models using oscillators and mixers

Unit -I	**Hours**
RF ISSUES Importance of RF design Electromagnetic spectrum, RF behavior of passive components, chip components and circuit board considerations, scattering parameters, smith chart and applications.	**9**
Unit –II	
RF FILTER DESIGN Overview, Basic resonator and filter configuration, special filter realizations, smith chart based filter design, coupled filter.	**9**
Unit-III	
ACTIVE RF COMPONENTS AND APPLICATIONS RF diodes, BJT, RF FET'S, High electron mobility transistors **Matching And Biasing Networks -**impedance matching using discrete components, microstrip line matching networks, amplifier classes of operation and biasing networks	**12**
Unit –IV	
RF AMPLIFIER DESIGNS Characteristics, amplifier power relations, stability considerations, constant gain circles, constant VSWR circles, low noise circles broadband, high power and multistage amplifiers.	**10**
Unit-V	
OSCILLATORS Basic oscillator model, High Frequency oscillator configuration, Applications and analysis, qualitative treatment **MIXERS & APPLICATIONS** Basic characteristic of mixers, wireless synthesizers, phase locked loops, detector and demodulator circuits	**08**

Course outcomes:

On completion of the course student will be able to:

1. To acquire the importance of RF Issues and various considerations for design
2. To understand the filter design in RF range

3. To understand the active components and applications
4. To design RF Amplifiers
5. To analyze the characteristics of RF Amplifiers
6. To analyze High frequency models using oscillators and mixers

Text Books:

1. Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory and Applications, Pearson Education Asia, First Edition, 2001.
2. Joseph.J. Carr, Secrets of RF Circuit Design , McGraw Hill Publishers, Thi rd Edition,2000.

Reference Books:

1. Mathew
   M. Radmanesh, Radio Frequency & Microwave Electronics, Pearson Educati on Asia, Second Edition, 2002.
2. Ulrich L. Rohde and David P. New Kirk, RF / Microwave Circuit Design, John Wiley & Sons USA 2000.
3. RolandE. Best,Phase Locked Loops: Design, simulation and applications, Mc Graw Hill Publishers 5^{TH} edition 2003

INTERNET OF THINGS (Professional Elective-V) SEMESTER VII			
Subject Code	21ETETP703B	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

Course Objective This course will enable students to:

1. To study fundamental concepts of IoT
2. To understand roles of sensors in IoT
3. To Learn different protocols used for IoT design
4. To be familiar with data handling and analytics tools in IoT
5. Understand the role of IoT in various domains of Industry.

Unit -1	**Hours**
Fundamentals of IoT: Introduction, Definitions & Characteristics of IoT, IoT Architectures,Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, AboutThings in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT andM2M.	**10**
Unit-2:	
Sensors Networks : Definition, Types of Sensors, Types of Actuators, Examples and Working,IoT Development Boards: Arduino IDE and Board Types, RaspberriPi Development Kit, RFID Principles and components, Wireless Sensor Networks: History and Context, The node, Connecting nodes, Networking Nodes, WSN and IoT.	**10**
Unit-3	
Wireless Technologies for IoT: WPAN Technologies for IoT: IEEE 802.15.4, Zigbee,HART, NFC, Z-Wave, BLE, Bacnet, Modbus.IP Based Protocols for IoT IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT.Edge connectivity and protocols.	**10**
Unit – 4	
Data Handling& Analytics: Introduction, Bigdata, Types of data, Characteristics of Big data,Data handling Technologies, Flow of data, Data acquisition, Data Storage, Introduction toHadoop. Introduction to data Analytics, Types of Data analytics, Local Analytics, Cloudanalytics and applications.	**10**
Unit – 5	
Applications of IoT: Home Automation, Smart Cities, Energy, Retail Management, Logistics,Agriculture, Health and Lifestyle, Industrial IoT, Legal challenges, IoT design Ethics, IoT inEnvironmental Protection.	**8**
Total	**48**

Course outcomes:

On completion of the course student will be able to

1. Understand the various concepts, terminologies and architecture of IoT systems.
2. Use sensors and actuators for design of IoT.
3. Understand and apply various protocols for design of IoT systems
4. Use various techniques of data storage and analytics in IoT
5. Understand various applications of IoT.

Text Books:

1. Hakima Chaouchi, ― "The Internet of Things Connecting Objects to the Web" ISBN :978-1- 84821-140-7, Wiley Publications

2. Olivier Hersent, David Boswarthick, and Omar Elloumi, — "The Internet of Things:Key Applications and Protocols", WileyPublications
3. Vijay Madisetti and ArshdeepBahga, — "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014.

Reference Books:

1. J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media,2016.
2. Keysight Technologies, "The Internet of Things: Enabling Technologies and Solutions for Design and Test", Application Note, 2016.
3. Daniel Minoli, — "Building the Internet of Things with IPv6 and MIPv6: The EvolvingWorld of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
4. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies,Platforms, and Use Cases", CRC Press

Web References:

1. https://onlinecourses.nptel.ac.in/noc17_cs22/course
2. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

Radar and Satellite Communications

(Professional Elective –V)

SEMESTER VII

Subject Code	21ETETP704C	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
			Credits – 3

Course Objectives:

This course will enable the students to:

- The goal of the course is to introduce students to the fundamentals of radar and satellite communication.
- To expose them to examples of applications and trade-offs that typically occur in engineering system design, and to ask them to apply the knowledge in design problems
- This course contributes to the educational objectives - Fundamental knowledge, specialization, design skills, and self – learning.

Unit -1	**Hours**
Introduction to Radar Introduction to radar, Radar block diagram and operation, Radar frequencies, Applications of radar, Prediction of range performance, Minimum detectable signal, Receiver noise, Probability density function, SNR, Integration of radar pulses, Radar cross-section of targets, PRF and range ambiguities, Transmitter power, System losses.	**10**
Unit -2	
Radar Technology Doppler Effect, CW radar, FM CW radar, multiple frequency CW radar. MTI radar, Delay line canceller, Range gated MTI radar, Blind speeds, Staggered PRF, Limitations to the performance of MTI radar, Non-coherent MTI radar. Tracking radar: sequential lobbing, conical scan, Mono pulse: amplitude comparison and phase comparison methods, Radar antennas. Radar displays.	**9**
Unit – 3	
Introduction to Satellite Communication Orbital aspects of Satellite Communication: Introduction to geo-synchronous and geostationary satellites, Kepler's laws, locating the satellite with respect to the earth, Subsatellite point, Look angles, Mechanics of launching a synchronous satellite, Orbital effects, Indian scenario in communication satellites	**10**
Unit – 4	
Spacecraft and Earth station Satellite sub-systems: Attitude and Orbit control systems, Telemetry, Tracking and command control system, Power supply system, Space craft antennas, and multiple access techniques, comparison of FDMA, TDMA, and CDMA. Earth station equipments, tracking systems	**10**
Unit – 5	
Satellite Link Design Introduction to satellite link design, basic transmission theory, system noise temperature and G/T ratio, design of down link and uplink, design of satellite links for specified C/N, satellite data communication protocols.	**9**

Course outcomes:

On completion of the course student will be able to

1. Analyze the RADAR equation and required parameters
2. Understand various RADAR technologies and concept of radar tracking.
3. Learn the communication satellite mechanics and keplers laws.
4. Analyze various orbital parameters and orbital effects.
5. Explain AOCS and various types of access techniques.
6. Analyze satellite link design and calculate C/N

Text Books:

1. Merril. I. Skolnik, “Introduction to Radar Systems”, 2/e, MGH, 1981.
2. Mark A. Richards, James A. Scheer and William A. Holm, “Principles of Modern Radar: Basic Principles,” YesDee Publishing Pvt. Ltd., India, 2012.

Reference Books:

1. Byron Edde, “Radar: Principles, Technology, Applications”, Pearson, 2008.
2. Timothy Pratt and Charles Bostian, “Satellite Communications”, John Wiley, 1986.
3. Dennis Roddy, “Satellite Communications”, MGraw Hill, Millan, 4th edition, 2013

Course Structure for IV B.Tech ECT Under the Regulations of SITE-21						
Semester -VIII						
S.No	**Subject Code**	**Name of the subject**	**L**	**T**	**P**	**C**
1	XXXXXX	Project work, seminar and internship in industry	0	0	24	12
					Total Semester Credits	**12**

Open Elective Courses Offered By Department of Electronics and Communication Technology

Open Elective Courses Offered by the Department of Electronics and Communication Technology to other Departments:

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21XXETOX0XA	Introduction to Signals and Systems	3	0	0	3
2	21XXETOX0XB	Digital Logic Design	3	0	0	3
3	21XXETOX0XC	Principles of Communication Systems	3	0	0	3

Open Elective-II

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21XXETO605A	Electronic Measurements	3	0	0	3
2	21XXETO605B	Biomedical Electronics	3	0	0	3
3	21XXETO605C	Embedded C Programming	3	0	0	3

Open Elective-III

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21XXETO704A	Introduction to Photonics	3	0	0	3
2	21XXETO704B	IC Applications	3	0	0	3
3	21XXETO704C	Nano Electronics	3	0	0	3

Open Elective-IV

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21XXECO705A	Remote Sensing and GIS	3	0	0	3
2	21XXECO705B	Satellite Communications	3	0	0	3
3	21XXECO705C	Image Processing and Pattern Recognition	3	0	0	3

Introduction to Signals and Systems (Open Elective)			
Subject Code	21XXETOX0XA	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives

This course will enable students to

1. Learn various signals, systems both in continuous time and discrete time.
2. Know the Fourier analysis of continuous-time periodic signals and finite energy signals.
3. Perform signal conversion by applying sampling theorem.
4. Make use of applying various signal and system properties to LTI systems
5. Extend the transform analysis to discrete time sequences

Unit -1	**Hours**
Introduction to Signals and Systems: Definition of Signals and Systems, Singularity functions and related functions. Complex exponential and sinusoidal signals. Classification of Signals, Operations on signals. Classification of	8
Unit -2	
Fourier Series: Fourier series representation of continuous time periodic signals, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series. **Fourier Transform:** Fourier transform of arbitrary signal, Fourier transform of standard signals, properties of Fourier transforms.	10
Unit -3	
Sampling Theorem: Representation of a CT signal by its samples: The Sampling theorem, impulse sampling, Natural and Flat-top Sampling, Reconstruction of signal from its samples, effect of under sampling–Aliasing. Review of Laplace Transforms, Properties, Inverse Laplace Transform, Relation between L.T and F.T of a signal.	10
Unit – 4	
Analysis of Linear Systems: Linear Time Invariant systems, impulse response, Response of a linear system, Transfer function of a LTI system, Concept of convolution and graphical representation of convolution. Cross-correlation and auto-correlation of signals, Relation between convolution and correlation.	10
Unit – 5	
Z–Transforms: Concept of Z- Transform of a discrete sequence. Distinction between Laplace, Fourier and Z transforms. Region of convergence, constraints on ROC for various classes of signals, Properties of Z-transforms, Inverse Z-transform. **Applications of signals and Systems:** Modulation for communication, Filtering of signals and Feedback control systems.	10
Total	**48**

Course outcomes

On completion of the course student will be able to

1. Understand various signals and systems and demonstrate their properties.
2. Develop Fourier analysis of continuous-time periodic signals and continuous-time finite energy signals.
3. Apply sampling theorem for signal conversion from continuous- time signals to discrete-time.
4. Illustrate various operations on LTI systems.
5. Apply Z-transform to analyze discrete-time signals.

Text Books

1. A.V. Oppenheim, A.S. Willsky and S.H. Nawab, "Signals and Systems", 2nd Edition, PHI, 2009.
2. A Anand Kumar, "Signals and Systems", PHI Publications.

Reference Books

1. B.P. Lathi, "Signal Processing & Linear Systems", 1st Edition, Oxford University Press, 2006
2. Simon Haykin and Van Veen, "Signals & Systems", 2nd Edition, John Wiley India, 2011.

Digital Logic Design (Open Elective)			
Subject Code	21XXETOX0XB	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
			Credits -03

Course Objectives:

This course will enable students to

1. Introduce the concepts and techniques associated with the number systems and Boolean algebra.
2. Design various combinational circuits and sequential circuits.
3. Know the different memories and PLD's.

Unit -1	**Hours**
Number Systems And Boolean Algebra: Number representation of different radix, conversion of bases, r-l's complements and r's complements of signed and unsigned numbers, weighted and non-weighted codes; Boolean theorems, principle of complementation & duality, De-morgans theorems, Basic logic operations and gates, Standard SOP and POS Forms, Minimization of logic functions using Boolean theorems and K-Map.	10
Unit -2	
Combinational Circuit Design: Design with basic logic gates, Design of Half adder, full adder ,4 bit parallel adder, BCD Adder, Carry look ahead adder circuit, adder- subtractor circuit, Comparators, Multiplexer, Demultiplexer, priority encoder, decoders, comparators, realization of Boolean functions using decoders and multiplexers.	10
Unit – 3	
Sequential Circuit Design-I: Memory elements and their excitation functions SR, JK, T, and D latches and flip-flops, Conversion from one flip-flop to another flip-flop, master slave JK flip-flop, edge-triggered flip-flop.	10
Unit – 4	
Sequential Circuit Design-II: Design of synchronous and asynchronous counters, Design of registers, finite-state machine, Realization of circuits using various flip-flops, minimization and transformation of sequential machines.	8
Unit – 5	
Memories and PLD's – PAL, PLA, PROM, ROM Architecture, Types of ROMS &Applications, RAM Architecture, Static & Dynamic RAMs, Introduction to FPGA and CPLD.	10
Total	48

Course outcomes:

Upon completion of the course, students will be able to

1. Understand the basic number systems, conversions and Boolean algebra.
2. Design digital systems using combinational circuits.
3. Design digital systems using sequential circuits.
4. Understand the concepts of logic families and corresponding logic levels.
5. Design digital system using PLDs and Understand the construction and working of memories

TEXT BOOKS:

1. John F. Wakerly, **"Digital Design Principles & Practices"**, 3rd Edition PHI/Pearson Education Asia,2005.

2. Morris Mano, Michael D Ciletti , **"Digital Design"** ,4th Edition, PEA

Reference Books:

1. W.H.Gothmann,**"Digital Electronics- An introduction to theory and practice"**,2nd Edition, PHI,2006.
2. Charles H. Roth Jr, **"Fundamentals of Logic Design"**, 5th Edition, Jaico Publishers. 2008
3. D.V. Hall, **"Digital Circuits and Systems"**,1st Edition, Tata McGraw Hill,1989.
4. Charles Roth, **"Digital System Design using VHDL"**, 2nd Edition Tata McGrawHill, 2012.
5. Stephen Brown and ZvonkoVramesic, **"Fundamentals of Digital Logic with VHDL Design"**, 2nd Edition, McGraw Hill, 2005.

PRINCIPLES OF COMMUNICATION SYSTEMS

(Open Elective)

Subject Code	21XXETOX0XC	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:

This course will enable students to

1. Analyze the performance of angle modulated signals.
2. Characterize analog signals in time domain as random processes and noise
3. Characterize the influence of channel on analog modulated signals
4. Determine the performance of analog communication systems in terms of SNR
5. Understand the concepts of noise and signal.

Unit -1	**Hours**
Amplitude modulation: Introduction, Amplitude Modulation: Time & Frequency – Domain description, switching modulator, Envelop detector. **Double side band-suppressed carrier modulation:** Time and Frequency – Domain description, Ring modulator, Coherent detection, Costas Receiver, Quadrature Carrier Multiplexing. **Single side and vestigial side band methods of modulation**: SSB Modulation, VSB Modulation, Frequency Translation, Frequency-Division Multiplexing, Theme Example: VSB Transmission of Analog and Digital Television	10
Unit -2	
Angle modulation: Basic definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, Transmission bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals, FM Stereo Multiplexing,	10
Unit -3	
Random variables & process: Introduction, Probability, Conditional Probability, Random variables, Several Random Variables. Statistical Averages: Function of a random variable, Moments, Random Processes, Mean, Correlation and Covariance function: Properties of autocorrelation function, Cross–correlation functions.	10
Unit – 4	
Noise in analog modulation: Introduction, Receiver Model, Noise in DSB-SC receivers and AM receivers, Threshold effect, Noise in FM receivers, Capture effect, FM threshold effect, FM threshold reduction, Pre-emphasis and De-emphasis in FM.	10
Unit – 5	
Digital Modulation: Introduction, Why Digitize Analog Sources? The Sampling process, Pulse Amplitude Modulation, Time Division Multiplexing, Pulse-Position Modulation, Generation of PPM Waves, Detection of PPM Waves, The Quantization Process, Quantization Noise, Pulse Code Modulation.	8
Total	**48**

Course outcomes:

On completion of the course student will be able to

1. Analyze the performance of analog modulation schemes in time and frequency domains.
2. Analyze the performance of angle modulated signals.
3. Characterize analog signals in time domain as random processes and noise

4. Characterize the influence of channel on analog modulated signals 5. Determine the performance of analog communication systems in terms of SNR
Text Books: 1. H Taub& D. Schilling, Gautam Sahe, Principles of Communication Systems –TMH, 2007, 3rd Edition. 2. B.P. Lathi, Communication Systems–BSPublication,20062. 3. Simon Haykin, Principles of Communication Systems –John Wiley, 2 nd Edition
Reference Books: 1. George Kennedy and Bernard Davis, Electronics & Communication System –TMH 2004. 2. R.P. Singh, SP Sapre, Communication Systems–Second Edition TMH,2007

Electronic Measurements

(Open Elective-II)

Subject Code	21XXETO605A	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
		Credits – 03	

Course Objectives:

This course will enable the students to:

- Understand the performance characteristics.
- Understand working of various meters in Electronic Measurements.
- Analyze the functioning of various types of oscilloscopes.
- Familiarize with different signal generators & wave analyzers.
- Design AC bridges which can measure Inductance, Capacitance, and Resistance.

Unit -1	**Hours**
Measurement and Error: Performance characteristics of instruments, Static characteristics: Accuracy, Resolution, Precision, Expected value, Error, Sensitivity. Errors in Measurement, Dynamic Characteristics: speed of response, Fidelity, Lag and Dynamic error.	**10**
Unit -2	
Voltmeters, Ammeters: DC Voltmeters, Multi-range voltmeters, AC voltmeters, True RMS responding voltmeter. Ammeter, Ohmmeters, series type, shunt type.	**9**
Unit – 3	
Oscilloscopes CRT features, vertical amplifiers, horizontal deflection system: sweep, trigger pulse, delay line, sync selector circuits. Dual beam CRO, Dual trace oscilloscope, sampling oscilloscope, Digital storage oscilloscope, Lissajous method of frequency measurement.	**10**
Unit – 4	
Signal Generator- Fixed and variable, AF oscillators, Standard and AF sine and square wave signal generators, Function Generators, Square pulse, Random noise, sweep, Wave Analyzers, Harmonic Distortion Analyzers, Spectrum Analyzers.	**10**
Unit – 5	
AC Bridges Measurement of inductance- Maxwell's bridge, Hay's bridge Anderson bridge, Owen's bridge. Measurement of capacitance -Schering Bridge, De Sauty bridge. Wheat stone bridge. Wien Bridge, Sources of errors in bridge circuits, Precautions and techniques used for reducing errors in bridges.	**9**
Total	**48**

Course outcomes:

On completion of the course student will be able to

1. Interpret the performance characteristics and principle of various meters in Electronic Measurements.
2. Understand the functional characteristics of voltmeter and ammeter
3. Discriminate a signal / waveform with various types of oscilloscopes.
4. Understand signal generator's features
5. Construct AC bridges which can measure Inductance, Capacitance, Resistance.

Text Books:

1. Electronic instrumentation, second edition - H.S.Kalsi, Tata McGraw Hill, 2004.
2. A. K. Sawhney, Electronics and Electrical Measurements, Dhanpat Rai &Sons. ISBN -81-7700-016-0

Reference Books:

1. Modern Electronic Instrumentation and Measurement Techniques – A.D. Helfrick and W.D. Cooper, PHI, 5th Edition, 2002.
2. Electronic Test Instruments, Analog and Digital Measurements - Robert A.Witte, Pearson Education, 2nd Ed., 2004.
3. Electronic Instrumentation & Measurements - David A. Bell, PHI, 2nd Edition, 2003.

BIOMEDICAL ELECRONICS (Open Elective-II)			
Subject Code	21XXETO605B	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70

Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:

This course will enable students to

1. Understand the concepts of bio-physiology and bio-potential.
2. Know the various bio-chemical and electrical measurements.
3. Understand the ASSIST devices like Ultrasonic Imaging System
4. Identify with Physical and Medical Biotelemetry.
5. Understand the different Modern medical instruments.

Unit -1	**Hours**
Electro-Physiology and Bio-Potential Recording: Sources of bio medical signals, Bio-potentials, Bio potential electrodes, biological amplifiers, ECG, EEG, EMG,PCG, typical waveforms and signal characteristics.	10
Unit -2	
Biochemical and Non-Electrical Parameter Measurement: pH, PO2, PCO2, Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement, Blood Cell Counters.	10
Unit -3	
Assist Devices: Cardiac pacemakers, DC Defibrillator, Dialyser, Ventilators, Magnetic Resonance Imaging Systems, and Ultrasonic Imaging System.	10
Unit – 4	
Physical Medicine and Biotelemetry: Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Biotelemetry.	09
Unit – 5	
Recent Trends in Medical Instrumentation: Telemedicine, Insulin Pumps, Radio pill, Endo microscopy, Brain machine interface, Lab on a chip.	09
Total	**48**

Course outcomes:

On completion of the course student will be able to

1. Understand the bio-physiology and bio-potential.
2. Understand the bio-chemical and electrical measurements.
3. Understand the ASSIST devices.
4. Understand Physical and Medical Biotelemetry.

TEXT BOOKS:

1. Leslie Cromwell —Biomedical Instrumentation and Measurement‖, Prentice Hall of India, New Delhi, 2007.
2. Bio Medical Electronics and Instrumentation by G.s. Sawhney,IK International 1ST edition, 30 nov 2011.

REFERENCES:

1. Khandpur, R.S., —Handbook of Biomedical Instrumentation‖, TATA Mc Graw -Hill, New Delhi,2003.
2. John G.Webster, —Medical Instrumentation Application and Design‖, 3rd Edition, Wiley India Edition, 2007.

3. Joseph J.Carr and John M.Brown, —Introduction to Biomedical Equipment Technology JohnWiley and Sons, New York, 2004

Embedded C Programming (Open Elective –II)			
Subject Code	21XXETO605C	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
			Credits – 03

Course Objectives:

This course will enable students

1. To gain knowledge about embedded system and c-programming.
2. To understand about the basics of embedded c.
3. To demonstrate about various data types in embedded c.
4. To understand about various operations in embedded c.
5. To gain knowledge about microcontroller program in embedded c.

Unit -1	**Hours**
Embedded system and c-programming: Introduction to embedded system, Programming in embedded system, Fundamentals of C Programming Language, Input and Output methods in C programming, C Programming Structure.	8
Unit -2	
Basics Of Embedded C: Difference between C and Embedded C, Variables in Embedded C, Control Structure in Embedded C,Function in Embedded C, Constants in Embedded C, Conditional Statements.	10
Unit -3	
Storage classes and data types: Arrays, Pointers and String Basics in embedded C, Arrays, Pointers and String Basics, Variables, Types, and Debugging. Basic learning of number systems, Binary, decimal, hexadecimal, octal number systems.	10
Unit – 4	
Operations in embedded c: Data Types in Embedded C: char, unsigned char, int, unsigned int, signed int, Arithmetic operations in Embedded C. **Bit-wise operations**: & l ^ << >> programming for the symbols, Bit masking in Embedded C, Bit monitoring in Embedded C.	10
Unit – 5	
Microcontroller programming: Program Flow Control, Advanced Types, Constants, and Expressions, keil and proteus software installation, Concept of Microcontroller, How it is different from Microprocessor, How to write program in embedded C, Steps to burn/embed a program in the microcontroller.	10
Total	**48**

Course outcomes:

On completion of the course student will be able to

1. Gain knowledge in embedded system and c-programming.
2. Understand the basics of embedded c.
3. Demonstrate about data types in embedded c.
4. Understand about operations in embedded c
5. Gain knowledge of programming in embedded c.

Text books:

1. Embedded C programming Techniques and applications of C and PIC MCUS
2. Embedded C programming and the atmal AVR by Barnette / cox / O'cull.

References:

1. Programming Embedded Systems in C and C++ (Michael Barr)
2. The Engineering of Reliable Embedded Systems (Michael J. Pont)

INTRODUCTION TO PHOTONICS (Open Elective-III)			
Subject Code	21XXETO704A	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
			Credits – 03

Course Objectives:

This course will enable students to

1. Understand the basic principles of photonics.
2. Illustrate about the geometrical optics in photonics.
3. Understand the principles of wave optics.
4. Illustrate about the statistical properties of light.
5. Describe the semiconductor junction characteristics.

Unit -1	**Hours**
Introduction To Photonics: Introduction, Science of light – evolution, ray/wave/statistical/quantum optics. Applications in Our Daily Lives. Introduction to Light Sources.	10
Unit -2	
Geometrical Optics: Light as a Ray. Blew of Reflection including Plane Mirrors. Law of Refraction including Optical Fiber Applications. Prisms and Thin Lenses, Wave phenomena – Interference, Diffraction.	10
Unit -3	
Principles Of Wave Optics: Interference and Interference Applications, Diffraction and Diffraction Gratings. Polarization Principles, light – evolution, ray/wave/statistical/quantum optics, Wave phenomena – Interference, Diffraction.	10
Unit – 4	
Statistical Properties of Light: Coherence, theory of photons, Photon properties - energy, flux, statistics, Interaction of photons with atoms, Light amplification, Laser fundamentals.	09
Unit – 5	
Semiconductor Junction Characteristics: Detectors - P-n junctions.Semiconductor light sources, Semiconductor light detectors, Interaction of light with RF and acoustic waves, Nonlinear optics. **Applications of photonics:** Fiber Optic Communications and Non-Communication Fundamentals and Applications.	09
Total	**48**

Course outcomes:

On completion of the course student will be able to

1. Understand the basic principles of photonics.
2. Discuss about the geometrical optics in photonics.
3. To Understand the principles of wave optics.
4. To illustrate about the statistical properties of light.
5. To Describe the semiconductor junction characteristics.

Text books:

1. Fundamentals of Photonics, Saleh & Teich.

References:

1. Robert O. Naess (2001). Physics curriculum: Optics for Technology Students. Upper Saddle River, NJ: Prentice-Hall

IC APPLICATIONS (Open Elective-III)			
Subject Code	21XXETO704B	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
			Credits – 03

Course Objectives:

This course will enable students to

1 To Understand the basic concepts and applications of analog ICs.

2 To Illustrate linear and non-linear applications of analog ICs.

3 To Analyze IC 555 timers, VCO and PLL.

4 To Analyze combinational logic circuits.

5 To Analyze sequential logic circuits.

Unit -1	**Hours**

Introduction To Analog ICs: Basic concept of analog ICs, Power management of analog IC Applications, application of analog IC as Operational amplifier(IC 741). Characteristics, functioning, specifications and parameters of IC 741.	08
Unit -2	
Linear Applications: Summing, scaling and averaging amplifiers, V-I and I-V converters, Differentiators and Integrators. **Non-Linear Applications:** Comparators, Multi vibrators, Square wave generators.	10
Unit -3	
Specialized ICs: 555 Timer- Block Schematic, pin Description & Applications, Introduction to VCO and PLL. Voltage Regulators: Introduction, IC voltage regulators, 723 general purpose regulators.	12
Unit – 4	
Digital ICs-1: Introduction to combinational logic circuits, Decoder (74x138), Priority Encoder (74x148), Multiplexer (74150 and 74x151), comparator (7485).	10
Unit – 5	
Digital ICs-2: Introduction to Sequential logic circuits, D flip-flop (IC7474)JK Flip-flop(IC7476), shift register using IC7474, Universal shift Register(IC74X194), synchronous counters using flip-flops, Decade counter using IC 7476.	10
Total	**50**

Course outcomes:

On completion of the course student will be able to

6. Understand the analog ICs and its applications. .
7. Illustrate the linear and non-linear applications of ICs.
8. Demonstrate the IC special applications IC 555 timer, PLL and VCO.
9. Design combinational logic circuits.

Text books:

1. Ramakanth A. Gayakwad, Op-Amps & Linear ICs , 4th Edition , Pearson, 2017
2. Wakerly J.F. Digital Design: Principles and Practices, 4th Edition, Pearson India, 2008.

REFERENCES:

1. D. Roy Choudhury, Linear Integrated Circuits, 2nd Edition, New Age International Private Limited, 2003.
2. R. P. Jain, Modern Digital Electronics, McGraw Hill Education (India Private Limited), 4th edition, 2012.
3. Sergio Franco, Design with Operational Amplifiers & Analog Integrated Circuits, 3rd edition, McGraw Hill, 1988.
4. Gray and Meyer, Analysis and Design of Analog Integrated Circuits, Wiley International, 2005.

NANO ELECTRONICS (Open Elective-III)			
Subject Code	21XXETO704C	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
			Credits – 03

Course Objectives: The objective of this course is to present the state of the art in the areas of semiconductor device physics and materials technology to enable the Nano electronics.
This course will enable students to

1. Understand the fundamentals and overview of nano electronics.
2. Acquire knowledge about nano electronics and nano computer architectures.
3. Analyze the Nano Electronic architectures.
4. To learn and understand the Principle and working of Spintronics.

Unit -1	**Hours**
Introduction: Recent past, the present and its challenges, Future, Overview of basic Nano electronics, Nano characterization, Definition of Technology node, Basic CMOS Process flow.	9
Unit -2	
Nano electronics & Nano computer architectures: Introduction to Nano computers, Nano computer Architecture, Quantum DOT cellular Automata (QCA), QCA circuits, Single electron circuits, molecular circuits, Logic switches – Interface engineering – Properties (Self-organization, Size-dependent) – Limitations.	10
Unit – 3	
Nano Fabrication: Nano fabrication – Nano patterning of Metallic/Semiconducting nano structures (e-beam/X-ray, Optical lithography, STM/AFM- SEM & Soft-lithography) – Nano phase materials – Self assembled Inorganic/Organic layers.	10
Unit – 4	
Spintronics: Introduction, Overview, History & Background, Generation of Spin Polarization Theories of spin Injection, spin relaxation and spin dephasing, Spintronic devices and applications, spin filters, spin diodes, spin transistors.	10
Unit – 5	
Memory Devices And Sensors: Memory devices and sensors – Nano ferroelectrics – Ferroelectric random access memory –Fe-RAM circuit design – ferroelectric thin film properties and integration – calorimetric -sensors – electrochemical cells – surface and bulk acoustic devices – gas sensitive FETs – resistive semiconductor gas sensors – semiconductor sensor array	9
Total	**48**

Course outcomes:

On completion of the course student will be able to

1. Understand the fundamentals and overview of nano electronics
2. Analyze the I-V characteristics of resonant tunneling diode and Single electron transistor.
3. Understand the principle and working of spintronics
4. Become familiar with recent research progress related to new devices and materials, and its application in nano electronics field.

Text Books:

1. Nano electronics & Nano systems: From Transistor to Molecular & Quantum Devices: Karl Goser, Jan Dienstuhl and others
2. Katsuhiko Ogata, Modern Control Engineering, Pearson, 4thEdition, 2012

Reference Books:

1. Concepts in Spintronics – Sadamichi Maekawa
2. Spin Electronics – David Awschalom.

Web References:

3. https://youtu.be/wdNFCWLuC10

REMOTE SENSING AND GIS OPEN ELECTIVE-IV			
Subject Code	21XXECO705A	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite		Credits – 03	

Course Objectives:

This course will enable students to

1. Understand the concept of photogrammetry and its significance.

2. Explain the basic concept of remote sensing and limitations. 3. Understand the vector data model and topology rules. 4. Explain the raster data model , elements and importance of source map and data editing	
Unit -1	**Hours**
Introduction to Photogrammetry: Principles& types of aerial photograph, geometry of vertical aerial photograph, Scale & Height measurement on single vertical aerial photograph, Height measurement based on relief displacement, Fundamentals of stereoscopy, fiducial points, parallax measurement using fiducial line.	09
Unit -2	
Remote Sensing: Basic concept of remote sensing, Data and Information, Remote sensing data Collection, Remote sensing advantages & Limitations, Remote Sensing process. Electromagnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, vegetation), Indian Satellites and Sensors characteristics, Resolution, Map and Image and False color composite, introduction to digital data, elements of visual interpretation techniques.	10
Unit -3	
Remote Sensing: Basic concept of remote sensing, Data and Information, Remote sensing data Collection, Remote sensing advantages & Limitations, Remote Sensing process. **Electromagnetic Spectrum**, Energy interactions with atmosphere and with earth surface features (soil, water, vegetation), Indian Satellites and Sensors characteristics, Resolution, Map and Image and False color composite, introduction to digital data, elements of visual interpretation techniques.	10
Unit – 4	
Vector Data Model: Representation of simple features- Topology and its importance; coverage and its data structure, Shape file; Data models for composite features Object Based Vector Data Model; Classes and their Relationship; The geobase data model; Geometric representation of Spatial Feature and data structure, Topology rules	10
Unit – 5	
Raster Data Model: Elements of the Raster data model, Types of Raster Data, Raster Data Structure, Data Conversion, Integration of Raster and Vector data. Data Input: Metadata, Conversion of Existing data, creating new data; Remote Sensing data, Field data, Text data, Digitizing, Scanning, on screen digitizing, importance of source map, Data Editing	09
Course Outcomes: The student will be able to 1. Retrieve the information content of remotely sensed data 2. Analyze the energy interactions in the atmosphere and earth surface features 3. Interpret the images for preparation of thematic maps 4. Apply problem specific remote sensing data for engineering applications 5. Analyze spatial and attribute data for solving spatial problems 6. Create GIS and cartographic outputs for presentation	

Text Books:

1. Remote Sensing and GIS Lillesand and Kiefer, John Willey 2008.
2. Remote Sensing and GIS B. Bhatta by Oxford Publishers 2015.
3. Introduction to Geographic Information System – Kang-Tsung Chang, McGraw-Hill 2015

Reference Books:

1. Concepts & Techniques of GIS by C. P. Lo Albert, K.W. Yonng, Prentice Hall (India) Publications.
2. Principals of Geo physical Information Systems – Peter A Burragh and Rachael A. Mc Donnell, Oxford Publishers 2004.
3. Basics of Remote sensing & GIS by S. Kumar, Laxmi Publications

SATELLITE COMMUNICATIONS OPEN ELECTIVE-IV			
Subject Code	21XXECO705B	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			
Course Objectives: This course will enable students to			

1. To understand the basic concept of Satellite communications and its applications.
2. To illustrate the concept of subsystem Satellite communication.
3. To Design the satellite link.
4. To demonstrate the various types of multiple access techniques and architecture of earth Station design.
5. To demonstrate the concepts of GPS and its architecture and satellite navigation.

Unit -1	**Hours**
INTRODUCTION Origin of Satellite Communications, Historical Back-ground, Basic Concepts of Satellite Communications, Frequency allocations for Satellite Services, Applications, Future Trends of Satellite Communications.	12
Unit -2	
SATELLITE SUB SYSTEMS: Attitude and orbit control system, telemetry, tracking, Command and monitoring, power systems, communication subsystems, Satellite antenna Equipment reliability and Space qualification.	08
Unit -3	
SATELLITE LINK DESIGN: Basic transmission theory, system noise temperature and G/T ratio, Basics of satellite links- down links, up link. Link Design example.	08
Unit – 4	
MULTIPLE ACCESS: Frequency division multiple access (FDMA), Time division Multiple Access (TDMA) Frame, DAMA, Code Division Multiple access (CDMA). **EARTH STATION TECHNOLOGY**: Introduction, Transmitters, Receivers, Antennas, Tracking system.	12
Unit – 5	
GEO-STATIONARY SATELLITE SYSTEMS: Orbit consideration, coverage and frequency considerations, Delay & Throughput considerations, System considerations, Operational NGSO constellation Designs. **SATELLITE NAVIGATION:** Radio and Satellite Navigation, Introduction to Global positioning system (GPS). GPS Receivers and codes.	10
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Understand the satellite communications and its applications and future trends in satellite Communications.
2. Illustrate the satellite subsystems.
3. Demonstrate the satellite uplink and satellite down-link.
4. To Demonstrate the types of multiple access techniques.

TEXT BOOKS:

1. Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2ndEdition, 2003.
2. Satellite Communications Engineering – Wilbur L. Pritchard, Robert A Nelson and Henri G.

REFERENCES:

1. Satellite Communications: Design Principles – M. Richharia, BS Publications, 2nd Edition, 2003.
2. Satellite Communication - D.C Agarwal, Khanna Publications, 5th Ed.
3. Fundamentals of Satellite Communications – K.N. Raja Rao, PHI, 2004.
4. Satellite Communications – Dennis Roddy, McGraw Hill, 2nd Edition, 1996.

IMAGE PROCESSING AND PATTERN RECOGNITION (Open Elective-IV)			
Subject Code	21XXECO705C	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

Course Objectives:

Students undergoing this course are expected to:

- Familiarize with basic concepts of digital image processing and different image transforms.
- Understand process of smoothing and sharpening images using frequency domain filters.
- Learn various image processing techniques like image enhancement, restoration, segmentation and compression.
- Understand pattern recognition.

Unit -1	**Hours**
INTRODUCTION: Introduction to Image Processing, Fundamental steps in digital image processing, components of an image processing system, image sensing and	

acquisition, image sampling and quantization, some basic relationships between pixels, an introduction to the mathematical tools used in digital image processing. **INTENSITY TRANSFORMATIONS AND SPATIAL FILTERING:** Background, Some basic intensity transformation functions, histogram processing, fundamentals of spatial filtering, smoothing spatial filters , sharpening spatial filters, Combining spatial enhancement methods.	08
Unit -2	
FILTERING IN THE FREQUENCY DOMAIN: Preliminary concepts, The Basics of filtering in the frequency domain, image smoothing using frequency domain filters, Image Sharpening using frequency domain filters, Selective filtering.	10
Unit -3	
IMAGE RESTORATION AND RECONSTRUCTION: A model of the image degradation / Restoration process, Noise models, restoration in the presence of noise only-Spatial Filtering, Periodic Noise Reduction by frequency domain filtering, Linear, Position –Invariant Degradations, Estimating the degradation function, Inverse filtering, Minimum mean square error (Wiener) filtering.	11
Unit – 4	
IMAGE COMPRESSION: Fundamentals, Basic compression methods: Huffman coding, Golomb coding, Arithmetic coding. **IMAGE SEGMENTATION:** Fundamentals, point, line, edge detection, thresholding, region –based segmentation.	9
Unit – 5	
INTRODUCTION TO PATTERN RECOGNITION: Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bays rule, discriminate functions, loss functions and Bayesian error analysis	10

Total	**48**

Course outcomes:

On completion of the course student will be able to

11. Perform image manipulations and different digital image processing techniques.
12. Able to understand the concepts of filtering in the frequency domain.
13. Understand the concepts of image restoration and reconstruction.
14. Perform basic operations like – segmentation, compression, techniques on image.
15. Understand the concepts of pattern recognition

TEXT BOOKS:

1. R. C. Gonzalez and R. E. Woods, Digital Image Processing, 3rd edition, Prentice Hall, 200
2. Jayaraman, S. Esakkirajan, and T. Veerakumar," Digital Image Processing", Tata McGraw-Hill Education, 2011.
3. Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification", 2nd Edition John Wiley & Sons,2001.

REFERENCES:

1. Anil K.Jain, “Fundamentals of Digital Image Processing”, Prentice Hall of India, 9th Edition, Indian Reprint, 2002.
2. B.Chanda, D.Dutta Majumder, “Digital Image Processing and Analysis”, PHI, 2009.
3. Bishop, “Pattern Recognition and Machine Learning”, Springer,2006.

SUBJECTS FOR
HONORS

POOL-1

Instrumentation and Control Systems: (any four of the following subjects which are not chosen as professional electives are to be considered for Honors Degree)

S. No.	Subject Code	Subject	L-T-P	Credits
1	21ETETHXXX	Data Acquisition systems	3-1-0	4
2	21ETETHXXX	Adaptive Control Systems	3-1-0	4
3	21ETETHXXX	Bio-Medical Instrumentation	3-1-0	4
4	21ETETHXXX	Digital Control Systems	3-1-0	4
5	21ETETHXXX	Process Control Instrumentation	3-1-0	4
6	21ETETHXXX	Transducers & sensors	3-1-0	4
7	21ETETHXXX	MEMS	3-1-0	4
8	21ETETHXXX	Intelligent & Smart Instrumentation	3-1-0	4
In addition to any of the four subjects, MOOCs/NPTEL Courses for 04 credits (02 courses@ 2 credits each) are compulsory in the domain of Electronics and Communication Engineering				

POOL-2

Integrated circuits and Systems: (any four of the following subjects which are not chosen as professional electives are to be considered for Honors Degree)

S. No.	Subject Code	Subject	L-T-P	Credits
1	21ETETHXXX	VLSI Technology and Design	3-1-0	4
2	21ETETHXXX	CMOS Analog IC Design	3-1-0	4
3	21ETETHXXX	CMOS Digital IC design	3-1-0	4
4	21ETETHXXX	Design for Testability	3-1-0	4
5	21ETETHXXX	System on Chip	3-1-0	4
6	21ETETHXXX	Programmable Logic Devices and ASIC	3-1-0	4
7	21ETETHXXX	Scripting Language	3-1-0	4
8	21ETETHXXX	Low Power VLSI Design	3-1-0	4
In addition to any of the four subjects, MOOCs/NPTEL Courses for 04 credits (02 courses@ 2 credits each) are compulsory in the domain of Electronics and Communication Engineering				

POOL-3

Communication Engineering: (any four of the following subjects which are not chosen as a professional electives are to be considered for Honors Degree)

S. No.	Subject Code	Subject	L-T-P	Credits
1	21ETETHXXX	Wireless Sensor Networks	3-1-0	4
2	21ETETHXXX	Software defined radio	3-1-0	4
3	21ETETHXXX	Data Communications & Computer Networks	3-1-0	4
4	21ETETHXXX	Cognitive radio	3-1-0	4
5	21ETETHXXX	5G Communications	3-1-0	4
6	21ETETHXXX	Satellite communication	3-1-0	4
7	21ETETHXXX	Optical Communication	3-1-0	4
8	21ETETHXXX	Global navigational satellite systems	3-1-0	4
In addition to any of the four subjects, MOOCs/NPTEL Courses for 04 credits (02 courses@ 2 credits each) are compulsory in the domain of Electronics and Communication Engineering				

POOL-4

Signal processing (any four of the following subjects which are not chosen as professional electives are to be considered for Honors Degree)

S. No.	Subject Code	Subject	L-T-P	Credits
1	21ETETHXXX	Speech Signal Processing	3-1-0	4
2	21ETETHXXX	Video Signal Processing	3-1-0	4
3	21ETETHXXX	Adaptive Signal Processing	3-1-0	4
4	21ETETHXXX	Bio- Medical Signal Processing	3-1-0	4
5	21ETETHXXX	DSP Processors and Architectures	3-1-0	4
6	21ETETHXXX	Wavelet Theory	3-1-0	4
7	21ETETHXXX	Multirate Systems And Filter Banks	3-1-0	4
8	21ETETHXXX	Mathematical methods for signal processing	3-1-0	4
In addition to any of the four subjects, MOOCs/NPTEL Courses for 04 credits (02 courses@ 2 credits each) are compulsory in the domain of Electronics and Communication Engineering				

GENERAL MINOR TRACKS

S. No.	**Subject Code**	**Subject**	**L-T-P**	**Credits**
1	21ETETHXXX	Cellular and Mobile Communication	3-1-0	4
2	21ETETHXXX	Switching Theory and Logic Design	3-1-0	4
3	21ETETHXXX	Digital Data Communications	3-1-0	4
4	21ETETHXXX	Signals and systems	3-1-0	4
5	21ETETHXXX	Electromagnetic Waves and Radiating Systems	3-1-0	4
6	21ETETHXXX	Antenna Theory	3-1-0	4
7	21ETETHXXX	Linear IC Applications	3-1-0	4
8	21ETETHXXX	Digital Signal processing	3-1-0	4
9	21ETETHXXX	Analog Communication	3-1-0	4
10	21ETETHXXX	Microwave and Radar engineering	3-1-0	4
In addition to any of the four subjects, MOOCs/NPTEL Courses for 04 credits (02 courses@ 2 credits each) are compulsory in the domain of Electronics and Communication Engineering				

Data Acquisition Systems POOL-1			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	LDIC	Credits – 04	

Course Objectives: Student will be able to

- Understand the concept of DAS and characteristics
- Explain ADCs, DACs and Data Converters
- Understand monolithic data converters and error budget analysis

Unit -1	**Hours**
INTRODUCTION: Objective of a DAS, single channel DAS, Multi-channel DAS, Components used in DAS– Converter Characteristics-Resolution-Non-linearity, settling time, Monotonicity.	**12**
Unit -2	
ANALOG TO DIGITAL CONVERTERS (ADCS): Classification of A/D Converters, Parallel feedback – Successive approximation – Ramp comparison – Dual slope integration – Voltage to frequency – Voltage to Time – Logarithmic types of ADCS. **NON-LINEAR DATA CONVERTERS (NDC):** Basic NDC configurations – Some common NDACS and NADCS – Programmable non-linear ADCS – NADC using optimal sized ROM – High speed hybrid NADC – PLS based NADC – Switched capacitor NDCS. ADC APPLICATIONS: Data Acquisition systems – Digital signal processing systems – PCM voice communication systems – Test and measurement instruments – Electronic weighing machines.	**13**
Unit – 3	
DIGITAL TO ANALOG CONVERTERS (DACS): Principles and design of – Parallel R– 2R, Weighted resistor, inverted ladder, D/A decoding – Codes other than ordinary binary. **DATA CONVERTER APPLICATIONS:** DAC applications – Digitally programmable V/I sources – Arbitrary waveform generators – Digitally programmable gain amplifiers – Analog multipliers/ dividers – Analog delay lines.	**13**
Unit – 4	
Monolithic data converters: typical study of monolithic DACS and ADCS. Interfacing of DACS and ADCS to a μP	**13**
Unit – 5	
Error budget of DACS and ADCS: Error sources, error reduction and noise reduction Techniques in DAS, Error budget analysis of DAS, case study of a DAC and an ADC	**13**

Course outcomes:

Students will be able to:

1. Identity a data acquisition system.
2. Prescribe a sensor type to measure a specific environmental change
3. Determine what type of amplifier is needed for a specific sensor output.
4. Familiar with different forms of signal conditioning.
5. Familiar with different methods of Analog-to-Digital conversion.
6. Identify the type of interface used to get a digital signal into a microprocessor

Text Books:

1. Electronic data converters fundamentals and applications – Dinesh K. Anvekar, B.S. Sonde – Tata McGraw Hil

Reference Books:

1. Electronic Analog/ Digital conversions – Hermann Schmid – Tata McGraw Hill.
2. E.R. Hanateck, User's Handbook of D/A and A/D converters – Wiley
3. Electronic instrumentation by HS Kalsi- TMH 2 ndEdition, 2004.
4. Data converters by G.B. Clayton

ADAPTIVE CONTROL SYSTEMS POOL-1			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	Control Systems	Credits – 04	

Course Objectives:

This course will enable the students to:

- Design Adaptive feedback linearizing control systems for nonlinear systems
- Apply the concept of different types of optimal control for solving problems
- Apply the concept of calculus of variation and principal of optimality for solving problems
- Apply the concept of Linear Quadratic method for solving problems

Unit -1	**Hours**
Introduction: Definitions, History of adaptive Control, Essential aspects of adaptive control, Classification of adaptive control system: Feedback adaptive controllers, Feed forward adaptive controllers, Why adaptive control?	**12**
Unit -2	
Model Reference Adaptive System: Different configuration of model reference adaptive Systems, classification of MRAS, Mathematical description, and Equivalent representation as a nonlinear time-varying system, direct and indirect MRAS	**13**
Unit – 3	
Analysis and Design of Model Reference Adaptive Systems: Model reference control with local parametric optimization (Gradient method), MIT rule **MRAS:** MRAS for a first order system, MRAS based on Lyapunov stability theory, Design of a first order MRAS based on stability theory, Hyper stability approach, Monopoli's augmented error approach.	**13**
Unit – 4	
Self Tuning Regulators: Introduction: The basic idea; process models, disturbance models, General linear difference equation models, model simplification, Different approaches to self tuning, Recursive Parameter Estimation Methods: The RLS method, extended Least squares, Recursive instrumental variable method; U-D factorization, Covariance resulting, variable data forgetting, Estimation accuracy, Direct and Indirect Self-tuning regulators, Clarke and Gawthrop's Self tuning Controller, Pole Placement approach to self tuning control; Connection between MRAS and STR.	**13**
Unit – 5	
Gain Scheduling: Introduction, The Principal, Design of Gain Scheduling Regulators, Nonlinear transformations, Applications of gain scheduling	**13**

Alternatives to Adaptive Control: Why not Adaptive Control? Robust High gain feedback control, Variable Structure schemes, Practical aspects, application and Perspectives on adaptive control.	

Course outcomes:

Student will be able to:

1. Design identifiers and adaptive controllers for linear systems
2. Design Adaptive feedback linear zing control systems for nonlinear systems
3. Apply the concept of different types of optimal control for solving problems
4. Apply the concept of calculus of variation and principal of optimality for solving problems
5. Apply the concept of Linear Quadratic method for solving problems
6. Apply the concept of adaptive control technique for solving problems

Text Books:

1. B Landau, Adaptive Control - The Model Reference Approach, New York; Marcel Dekker, 1979.
2. K. J. Astrom and B. Wittenmark, Adaptive Control, Addison Wesley Publication Company, 1989.

References Books:

1. B. Roffel, P. J. Vermeer, P. A. Chin, Simulation and Implementation of self Tuning Controllers, Prentice-Hall, Englewood cliffs, NJ, 1989.
2. R. Isermann, K. Lashmann and D. Marko, Adaptive Control Systems, Printice-Hall International (UK) Ltd. 1992.
3. K. S. Narendra and A. M. Annaswamy, Stable Adaptive Systems

BIO-MEDICAL INSTRUMENTATION POOL-1			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	Biology	Credits – 04	

Course Objectives:

This course will enable the students to:

- Recognize different types of transducers, ongoing progress in improving their design, and their application in medical measurements
- Apply principles and concepts of engineering to quantify and model measurements of bio potentials
- Apply principles and concepts of sensing and engineering to (i) design diagnostic devices for detection of markers in bio fluids, and (ii) be able to evaluate quality of diagnostic devices

Unit -1	**Hours**
Sources of Bioelectric potentials and Electrodes: Resisting and Action Potentials, Propagation of Action Potentials, The Bioelectric Potentials. Electrodes: Electrode theory, Bio Potential Electrodes, Biochemical Transducers, introduction to bio-medical signals	**12**
Unit -2	
The Cardiovascular System: The Heart and Cardiovascular System, The Heart, Blood Pressure, Characteristics of Blood Flow, Heart Sounds, Cardio Vascular Measurements, Electrocardiography, Measurement of Blood Pressure, Measurement of Blood Flow and Cardiac output, Plethysmography, Measurement of Heart Sounds, Event detection, PQRS & T-Waves in ECG, the first & second Heart beats, ECG rhythm analysis, the di-crotic notch in the carotid pulse detection of events and waves, analysis of exercise ECG, analysis of event related Potentials, correlation analysis of EEG channels, correlation of muscular contraction.	**13**
Unit – 3	
Patient Care & Monitory and Measurements in Respiratory System: The elements of Intensive Care Monitory, Diagnosis, Calibration and reparability of Patient Monitoring equipment, **Other Instrumentation For Monitoring Patients**, pace makers, defibrillators, the physiology of respiratory system, tests and instrumentation for mechanics of breathing, respiratory theory equipment, analysis of respiration.	**13**
Unit – 4	
Bio telemetry and Instrumentation for the clinical laboratory Introduction to bio telemetry, Physiological parameters adaptable to bio telemetry, the components of bio telemetry system, implantable units, applications of telemetry in patient care – The blood, tests on blood cells, chemical test, automation of chemical tests.	**13**
Unit – 5	
X-ray and radioisotope instrumentation and electrical safety of medical equipment: Generation of Ionizing radiation, instrumentation for diagnostic X-rays, special techniques, instrumentation for the medical use of radioisotopes,	**13**

radiation therapy - Physiological effects of electrical current, shock Hazards from electrical equipment, Methods of accident prevention, Modern Imaging Systems: Tomography, Magnetic resonance Imaging System, Ultrasonic Imaging System, Medical Thermography	

Course outcomes:

1. Apply principles and concepts of electronics to analyze input and output signals in medical electronics
2. Apply principles and concepts of electronics to design filters for de-noising of medical measurements
3. Recognize different types of transducers, ongoing progress in improving their design, and their application in medical measurements
4. Apply principles and concepts of engineering to quantify and model measurements of bio potentials
5. Apply principles and concepts of sensing and engineering to (i) design diagnostic devices for detection of markers in bio fluids, and (ii) be able to evaluate quality of diagnostic devices
6. Apply engineering tools to evaluate parameters needed for point-of-care health screening and mobile-health, and design of appropriate point-of-care diagnostic devices

Text Books:

1. Biomedical Instrumentation and Measurements – C. Cromwell, F.J. Weibell, E.A.Pfeiffer – Pearson education.
2. Biomedical signal analysis – Rangaraj, M. Rangayya – Wiley Inter science – John Willey & Sons Inc

Reference:

1. Hand Book of Bio-Medical Instrumentation – R.S. Khandpur, (TMH)
2. Introduction to Bio-Medical Engineering – Domach, (Pearson)
3. Introduction to Bio-Medical Equipment Technology – Cart, (Pearson)

DIGITAL CONTROL SYSTEMS POOL-1			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite	Control systems	Credits – 04	

Course Objectives:

This course will enable the students to:

- Design a pure, two-pole system that satisfies specified performance specifications like percent overshoot, peak time, settling time, and DC gain.
- Calculate the z-plane location of a pair of dominant poles given time-domain performance information like percent overshoot, settling time, and peak time.
- Create discrete equivalents from given continuous-time systems
- Able to Construct a discrete-time difference equation containing input variables and output variables at particular time instances from a system's discrete-time transfer function.

Unit -1	**Hours**
Sampling and Reconstruction: Introduction, sample and hold operations, Sampling theorem, Reconstruction of original sampled signal to continuous-time signal. **The Z – Transforms**: Introduction, Linear difference equations, pulse response, Z – transforms, Theorems of Z –Transforms, the inverse Z – transforms, Modified Z- Transforms. **Z-Plane Analysis of Discrete-Time Control System**: Z-Transform method for solving difference equations; Pulse transforms function, block diagram analysis of sampled – data systems, mapping between s-plane and z-plane: Primary strips and Complementary Strips.	**12**
Unit -2	
State Space Analysis: State Space Representation of discrete time systems, Pulse Transfer Function Matrix solving discrete time state space equations, State transition matrix and its Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state – space equations	**13**
Unit – 3	
Controllability and Observability: Concepts of Controllability and Observability, Tests for controllability and Observability, Duality between Controllability and Observability, Controllability and Observability conditions for Pulse Transfer Function. **Stability Analysis**: Stability Analysis of closed loop systems in the Z-Plane, Jury stability test – Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion, Stability analysis using Liapunov theorems.	**13**
Unit – 4	
Design of Discrete Time Control System by Conventional Methods: Design of digital control based on the frequency response method – Bilinear Transformation and Design procedure in the W-plane, Lead, Lag and Lead-Lag compensators and digital PID controllers. Design digital control through deadbeat response method.	**13**
Unit – 5	

State Feedback Controllers and Observers: Design of state feedback controller through pole placement – Necessary and sufficient conditions, Ackerman's formula, State Observers – Full order and Reduced order observers. Introduction to Kalman filters, State estimation through Kalman filters, introduction to adaptive controls.	**13**

Course outcomes:

1. Design a pure, two-pole system that satisfies specified performance specifications like percent overshoot, peak time, settling time, and DC gain.
2. Calculate the z-plane location of a pair of dominant poles given time-domain performance information like percent overshoot, settling time, and peak time.
3. Create discrete equivalents from given continuous-time systems,
4. Able to Construct a discrete-time difference equation containing input variables and output variables at particular time instances from a system's discrete-time transfer function.
5. Numerically compute the value of any system variable (e.g., state variable or output variable) at any discrete, time instant given initial conditions and input waveforms.

Text Books:

1. K. Ogata - "Discrete-Time Control systems" - Pearson Education/PHI, 2nd Edition.
2. M.Gopal - "Digital Control and State Variable Methods"- TMH

REFERENCE BOOKS:

1. Kuo - "Digital Control Systems"- Oxford University Press, 2nd Edition, 2003.
2. M. Gopal - "Digital Control Engineering".

PROCESS CONTROL INSTRUMENTATION POOL-1			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	Control systems	Credits – 04	

Course Objectives:

This course will enable the students to:

- Understand the different security design approaches, Engineering and operator interface
- Issues for designing Distributed control system.
- Know the latest communication technologies like HART and Field bus protocol.

Unit -1	**Hours**
P & ID symbols. Process characteristics: Process load, Process lag, self-regulation. Control system parameters: control lag, dead time, cycling. Discontinuous controller modes: two position, multi position, floating control modes. Continuous controller modes: Mathematical representation and description of P, I, D controller modes. Composite control modes: Mathematical representation and description of PI, PD, PID control modes. Response of control modes to linear, step and square wave error signals.	**13**
Unit -2	
Electronic Controller mode implementation: Designing of P, PI, PD, PID using OP amplifiers.	**12**
Unit – 3	
Pneumatic controller mode implementation: Implementation of P, PI, PD, PID using flapper – nozzle system. **Final control:** Actuators – Electrical & Pneumatic.	**13**
Unit – 4	
Final control: Actuators – Control Valves – Quick opening, linear and equal percentage control valves, valve sizing. I to P, P to I converters	**13**
Unit – 5	
Programmable controllers & Digital Controllers: Programmable controllers: Ladder Diagram, Programmable controller program from the ladder diagram of simple applications. Digital Controllers: Data logging, supervisory control, computer based controller.	**13**

Course outcomes:

Students will be able to:

1. Understand the popular process automation technologies.
2. Design and development of different PLC programming for simple process applications.
3. Understand the different security design approaches, Engineering and operator interface
4. Issues for designing Distributed control system.
5. Know the latest communication technologies like HART and Field bus protocol.

Text Books:

1. Process control Instrumentation Technology by Curtis Johnson, 4 th Edition – PHI, Dec, 2000.

Reference Books:

1. Principles of Process control by D. Patranabis- TMH 2 nd Edition, 1996
2. P. Harriott, process control, Tata MoGraw – Hill publishing Co., Ltd., New Delhi, 1984

TRANSDUCERS AND SENSORS POOL-1			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite	Physics, Electronics	Credits – 04	

Course Objectives:

This course will enable the students to:

- Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc
- Predict correctly the expected performance of various sensors
- Locate different type of sensors used in real life applications and paraphrase their importance
- Set up testing strategies to evaluate performance characteristics of different types of sensors and transducers

Unit -1	**Hours**
Introduction: functional elements of an instrument, generalized performance characteristics of instruments – static characteristics, dynamic characteristics. Zero order, first order, second order instruments – step response, ramp response and impulse response. Response of general form of instruments to periodic input and to transient input Experimental determination of measurement system parameters, loading effects under dynamic conditions	**13**
Unit -2	
Transducers for motion and dimensional measurements: Relative displacement, translation and rotational resistive potentiometers, resistance strain gauges, LVDT, synchros, capacitance pickups, Piezo-electric transducers, electro-optical devices, nozzle – flapper transducers, digital displacement transducers, ultrasonic transducers. Magnetic and photoelectric pulse counting methods, relative acceleration measurements, seismic acceleration pickups, calibration of vibration pickups. Gyroscopic sensors	**12**
Unit – 3	
TRANSDUCERS FOR FORCE MEASUREMENT: Bonded strain guage transducers, Photo-electric transducers, variable reluctance pickup, torque measurement dynamometers. **TRANSDUCERS FOR FLOW MEASUREMENT**: Hot wire and hot-film anemometers, Electro-magnetic flow meters, laser Doppler velocity meter TRANSDUCERS FOR PRESSURE MEASUREMENT: Manometers, elastic transducers, liquid systems, gas systems, very high pressure transducers. Thermal conductivity gauges, ionization gauges, microphone.	**13**
Unit – 4	
TRANSDUCERS FOR TEMPERATURE MEASUREMENT: Thermal expansion methods, Thermometers (liquid in glass), pressure thermometers, Thermocouples, Materials configuration and techniques. Resistance thermometers, Thermistor, junction semiconductors, Sensors, Radiation methods, Optical pyrometers, Dynamic response of temperature sensors heat flux Sensors, Transducers for liquid level measurement, humidity, silicon and quartz sensors, fiber optic sensors.	**13**
Unit – 5	
Smart sensors: Introduction, primary sensors, converters, compensation. Recent trends in sensor technology – film sensors, semi conductor IC technology, MEMS, Nano-sensors.	**13**

Course outcomes:

1. Use concepts in common methods for converting a physical parameter into an electrical quantity
2. Classify and explain with examples of transducers, including those for measurement of temperature, strain, motion, position and light
3. Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc
4. Predict correctly the expected performance of various sensors
5. Locate different type of sensors used in real life applications and paraphrase their importance
6. Set up testing strategies to evaluate performance characteristics of different types of sensors and transducers, develop professional skills in acquiring and applying the knowledge outside the classroom through design of a real-life instrumentation system.

Text Books:

1. Doebelin, E.O., "Measurement systems – Application and Design", McGraw Hill.
2. D. Patranabis, "Sensors and Transducers", PHI, 2nd Edition.

Reference:

1. Instrumentation Measurement & Analysis, by B.C. Nakra, K.K. Choudry, (TMH)
2. Transducers and Instrumentation, by D.V.S. Murthy (PHI)

MEMS
POOL-1

Subject Code	21ETETHXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite		Credits – 04	

Course Objectives:

This course will enable the students to:

- Understand the basic overview of MEMS and Microsystems with broad category of MEMS& Micro system applications.
- Understanding the working principles of Microsystems.
- Understand the Scaling Laws in Miniaturization and Materials for MEMS and Microsystems
- Understand the Micro system Fabrication Process and Analyze the different Micro manufacturing process and Applications.

Unit -1	**Hours**
Overview of MEMS and Microsystems: MEMS and Microsystems, Typical MEMS and Micro-system products, Evolution of Micro-fabrication, Micro-system and Microelectronics, The Multidisciplinary nature of micro-system design and manufacture, Micro-system and Miniaturization. Application of Microsystems in the automotive industry, Application of Microsystems in other industries: Health care industry, Aerospace industry, Industrial products, Consumer products, Telecommunications. Markets for Microsystems	**13**
Unit -2	
Working Principles of Microsystems: Introduction, Micro-sensors: Acoustic Wave Sensors, Biomedical sensors and Biosensors, Chemical sensors, Pressure sensors, Thermal sensors. Micro actuation: Actuation using thermal forces, shaped memory alloys, Piezoelectric crystals, Electrostatic forces. MEMS with Micro actuators: Micro-grippers, Micro-motors, Micro valves, Micro-pumps, Micro accelerators, Micro-fluidics.	**12**
Unit – 3	
Scaling Laws in Miniaturization: Introduction to scaling, Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic Forces, Scaling in Electromagnetic Forces, Scaling in Electricity, Scaling in Fluid Mechanics, Scaling in Heat Transfer. **Materials for MEMS and Microsystems:** Introduction, Substrates and wafers, Active substrate materials, Silicon as a substrate material. Silicon compounds, Silicon piezo resistors, Gallium Arsenide, Quartz, Piezoelectric crystals, Polymers, Packing materials.	**13**
Unit – 4	
Micro system Fabrication Process: Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapour Deposition, Physical Vapour Deposition, Deposition by Epitaxy, Etching. Overview of Micro manufacturing and Applications: Bulk Micro manufacturing- any one example of application, Surface Micromachining- any one example of application. LIGA Process- any one example of application	**13**
Unit – 5	
Applications of MEMS-Switching: Introduction, Switch parameters, Basics of switching, Mechanical switches, Electronic switches for RF and microwave applications, Mechanical RF switches, PIN diode RF switches.	**13**

Course outcomes:

1. Understand the basic overview of MEMS and Microsystems with broad category of MEMS& Micro system applications.
2. Understanding the working principles of Microsystems
3. Understand the Scaling Laws in Miniaturization and Materials for MEMS and Microsystems
4. Understand the Micro system Fabrication Process and Analyze the different Micro manufacturing process and Applications.
5. Study and Analyze the different types of RF switches, Various Switching Mechanism and their applications.

Text Books:

1. Tai-Ran Hsu, "MEMS and Microsystems: Design and Manufacture", Tata McGraw Hill, (2002).
2. Gabriel M. Rebeiz, "RF MEMS Theory, Design and Technology", Wiley India Pvt Ltd

Reference Books:

1. Stephen D. Senturia, "Microsystem Design", Springer International Edition, (2010).
2. Mohamed Gad-el-Hak, "The MEMS Handbook", CRC Press,(2002).
3. Chang Liu, "Foundations of MEMS", Second Edition, Pearson Publication

Intelligent and Smart Instrumentation
POOL-1

Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	Instrumentation	Credits – 04	

Course Objectives:

This course will enable the students to:

- To be study the concepts of intelligent sensor devices, their performance characteristics and signal and system dynamics.
- To address the issues in dealing signal conditioning operations such as calibration, linearization and compensation
- To use artificial intelligence in sensor signal processing to solve real world problems
- To deal with interfacing protocols in wireless networking platform.

Unit -1	**Hours**
Introduction: Definition of intelligent instrumentation, types of instruments, Static Characteristics: Accuracy and Precision, Error, Correction, and Uncertainty, Repeatability, Reproducibility, and Hysteresis, Sensitivity, Offset, and Dead Band, Resolution and Linearity, Statistical Characteristics, Error Modeling, Dynamic Characteristics, Dynamic Error and Dynamic Sensitivity, Input-Output Impedances, Historical Perspective, Current status, software based instruments.	**12**
Unit -2	
Intelligent Sensors: Classification, Smart sensors , Cogent Sensors, Soft or Virtual sensors, Self Adaptive Sensors, Self-Validating Sensors, VLSI Sensors, Temperature Compensating Intelligent Sensors, Pressure Sensor, Indirect Sensing	**13**
Unit – 3	
Linearization, Calibration, and Compensation: Analog Linearization of Positive and Negative Coefficient Resistive Sensors, Higher-Order Linearization, Nonlinear ADC- and Amplifier-Based Linearization, Interpolation, Piecewise Linearization, Microcontroller-Based Linearization, **Artificial Neural Network–Based Linearization** Nonlinear, Adaptive Filter–Based Linearization, Sensor Calibration, Conventional Calibration Circuits, Offset Compensation, Error and Drift Compensation, Lead Wire Compensation	**13**
Unit – 4	
Sensors with Artificial Intelligence: Artificial Intelligence, Sensors with Artificial Intelligence, Multidimensional Intelligent Sensors, AI for Prognostic Instrumentation, ANN-Based Intelligent Sensors, Fuzzy Logic–Based Intelligent Sensors	**13**
Unit – 5	
Intelligent Sensor Standards and Protocols: IEEE 1451 Standard, STIM, TEDS, NCAP, Network Technologies, LonTalk, CEBUS, J1850 Bus, 1 Signal Logic and Format, MI Bus, Plug-n-Play Smart Sensor Protocol	**13**

Course outcomes:

1. To develop the design methodologies for measurement and instrumentation of real world problems.
2. To be study the concepts of intelligent sensor devices, their performance characteristics and signal and system dynamics.
3. To address the issues in dealing signal conditioning operations such as calibration, linearization and compensation
4. To use artificial intelligence in sensor signal processing to solve real world problems

5. To deal with interfacing protocols in wireless networking platform.

Text Books:

1. Manabendra Bhuyan, ―Intelligent Instrumentation: Principles and Applications‖ CRC Press,2011
2. G. C. Barney, ―Intelligent Instrumentation‖, Prentice Hall, 1995.
3. J.B DIXIT, A. yadav Laxmi Publications, Ltd., 01-Sep-2011

VLSI TECHNOLOGY AND DESIGN POOL-2			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	DSD	Credits – 04	

Course Objectives:

This course will enable the students to:

- Learn about the MOS fabrication process and short channel effects.
- Learn about the basic rules in layout designing.
- Analyze various combinational logic networks and sequential systems.

Unit -1	**Hours**
MOS Transistors Introduction, The Structure of MOS Transistors, The Fluid Model, The MOS Capacitor, The MOS Transistor, Modes of Operation of MOS Transistors, Electrical Characteristics of MOS Transistors, Threshold Voltage, Transistor Trans conductance gm, Figure of Merit, Body Effect, Channel-Length Modulation, MOS Transistors as a Switch, Transmission Gate	**12**
Unit -2	
MOS Fabrication Technology Introduction, Basic Fabrication Processes, Wafer Fabrication, Oxidation, Mask Generation, Photolithography, Diffusion, Deposition. N-MOS Fabrication Steps, CMOS Fabrication Steps, n-Well Process, p-Well Process, Twin-Tub Process, Latch-Up Problem and Its Prevention, Use of Guard Rings, Use of Trenches, Short-Channel Effects-Channel Length Modulation Effect. Drain-Induced Barrier Lowering, Channel Punch Through, Hot carrier effect, Velocity Saturation Effect	**13**
Unit – 3	
Layout Design Rules Scaling Theory, Scalable CMOS Design Rules, CMOS Process Enhancements, Transistors, Interconnects, Circuit Elements, Efficient layout Design techniques	**13**
Unit – 4	
Combinational Logic Networks Layouts for logic networks. Delay through networks. Power optimization. Switch logic networks. Combinational logic testing	**13**
Unit – 5	
Sequential Systems Memory cells and Arrays, clocking disciplines, sequential circuit Design, Performance Analysis, Power optimization, Design validation and testing.	**13**

Course outcomes:

1. Understand the basics of MOS transistors and also the characteristics of MOS transistors.
2. Learn about the MOS fabrication process and short channel effects.
3. Learn about the basic rules in layout designing.
4. Analyze various combinational logic networks and sequential systems.

Text Books:

1. Principals of CMOS VLSI Design-N.H.EWeste, K. Eshraghian, 2nd Edition, Addison Wesley.
2. CMOS Digital Integrated Circuits Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH, 3rd Ed., 2011.
3. Low-Power VLSI Circuits and Systems, Ajit Pal, SPRINGER PUBLISHERS

4. Modern VLSI Design – Wayne Wolf, 3rd Ed., 1997, Pearson Education.

Reference Books:

1. Digital Integrated Circuit Design – Ken Martin, Oxford University Press, 2011.
2. Digital Integrated Circuits – A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan, BorivojeNikolic, 2nd Ed., PHI

CMOS ANALOG IC DESIGN POOL-2			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite	VLSI Design	Credits – 04	

Course Objectives:

This course will enable the students to:

- Analyze analog circuits at least to the first order.
- Appreciate the trade-offs involved in analog integrated circuit design.
- Understand and appreciate the importance of noise and distortion in analog circuits.

Unit -1	**Hours**
Basic MOS Device Physics – General Considerations, MOS I/V Characteristics, Second Order effects, MOS Device models. Short Channel Effects and Device Models. Single Stage Amplifiers –Basic Concepts, Common Source Stage, Source Follower, Common Gate Stage, Cascode Stage	**12**
Unit -2	
Differential Amplifiers – Single Ended and Differential Operation, Basic Differential Pair, Common Mode Response, Differential Pair with MOS loads, Gilbert Cell. Passive and Active Current Mirrors– Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors	**13**
Unit – 3	
Frequency Response of Amplifiers – General Considerations, Common Source Stage, Source Followers, Common Gate Stage, Cascode Stage, Differential Pair. **Noise** – Types of Noise, Representation of Noise in circuits, Noise in single stage amplifiers, Noise in Differential Pairs.	**13**
Unit – 4	
Feedback Amplifiers – General Considerations, Feedback Topologies, Effect of Loading. Operational Amplifiers – General Considerations, One Stage Op Amps, Two Stage Op Amps, Gain Boosting, Common – Mode Feedback, Input Range limitations, Slew Rate, Power Supply Rejection, Noise in Op Amps. Stability and Frequency Compensation.	**13**
Unit – 5	
Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators.	**13**

Course outcomes:

1. Design MOSFET based analog integrated circuits.
2. Analyze analog circuits at least to the first order.
3. Appreciate the trade-offs involved in analog integrated circuit design.
4. Understand and appreciate the importance of noise and distortion in analog circuits.

Text Books:

1. B.Razavi, “Design of Analog CMOS Integrated Circuits”, 2nd Edition, McGraw Hill Edition2016.
2. Paul. R.Gray&Robert G. Meyer, “Analysis and Design of Analog Integrated Circuits”, Wiley, 5th Edition, 2009

Reference Books:

1. T. C. Carusone, D. A. Johns & K. Martin, “Analog Integrated Circuit Design”, 2nd Edition, Wiley, 2012.
2. P.E.Allen &D.R. Holberg, “CMOS Analog Circuit Design”, 3rd Edition, Oxford University Press, 2011.
3. R. Jacob Baker, “CMOS Circuit Design, Layout, and Simulation”, 3rd Edition, Wiley, 2010.
4. Recent literature in Analog IC Design.

CMOS DIGITAL IC DESIGN POOL-2			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	DSD	Credits – 04	

Course Objectives:

This course will enable the students to:

- Demonstrate advanced knowledge in Static and dynamic characteristics of CMOS, Alternative CMOS Logics, Estimation of Delay and Power, Adders Design.
- Classify different semiconductor memories. 3. Analyze, design and implement combinational and sequential MOS logic circuits.
- Analyze complex engineering problems critically in the domain of digital IC design for conducting research.

Unit -1	**Hours**
MOS Design Pseudo NMOS Logic – Inverter, Inverter threshold voltage, Output high voltage, Output Low voltage, Gain at gate threshold voltage, Transient response, Rise time, Fall time, Pseudo NMOS logic gates, Transistor equivalency, CMOS Inverter logic.	**12**
Unit -2	
Combinational MOS Logic Circuits: MOS logic circuits with NMOS loads, Primitive CMOS logic gates – NOR & NAND gate, Complex Logic circuits design – Realizing Boolean expressions using NMOS gates and CMOS gates, AOI and OAI gates, CMOS full adder, CMOS transmission gates, Designing with Transmission gates	**13**
Unit – 3	
Sequential MOS Logic Circuits Behaviour of bistable elements, SR Latch, Clocked latch and flip flop circuits, CMOS D latch and edge triggered flip-flop.	**13**
Unit – 4	
Dynamic Logic Circuits Basic principle, Voltage Bootstrapping, Synchronous dynamic pass transistor circuits, Dynamic CMOS transmission gate logic, High performance Dynamic CMOS circuits.	**13**
Unit – 5	
Semiconductor Memories Types, RAM array organization, DRAM – Types, Operation, Leakage currents in DRAM cell and refresh operation, SRAM operation Leakage currents in SRAM cells, Flash Memory NOR flash and NAND flash.	**13**

Course outcomes:

1. Demonstrate advanced knowledge in Static and dynamic characteristics of CMOS,
2. Alternative CMOS Logics, Estimation of Delay and Power, Adders Design.
3. Classify different semiconductor memories.
4. Analyze, design and implement combinational and sequential MOS logic circuits.
5. Analyze complex engineering problems critically in the domain of digital IC design for conducting research.
6. Solve engineering problems for feasible and optimal solutions in the core area of digital ICs.

Text Books:

1. Digital Integrated Circuit Design – Ken Martin, Oxford University Press, 2011.
2. CMOS Digital Integrated Circuits Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH, 3rd Ed., 2011.

Reference Books:

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 201.
2. Digital Integrated Circuits – A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan Borivoje Nikolic, 2nd Ed., PHI.

DESIGN OF TESTABILITY POOL-2			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	DSD	Credits – 04	

Course Objectives:

This course will enable the students to:

- Analyse the various test generation methods for static & dynamic CMOS circuits.
- Identify the design for testability methods for combinational & sequential CMOS circuits.
- Recognize the BIST techniques for improving testability.

Unit -1	**Hours**
Introduction to Testing Testing Philosophy, Role of Testing, Digital and Analog VLSI Testing, VLSI Technology Trends affecting Testing, Types of Testing, Fault Modeling: Defects, Errors and Faults, Functional Versus Structural Testing, Levels of Fault Models, Single Stuck-at Fault.	**12**
Unit -2	
Logic and Fault Simulation Simulation for Design Verification and Test Evaluation, Modeling Circuits for Simulation, Algorithms for True-value Simulation, Algorithms for Fault Simulation	**13**
Unit – 3	
Testability Measures SCOAP Controllability and Observability, High Level Testability Measures. **Digital DFT and Scan Design:** Ad-Hoc DFT Methods, Scan Design, Partial-Scan Design, Variations of Scan.	**13**
Unit – 4	
Built-In Self-Test The Economic Case for BIST, Random Logic BIST: Definitions, BIST Process, Pattern Generation, Response Compaction, Built-In Logic Block Observers, Test-Per-Clock, TestPer- Scan BIST Systems, Circular Self Test Path System, Memory BIST, Delay	**13**
Unit – 5	
Boundary Scan Standard Motivation, System Configuration with Boundary Scan: TAP Controller and Port, Boundary Scan Test Instructions, Pin Constraints of the Standard, Boundary Scan Description Language: BDSL Description Components, Pin Descriptions.	**13**

Course outcomes:

1. Apply the concepts in testing which can help them design a better yield in IC design.
2. Tackle the problems associated with testing of semiconductor circuits at earlier design levels so as to significantly reduce the testing costs.
3. Analyse the various test generation methods for static & dynamic CMOS circuits.
4. Identify the design for testability methods for combinational & sequential CMOS circuits.
5. Recognize the BIST techniques for improving testability.

Text Books:

1. Essentials of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuits - M.L. Bushnell, V. D. Agrawal, Kluwer Academic Publishers.

REFERENCE BOOKS:

1. Digital Systems and Testable Design - M. Abramovici, M.A.Breuer and A.D Friedman, Jaico Publishing House.
2. Digital Circuits Testing and Testability - P.K. Lala, Academic Press.

SYSTEM ON CHIP POOL-2			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	Emdded systems	Credits – 04	

Course Objectives:

This course will enable the students to:

- Identify and formulate a given problem in the framework of SoC based design approaches
- Design SoC based system for engineering applications
- Realize impact of SoC on electronic design philosophy and Macro-electronics thereby incline towards entrepreneurship & skill development

Unit -1	**Hours**
ASIC: Overview of ASIC types, design strategies, CISC, RISC and NISC approaches for SOC architectural issues and its impact on SoC design methodologies, Application Specific Instruction Processor (ASIP) concepts.	**12**
Unit -2	
NISC: NISC Control Words methodology, NISC Applications and Advantages, Architecture Description Languages (ADL) for design and verification of Application Specific Instruction set Processors (ASIP), No-Instruction-Set-computer (NISC)- design flow, modeling NISC architectures and systems, use of Generic Netlist Representation - A formal language for specification, compilation and synthesis of embedded processors.	**13**
Unit – 3	
Simulation: Different simulation modes, behavioral, functional, static timing, gate level, switch level, transistor/circuit simulation, design of verification vectors, Low power FPGA. **Reconfigurable systems** : SoC related modeling of data path design and control logic, Minimization of interconnects impact, clock tree design issues.	**13**
Unit – 4	
Low power SoC design / Digital system: Design synergy, Low power system perspectivepower gating, clock gating, adaptive voltage scaling (AVS), Static voltage scaling, Dynamic clock frequency and voltage scaling (DCFS),building block optimization, building block memory, power down techniques, power consumption verification.	**13**
Unit – 5	
Synthesis: Role and Concept of graph theory and its relevance to synthesizable constructs, Walks, trails paths, connectivity, components, mapping/visualization, nodal and admittance graph. Technology independent and technology dependent approaches for synthesis, optimization constraints, Synthesis report analysis Single core and Multi core systems, dark silicon issues, HDL coding techniques for minimization of power consumption, Fault tolerant designs	**13**

Course outcomes:

1. Identify and formulate a given problem in the framework of SoC based design approaches
2. Design SoC based system for engineering applications
3. Realize impact of SoC on electronic design philosophy and Macro-electronics thereby incline towards entrepreneurship & skill development

Text Books:

1. Hubert Kaeslin, “Digital Integrated Circuit Design: From VLSI Architectures to CMOS Fabrication”, Cambridge University Press, 2008.
2. B. Al Hashimi, “System on chip-Next generation electronics”, The IET, 2006

Reference Books:

1. Rochit Rajsuman, “System-on- a-chip: Design and test”, Advantest America R & D Center,2000.
2. P Mishra and N Dutt, “Processor Description Languages”, Morgan Kaufmann, 2008.
3. Michael J. Flynn and Wayne Luk, “Computer System Design: System-on-Chip”,Wiley,2011.

PROGRAMMABLE LOGIC DEVICES AND ASIC POOL-2			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	DSD	Credits – 04	

Course Objectives:

This course will enable the students to:

- Describe architecture of programmable devices.
- Explain programmable methodologies.
- Recall IC fabrication techniques vis-à-vis CMOS switch
- Relate design and implementation flow for PLDs
- Low power design techniques and methodologies

Unit -1	**Hours**
INTRODUCTION TO ASICS, CMOS LOGIC, ASIC LIBRARY DESIGN: Types of ASICs - Design flow – CMOS transistors- CMOS Design rules – Combinational logic Cell Sequential logic cell - Transistor as Resistors - Transistor parasitic capacitance – Logical effort - Library cell design – Library architecture.	**12**
Unit -2	
PROGRAMMABLE ASICS, PROGRAMMABLE ASIC LOGIC CELLS AND PROGRAMMABLE ASIC I/O CELLS: Anti fuse - Static RAM - EPROM and EEPROM technology - PREP benchmarks - Actel ACT - Xilinx LCA – Altera FLEX - Altera MAX DC & AC inputs and outputs - Xilinx I/O blocks	**13**
Unit – 3	
PROGRAMMABLE ASIC INTERCONNECT, PROGRAMMABLE ASIC 09 DESIGN SOFTWARE AND LOW LEVEL DESIGN: Entry: Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX 9000 - Altera FLEX – Design systems - Logic Synthesis - Half gate ASIC -Low level design language - PLA tools EDIF- CFI design representation.	**13**
Unit – 4	
SILICON ON CHIP DESIGN: Voice over IP SOC - Intellectual Property – SOC Design challenges- Methodology and design-FPGA to ASIC conversion – Design for integrationSOC verification-Set top box SOC.	**13**
Unit – 5	
PHYSICAL AND LOW POWER DESIGN: Over view of physical design flow-tips and guideline for physical design- modern physical design techniques- power dissipation-low power design techniques and methodologies-low power design tools- tips and guideline for low power design.	**13**

Course outcomes:

1. Recognize need for programmable devices
2. Describe architecture of programmable devices.
3. Explain programmable methodologies.
4. Recall IC fabrication techniques vis-à-vis CMOS switch
5. Relate design and implementation flow for PLDs 6. low power design techniques and methodologies

Text Books:

1. M.J.S. Smith, ―Application Specific Integrated Circuits‖, Pearson Education, 2008
2. Wayne Wolf, ―FPGA-Based System Design‖, Prentice Hall PTR, 2009.
3. Farzad Nekoogar and Faranak Nekoogar, ―From ASICs to SOCs: A Practical Approach‖, Prentice Hall PTR, 2003.

SCRIPTING LANGUAGE POOL-2			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite		Credits – 04	

Course Objectives:

This course will enable the students to:

- Gain fluency in programming with scripting languages
- Create and run scripts using PERL/TCL/PYTHON in CAD Tools
- Demonstrate the use of PERL/PYTHON/ TCL in developing system and web applications

Unit -1	**Hours**
Introduction to Scripts and Scripting: Basics of Linux, Origin of Scripting languages, scripting today, Characteristics and uses of scripting languages. **PERL:** Introduction to PERL, Names and values, Variables and assignment, Scalar expressions, Control structures, Built-in functions, Collections of Data, working with arrays, Lists and hashes, Simple input and output, Strings, Patterns and regular expressions, Subroutines, Scripts with arguments	**12**
Unit -2	
Advanced PERL: Finer points of Looping, Subroutines, Using Pack and Unpack, working with files, Type globs, Eval, References, Data structures, Packages, Libraries and modules, Objects, Objects and modules in action, tied variables, interfacing to the operating systems, Security issues	**13**
Unit – 3	
TCL: The TCL phenomena, Philosophy, Structure, Syntax, Parser, Variables and data in TCL, Control flow, Data structures, Simple input/output, Procedures, Working with Strings, Patterns, Files and Pipes, Example code	**13**
Unit – 4	
Advanced TCL: The eval, source, exec and up-level commands, Libraries and packages, Namespaces, trapping errors, Event-driven programs, Making applications 'Internet-aware',' Nuts-and-bolts' internet programming, Security issues, TCL and TK integration.	**13**
Unit – 5	
PYTHON: Introduction to PYTHON language, PYTHON-syntax, statements, functions, Built-in functions and Methods, Modules in PYTHON, Exception Handling	**13**

Course outcomes:

1. Gain fluency in programming with scripting languages
2. Create and run scripts using PERL/TCL/PYTHON in CAD Tools
3. Demonstrate the use of PERL/PYTHON/ TCL in developing system and web applications

Text Books:

1. The World of Scripting Languages- David Barron, Wiley Student Edition, 2010.
2. PYTHON Web Programming, Steve Holden and David Beazley, New Riders Publications.

References:

1. TCL/TK: A Developer's Guide- ClifFlynt, 2003, Morgan Kaufmann Series.
2. Core PYTHON Programming, Chun, Pearson Education, 2006.

3.Learning Perl, Randal L. Schwartz, O' Reilly publications 6th edition 2011.
4.Linux: The Complete Reference", Richard Peterson McGraw Hill Publications, 6th Edition, 2008.

LOW POWER VLSI DESIGN POOL-2			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	VLSI DESIGN	Credits – 04	

Course Objectives:

This course will enable the students to:

- Identify the sources of power dissipation in digital IC systems
- Understand the impact of power on system performance and reliability.
- Characterize and model power consumption
- Understand the basic analysis methods
- Understand leakage sources and reduction techniques.

Unit -1	**Hours**
Sources of Power Dissipation Introduction, Short-Circuit Power Dissipation, Switching Power Dissipation, Dynamic Power for a Complex Gate, Reduced Voltage Swing, Switching Activity, Leakage Power Dissipation, p–n Junction Reverse-Biased Current, Band-to-Band Tunneling Current, Sub threshold Leakage Current, Short-Channel Effects	**12**
Unit -2	
Supply Voltage Scaling for Low Power Device Feature Size Scaling, Constant-Field Scaling, Constant-Voltage Scaling, Architectural-Level Approaches: Parallelism for Low Power, Pipelining for Low Power, Combining Parallelism with Pipelining, Voltage Scaling Using High-Level Transformations: Multilevel Voltage Scaling Challenges in MVS Voltage Scaling Interfaces, Static Timing Analysis Dynamic Voltage and Frequency Scaling	**13**
Unit – 3	
Switched Capacitance Minimization Probabilistic Power Analysis: Random logic signals, probability and frequency, probabilistic power analysis techniques, signal entropy. **Bus Encoding:** Gray Coding, One-Hot Coding, Bus-Inversion, T0 Coding, Clock Gating, Gated-Clock FSMs FSM State Encoding, FSM Partitioning, Pre computation, Glitching Power Minimization	**13**
Unit – 4	
Leakage Power Minimization Fabrication of Multiple Threshold Voltages, Multiple Channel Doping, Multiple Oxide CMOS, Multiple Channel Length, Multiple Body Bias, VTCMOS Approach, MTCMOS Approach, Power Gating, Clock Gating Versus Power Gating, Power-Gating Issues, Isolation Strategy, State Retention Strategy, Power-Gating Controller, Power Management, Combining DVFS and Power Management	**13**
Unit – 5	
Low power clock distribution & Simulation Power Analysis Low power clock distribution: Power dissipation in clock distribution, single driver versus distributed buffers, Zero skew versus tolerable skew, chip and package co design for clock network.	**13**

Simulation Power Analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, architecture level analysis, data correlation analysis of DSP systems, Monte Carlo Simulation	

Course outcomes:

1. Identify the sources of power dissipation in digital IC systems & understand the impact of power on system performance and reliability.
2. Characterize and model power consumption & understand the basic analysis methods.
3. Understand leakage sources and reduction techniques.

Text Books:

1. Low-Power VLSI Circuits and Systems, Ajit Pal, SPRINGER PUBLISHERS
2. Practical Low Power Digital Vlsi Design , Gary Yeap Motorola, Springer Science Business Media, LLC.

Reference Books:

1. Low Power CMOS Design – Anantha Chandrakasan, IEEE Press/Wiley International, 1998.
2. Massoud Pedram, Jan M. Rabaey , "Low power design methodologies ", Kluwer Academic Publishers.
3. Low Power CMOS VLSI Circuit Design – A. Bellamour, M. I. Elamasri, Kluwer Academic Press, 1995.

WIRELESS SENSOR NETWORKS POOL-3			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	Computer Networks	Credits – 04	

Course Objectives:

This course will enable the students to:

- Understand the hardware details of different types of sensors and select right type of sensor for various applications.
- Understand radio standards and communication protocols to be used for wireless sensor network based systems and application.
- Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.

Unit -1	**Hours**
Introduction and overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.	**12**
Unit -2	
Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tiny OS, MANTIS, Contiki, and RetOS.	**13**
Unit – 3	
Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation. **Experimental platforms** : open source (ns-2) and commercial (QualNet, Opnet)	**13**
Unit – 4	
Overview of sensor network protocols (details of atleast 2 important protocol per layer): Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy), UWB.	**13**
Unit – 5	
Data dissemination and processing; differences compared with other database management systems, data storage; query processing. Specialized features: Energy preservation and efficiency; security challenges; fault- tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network.	**13**

Course outcomes:

1. Design wireless sensor network system for different applications under consideration.
2. Understand the hardware details of different types of sensors and select right type of sensor for various applications.
3. Understand radio standards and communication protocols to be used for wireless sensor network based systems and application.
4. Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.
5. Handle special issues related to sensors like energy conservation and security challenges

Text Books:

1. H. Karl and A. Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, India,2012.
2. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, “Wireless Sensor Networks”, Springer Verlag, 1stIndian reprint,2010.

REFERENCES:

1. F. Zhao and L. Guibas, “Wireless Sensor Networks: An Information Processing Approach”, Morgan Kaufmann, 1st Indian reprint,2013.
2. YingshuLi, MyT. Thai, Weili Wu, “Wireless sensor Network and Applications”, Springer series on signals and communication technology,2008.

SOFTWARE DEFINED RADIO POOL-3			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	Communications	Credits – 04	

Course Objectives:

This course will enable the students to:

- Analyze complex problems critically in the domains of Radio frequency implementation issues, Multirate signal processing in SDR, as well as a Smart antenna techniques for better spectrum exploitation for conducting research.
- Apply appropriate techniques for the development of scientific and technology
- knowledge in designing software defined radios and their usage for cognitive radio.

Unit -1	**Hours**
Introduction: The Need for Software Radios, What is Software Radio, Characteristics and benefits of software radio- Design Principles of Software Radio, RF Implementation issues- The Purpose of RF Front – End, Dynamic Range- The Principal Challenge of Receiver Design – RF Receiver Front- End Topologies- Enhanced Flexibility of the RF Chain with Software Radios- Importance of the Components to Overall Performance- Transmitter Architectures and Their Issues- Noise and Distortion in the RF Chain, ADC and DAC Distortion.	**12**
Unit -2	
Multi Rate Signal Processing: Introduction- Sample Rate Conversion Principles- Polyphase Filters Digital Filter Banks- Timing Recovery in Digital Receivers Using Multirate Digital Filters. Digital Generation of Signals: Introduction- Comparison of Direct Digital Synthesis with Analog Signal Synthesis- Approaches to Direct Digital Synthesis- Analysis of Spurious Signals- Spurious Components due to Periodic jitter- Band Pass Signal Generation- Performance of Direct Digital Synthesis Systems- Hybrid DDS-PLL Systems- Applications of direct Digital Synthesis- Generation of Random Sequences- ROM Compression Techniques.	**13**
Unit – 3	
Analog to Digital and Digital to Analog Conversion: Parameters of ideal data converters Parameters of Practical data converters. **Analog to Digital and Digital to Analog Conversion:** Techniques to improve data converter performance- Common ADC and DAC architectures.	**13**
Unit – 4	
Digital Hardware Choices: Introduction- Key Hardware Elements- DSP Processors- Field Programmable Gate Arrays- Trade-Offs in Using DSPs, FPGAs, and ASICs- Power Management Issues Using a Combination of DSPs, FPGAs, and ASICs.	**13**
Unit – 5	
Object – Oriented Representation of Radios and Network Resources: Networks- Object Oriented Programming- Object Brokers- Mobile Application Environments- Joint Tactical Radio System. Case Studies in Software Radio Design: Introduction and Historical Perspective, SPEAK easy- JTRS, Wireless Information Transfer System, SDR-3000 Digital Transceiver Subsystem, Spectrum Ware, CHARIOT	**13**

Course outcomes:

1. Demonstrate advanced knowledge in the evolving paradigm of Software defined radio and

technologies for its implementation.
2. Analyze complex problems critically in the domains of Radio frequency implementation issues, Multirate signal processing in SDR, as well as a Smart antenna techniques for better spectrum exploitation for conducting research.
3. Apply appropriate techniques for the development of scientific and technological knowledge in designing software defined radios and their usage for cognitive radio.

Text Books:

1. Software Radio: A Modern Approach to Radio Engineering - Jeffrey H. Reed, 2002, PEA Publication.
2. Software Defined Radio: Enabling Technologies- Walter Tuttle Bee, 2002, Wiley Publications.

REFERENCE BOOKS:

1. Software Defined Radio for 3G - Paul Burns, 2002, Artech House.
2. Software Defined Radio: Architectures, Systems and Functions - Markus Dillinger, KambizMadani, Nancy Alonistioti, 2003, Wiley.
3. Software Radio Architecture: Object Oriented Approaches to wireless System Engineering – Joseph Mitola, III, 2000, John Wiley & Sons.
4. R.F Microelectronics – B. Razavi, 1998, PHI.
5. DSP – A Computer Based Approach – S. K. Mithra, 1998, McGraw-Hill

DATA COMMUNICATION &COMPUTER NETWORKS

POOL-3			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	Communication systems	Credits – 04	

Course Objectives:

This course will enable the students to:

- Know the Categories and functions of various Data communication Networks
- Design and analyze various error detection techniques.
- Demonstrate the mechanism of routing the data in network layer
- Know the significance of various Flow control and Congestion control Mechanisms

Unit -1	**Hours**
Introduction to Data Communications: Components, Data Representation, Data Flow, Networks- Distributed Processing, Network Criteria, Physical Structures, Network Models, Categories of Networks Interconnection of Networks, The Internet - A Brief History, The Internet Today, Protocol and Standards - Protocols, Standards, Standards Organizations, Internet Standards. Network Models, Layered Tasks, OSI model, Layers in OSI model, TCP/IP Protocol Suite, Addressing Introduction, Wireless Links and Network Characteristics, WiFi: 802.11 Wireless LANs -The 802.11 Architecture	**12**
Unit -2	
Data Link Layer: Links, Access Networks, and LANs- Introduction to the Link Layer, The Services Provided by the Link Layer, Types of errors, Redundancy, Detection vs Correction, Forward error correction Versus Retransmission Error-Detection and Correction Techniques, Parity Checks, Check summing Methods, Cyclic Redundancy Check (CRC) , Framing, Flow Control, and Error Control protocols , Noisy less Channels and Noisy Channels, HDLC, Multiple Access Protocols, Random Access ,ALOHA, Controlled access, Channelization Protocols. 802.11 MAC Protocol, IEEE 802.11 Frame	**13**
Unit – 3	
The Network Layer: Introduction, Forwarding and Routing, Network Service Models, Virtual Circuit and Datagram Networks-Virtual-Circuit Networks, Datagram Networks, Origins of VC and Datagram Networks, Inside a Router-Input Processing, Switching, Output Processing, Queuing, The Routing Control Plane. **The Internet Protocol(IP):** Forwarding and Addressing in the Internet-Datagram format, Ipv4 Addressing, Internet Control Message Protocol(ICMP), IPv6	**13**
Unit – 4	
Transport Layer: Introduction and Transport Layer Services : Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet, Multiplexing and Demultiplexing, Connectionless Transport: UDP -UDP Segment Structure, UDP Checksum, Principles of Reliable Data Transfer-Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, Go- Back-N(GBN), Selective Repeat(SR), Connection Oriented Transport: TCP - The TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management, Principles of Congestion Control - The Cause and the Costs of Congestion, Approaches to Congestion Control-The Cause and the Costs of Congestion, Approaches to Congestion Control	**13**

Unit – 5	
Application Layer: Principles of Networking Applications – Network Application Architectures, Processes Communicating, Transport Services Available to Applications, Transport Services Provided by the File Transfer: FTP,- FTP Commands and Replies, Electronic Mail in the Internet- STMP, Comparison with HTTP, DNS-The Internet's Directory Service – Service Provided by DNS, Overview of How DNS Works, DNS Records and messages.	**13**

Course outcomes:

1. Know the Categories and functions of various Data communication Networks
2. Design and analyze various error detection techniques.
3. Demonstrate the mechanism of routing the data in network layer
4. Know the significance of various Flow control and Congestion control Mechanisms
5. Know the Functioning of various Application layer Protocols.

Text Books:

1. Computer Networking A Top-Down Approach – Kurose James F, Keith W, 6th Edition, Pearson.
2. Data Communications and Networking Behrouz A. Forouzan 4th Edition McGrawHill Educatio

REFERENCES:

1. Data communication and Networks - Bhusan Trivedi, Oxford university press, 2016
2. Computer Networks -- Andrew S Tanenbaum, 4th Edition, Pearson Education
3. Understanding Communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning

COGNITIVE RADIO
POOL-3

Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite		Credits – 04	

Course Objectives:

This course will enable the students to:

- Develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it.
- Understand technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing business models/policies.
- Understand fundamental issues regarding dynamic spectrum access, the radio resource management and trading, as well as a number of optimization techniques for better Spectrum exploitation

Unit -1	**Hours**
Introduction to Cognitive Radios: Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio.	**12**
Unit -2	
Sensing: Spectrum sensing, detection of spectrum holes (TVWS), collaborative sensing, geo-location database and spectrum sharing business models (spectrum of commons, real time secondary spectrum market).	**13**
Unit – 3	
Optimization Techniques of Dynamic Spectrum Allocation: Linear programming, convex programming. **Non-Linear Programming,** integer programming, dynamic programming, stochastic programming	**13**
Unit – 4	
Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.	**13**
Unit – 5	
Spectrum Trading: Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), classification of auctions (single auctions, double auctions, concurrent, sequential).Research Challenges in Cognitive Radio: Network layer and transport layer issues, cross- layer design for cognitive radio networks	**13**

Course outcomes:

1. Understand the fundamental concepts of cognitive radio networks.
2. Develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it.
3. Understand technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing business models/policies.
4. Understand fundamental issues regarding dynamic spectrum access, the radio resource management and trading, as well as a number of optimization techniques for better Spectrum exploitation

Text Books:

1. Ekram Hossain, DusitNiyato, Zhu Han, "Dynamic Spectrum Access and Management in Cognitive Radio Networks", Cambridge University Press,2009.

2. Kwang-Cheng Chen, Ramjee Prasad, “Cognitive radio networks”, John Wiley & Sons Ltd.,2009.

REFERENCE BOOKS

1. Bruce Fette, “Cognitive radio technology”, Elsevier, 2nd edition,2009.
2. HuseyinArslan, “Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems”, Springer,2007.
3. Francisco Rodrigo Porto Cavalcanti, Soren Andersson, “Optimizing Wireless Communication Systems” Springer,2009.
4. Linda Doyle, “Essentials of Cognitive Radio”, Cambridge University Press,2009

5G COMMUNICATION POOL-3			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	Communication Systems	Credits – 04	

Course Objectives:

This course will enable the students to:

- Learn 5G Technology advances and their benefits
- Learn the key RF, PHY, MAC and air interface changes required to support 5G
- Learn Device to device communication and millimeter wave communication
- Implementation options for 5G

Unit -1	**Hours**
Overview of 5G Broadband Wireless Communications: Evaluation of mobile technologies 1G to 4G (LTE, LTEA, LTEA Pro) , An Overview of 5G requirements, Regulations for 5G, Spectrum Analysis and Sharing for 5G	**12**
Unit -2	
The 5G wireless Propagation Channels: Channel modeling requirements, propagation scenarios and challenges in the 5G modeling, Channel Models for mm Wave MIMO Systems.	**13**
Unit – 3	
Transmission and Design Techniques for 5G: Basic requirements of transmission over 5G, Modulation Techniques – Orthogonal frequency division multiplexing (OFDM), generalized frequency division multiplexing (GFDM), filter bank multi-carriers (FBMC) and universal filtered multi-carrier (UFMC). **Multiple Accesses Techniques** – orthogonal frequency division multiple accesses (OFDMA), generalized frequency division multiple accesses (GFDMA), non-orthogonal multiple accesses (NOMA).	**13**
Unit – 4	
Device-to-device (D2D) and machine-to-machine (M2M) type communications – Extension of 4G D2D standardization to 5G, radio resource management for mobile broadband D2D, multi-hop and multi-operator D2D communications	**13**
Unit – 5	
Millimeter-wave Communications – spectrum regulations, deployment scenarios, beam forming, physical layer techniques, interference and mobility management, Massive MIMO propagation channel models, Channel Estimation in Massive MIMO, Massive MIMO with Imperfect CSI, Multi-Cell Massive MIMO, Pilot Contamination, Spatial Modulation (SM)	**13**

Course outcomes:

1. Learn 5G Technology advances and their benefits
2. Learn the key RF, PHY, MAC and air interface changes required to support 5G
3. Learn Device to device communication and millimeter wave communication
4. Implementation options for 5G

Text Books:

1. Martin Sauter "From GSM From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", Wiley-Blackwell.
2. Afif Osseiran, Jose.F.Monserrat, Patrick Marsch, "Fundamentals of 5G Mobile Networks" , Cambridge University Press.

3. Athanasios G.Kanatos, Konstantina S.Nikita, Panagiotis Mathiopoulos, “New Directions in Wireless Communication Systems from Mobile to 5G”, CRC Press.
4. Theodore S.Rappaport, Robert W.Heath, Robert C.Danials, James N.Murdock “Millimeter Wave Wireless Communications”, Prentice Hall Communications.

References:

1. Jonathan Rodriguez, “Fundamentals of 5G Mobile Networks”, John Wiley & Sons.
2. Amitabha Ghosh and Rapeepat Ratasuk “Essentials of LTE and LTE-A”, Cambridge University Press

SATELLITE COMMUNICATIONS POOL-3			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	Communication Systems	Credits – 04	

Course Objectives:

This course will enable the students to:

- Understand the concepts, applications and subsystems of Satellite communications.
- Derive the expression for G/T ratio and to solve some analytical problems on satellite link design.
- Understand the various types of multiple access techniques and architecture of earth station design.
- Understand the concepts of GPS and its architecture.

Unit -1	**Hours**
INTRODUCTION Origin of Satellite Communications, Historical Back-ground, Basic Concepts of Satellite Communications, Frequency allocations for Satellite Services, Applications, Future Trends of Satellite Communications. **ORBITAL MECHANICS AND LAUNCHERS** : Orbital Mechanics, Look Angle determination, Orbital perturbations, Orbit determination, launches and launch vehicles, Orbital effects in communication systems performance.	**12**
Unit -2	
ORBITAL MECHANICS AND LAUNCHERS : Orbital Mechanics, Look Angle determination, Orbital perturbations, Orbit determination, launches and launch vehicles, Orbital effects in communication systems performance.	**13**
Unit – 3	
SATELLITE SUB SYSTEMS: Attitude and orbit control system, telemetry, tracking, Command and monitoring, power systems, communication subsystems, Satellite antenna Equipment reliability and Space qualification. **SATELLITE LINK DESIGN:** Basic transmission theory, system noise temperature and G/T ratio, Design of down links, up link design, Design of satellite links for specified C/N, System design example.	**13**
Unit – 4	
MULTIPLE ACCESS: Frequency division multiple access (FDMA) Intermodulation, Calculation of C/N. Time division Multiple Access (TDMA) Frame structure, link design using TDMA, Examples. Satellite Switched TDMA Onboard processing, DAMA, Code Division Multiple access (CDMA), Spread spectrum transmission and reception. **EARTH STATION TECHNOLOGY:** Introduction, Transmitters, Receivers, Antennas, Tracking systems, Terrestrial interface, Primary power test methods.	**13**
Unit – 5	
LOW EARTH ORBIT AND GEO-STATIONARY SATELLITE SYSTEMS: Orbit consideration, coverage and frequency considerations, Delay & Throughput considerations, System considerations, Operational NGSO constellation Designs SATELLITE NAVIGATION & THE **GLOBAL POSITIONING SYSTEM:** Radio and Satellite Navigation, GPS Position Location principles, GPS Receivers and codes, Satellite signal acquisition, GPS Navigation Message, GPS signal levels, GPS receiver operation, GPS C/A code accuracy, Differential GP	**13**

Course outcomes:

1. Understand the concepts, applications and subsystems of Satellite communications.

2. Derive the expression for G/T ratio and to solve some analytical problems on satellite link design.
3. Understand the various types of multiple access techniques and architecture of earth station design.
4. Understand the concepts of GPS and its architecture.

Text Books:

1. Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2ndEdition, 2003.
2. Satellite Communications Engineering – Wilbur L. Pritchard, Robert A Nelson and Henri G. Suyderhoud, 2ndEdition, Pearson Publications, 2003.

REFERENCES:

1. Satellite Communications : Design Principles – M. Richharia, BS Publications, 2nd Edition, 2003.
2. Satellite Communication - D.C Agarwal, Khanna Publications, 5th Ed.
3. Fundamentals of Satellite Communications – K.N. Raja Rao, PHI, 2004
4. Satellite Communications – Dennis Roddy, McGraw Hill, 2nd Edition, 1996.

OPTICAL COMMUNICATION

POOL-3			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	Communication Systems	Credits – 04	

Course Objectives:

This course will enable the students to:

- Design and build optical fiber experiments in the laboratory
- Calculate electromagnetic modes in waveguides, the amount of light lost going through an optical system, dispersion of optical fibers.
- Use different types of photo detectors and optical test equipment to analyze optical fiber and light wave systems.
- Choose the optical cables for better communication with minimum losses

Unit -1	**Hours**
Overview of optical fiber communication - Historical development, The general system, advantages of optical fiber communications. Optical fiber wave guides- Introduction, Ray theory transmission, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays, Cylindrical fibers- Modes, V-number, Mode coupling, Step Index fibers, Graded Index fibers, Single mode fibers- Cut off wavelength, Mode Field Diameter, Effective Refractive Index, Related problems	**12**
Unit -2	
Fiber materials:- Glass, Halide, Active glass, Chalgenide glass, Plastic optical fibers. Signal distortion in optical fibers-Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses, Information capacity determination, Group delay, Types of Dispersion:- Material dispersion, Wave-guide dispersion, Polarization-Mode dispersion, Intermodal dispersion, Pulse broadening in Graded index fiber, Related problems.	**13**
Unit – 3	
Optical fiber Connectors-Connector types, Single mode fiber connectors, Connector return loss. **Fiber Splicing** - Splicing techniques, Splicing single mode fibers, Fiber alignment and joint loss- Multimode fiber joints, single mode fiber joints	**13**
Unit – 4	
Optical sources - LEDs, Structures, Materials, Quantum efficiency, Power, Modulation, Power bandwidth product. Injection Laser Diodes- Modes, Threshold conditions, External quantum efficiency, Laser diode rate equations, Resonant frequencies, Reliability of LED & ILD. **Optical detectors** - Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors, Related problems	**13**
Unit – 5	
Source to Fiber Power Launching - Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Laser diode to fiber coupling, Optical receiver operation Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration, Digital receiver performance, Probability of Error, Quantum limit, Analog receivers. **Optical system design** - Point-to- point links- Component choice and considerations, Link power budget, Rise time budget with examples, Line coding	**13**

in Optical links, WDM, Necessity, Principles, Measurement of Attenuation and Dispersion, Eye pattern.	

Course outcomes:

1. Choose necessary components required in modern optical communications systems .
2. Design and build optical fiber experiments in the laboratory, and learn how to calculate electromagnetic modes in waveguides, the amount of light lost going through an optical system, dispersion of optical fibers.
3. Use different types of photo detectors and optical test equipment to analyze optical fiber and light wave systems.
4. Choose the optical cables for better communication with minimum losses
5. Design, build, and demonstrate optical fiber experiments in the laboratory

Text Books:

1. Optical Fiber Communications – Gerd Keiser, Mc Graw-Hill International edition, 3 rd Edition, 2000.
2. Optical Fiber Communications – John M. Senior, PHI, 2nd Edition, 2002.

RERFERENCES:

1. Fiber Optic Communications – D.K. Mynbaev , S.C. Gupta and Lowell L. Scheiner, Pearson Education,2005.
2. Text Book on Optical Fiber Communication and its Applications – S.C.Gupta, PHI, 2005.
3. Fiber Optic Communication Systems – Govind P. Agarwal , John Wiley, 3rd Edition, 2004.
4. Fiber Optic Communications – Joseph C. Palais, 4th Edition, Pearson Education, 2004.

GLOBAL NAVIGATIONAL SATELLITE SYSTEMS

POOL-3			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	Communication Systems	Credits – 04	

Course Objectives:

This course will enable the students to:

- Understand global navigational satellite systems
- Understand Indian regional Navigational Satellite System
- Develop GNSS Receiver

Unit -1	**Hours**
Introduction, GNSS overview, Global Positioning System, Russian GLONASS system, Galileo satellite system, Chinese BeiDou system, Regional system: Quasi-Zenith Satellite System (QZSS), Navigation with Indian Constellation (NavIC), Augmentations, Markets and Applications. **Fundamentals of satellite Navigation:** Concept of Ranging using Time of arrival Measurements: Two-Dimensional Position Determination, Principle of Position Determination via Satellite-Generated Ranging Codes, Fundamentals of satellite orbits: Orbital Mechanics, Constellation Design, Positioning determination using Ranging codes: Determining Satellite-to-User Range,	**12**
Unit -2	
Global positioning system: overview: Space Segment Overview, Control Segment Overview, User Segment Overview, Space segment description: GPS Satellite Constellation Description, Space Segment Phased Development, Control segment description: OCS Current Configuration, OCS Transition, OCS Planned Upgrades, User segment: GNSS Receiver Characteristics	**13**
Unit – 3	
Navigation with Indian Constellation (NavIC): overview, space segment, NavIC control segment, Geodesy and time system. **Navigation services**, signals, applications and NavIC user equipment.	**13**
Unit – 4	
GNSS Receiver: Acquisition**:** Single Trial Detector, Tong Search Detector, M of N Search Detector, Combined Tong and M of N Search Detectors, FFT-Based Techniques, Direct Acquisition of GPS Military Signals, Vernier Doppler and Peak Code Search, carrier tracking, code tracking: Carrier Loop Discriminator, sequence of initial receiver operation.	**13**
Unit – 5	
GNSS errors: Introduction, Measurement errors: satellite clock error, ephemeris error, relative effects, atmospheric effects, receiver noise and resolution, multipath and shadowing effects, hardware bias errors, Psedorange error budgets.	**13**

Course outcomes:

1. Understand global navigational satellite systems
2. Understand Indian regional Navigational Satellite System
3. Develop GNSS Receiver

Text Books:

1. Elliott D. Kaplan, Christopher J. Hegarty, Understanding GPS/GNSS principles and applications, third edition, artech house publishers, Boston, 2017

Reference Books:

1. G S Rao, Global Navigational satellite system, Tata McGraw-Hill education private Ltd, New Delhi, 2010

2. ISRO-IRNSS-ICD-SPS-1.1, Bangalore, 2017
3. Bhatta, B., 2010. Global Navigation Satellite Systems: Insights Into GPS, Glonass, Galileo, Compass, and Others, BS Publications, New Delhi
4. Grewal, M. S., Weill, L. R., Andrews, A. P., 2006. Global Positioning Systems, Inertial Navigation, and Integration, John Wiley & Sons, New York.
5. Hofmann-Wellenhof, B., Lichtenegger, H., Wasle, E., 2008. GNSS – Global Navigation Satellite Systems, Springer, Verlag Wien.

SPEECH SIGNAL PROCESSING
POOL-4

Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	SS,DSP	Credits – 04	

Course Objectives:

This course will enable the students to:

- Identify the time domain speech signal parameters
- Differentiate time and frequency domain methods of speech processing
- Attribute linear predictive analysis for speech signals
- Explain the solutions for LPC equations

Unit -1	**Hours**
Mechanics of speech: Speech production: Mechanism of speech production, Acoustic phonetics, The Acoustic Theory of Speech Production: Uniform lossless tube, Effects of losses in the vocal tract, Digital models for speech signals: Vocal tract, Radiation, Excitation, Auditory perception: psycho acoustics. Representations of speech waveform: Sampling of speech signals, Quantization.	**12**
Unit -2	
Time and frequency domain methods for speech processing: Time domain parameters of Speech signal: Short-Time Energy, Average Magnitude, Average Zero crossing Rate, Silence Discrimination using ZCR and energy, Short Time Auto Correlation Function, Pitch period estimation using Auto Correlation Function. **Short Time Fourier analysis:** Fourier transform and linear filtering interpretations, Sampling rates in time and frequency, Pitch detection, Analysis by Synthesis, Analysis synthesis systems: Phase Vocoder, Channel Vocoder, Median Smoothing, Spectrographic displays	**13**
Unit – 3	
Linear predictive analysis of speech: Basic Principles of linear predictive analysis: Auto correlation method, Covariance method. **Solution of LPC equations:** Cholesky method, Durbin's Recursive algorithm, Application of LPC parameters: Pitch detection using LPC parameters, Formant analysis using LPC parameters, VELP. Relations Between the Various Speech Parameters, CELP.	**13**
Unit – 4	
Application of speech processing: Voice response systems: General considerations in the design of voice response systems, A multiple output digital voice response system, Speaker recognition systems: Speaker verification system, Speaker identification system.	**13**
Unit – 5	
Speech recognition systems: Isolated digit recognition system, Continuous digit recognition system. Typical applications of computer voice response systems: Wiring communication equipment, Information retrieval systems	**13**

Course outcomes:

1. Summarize the mechanism of human speech production and articulation
2. Identify the time domain speech signal parameters
3. Differentiate time and frequency domain methods of speech processing
4. Attribute linear predictive analysis for speech signals
5. Explain the solutions for LPC equations
6. Implement the different algorithms and models involved for speaker and speech recognition systems

Text Books:

1. L.R.Rabinerand, R.W.Schaffer, Digital Processing of Speech signals, Prentice Hall, 2004
2. Ben Gold and Nelson Morgan, Speech and Audio Signal Processing, John Wiley and Sons Inc., Singapore, 2004

Reference Books:

1. Quatieri, Discrete-time Speech Signal Processing, PrenticeHall,2001
2. L.R. Rabiner and B. H. Juang, Fundamentals of speech recognition, Prentice Hall, 1999.

VIDEO SIGNAL PROCESSING POOL-4			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	SS,DSP,DIP	Credits – 04	

Course Objectives:

This course will enable the students to:

- Understand the formation of video, its perception and representation and characterization of video in frequency domain
- Understand the concept of Lattice theory and sampling of video signals
- Modeling of the video signal in different methods and understand the different motion estimation algorithms
- Coding of video in different approaches / algorithms

Unit -1	**Hours**
Video formation, perception and representation – color perception and specification – video capture and display – Analog video raster – Analog color television systems, Digital video and Frequency Domain characterization of Video Signals.	**12**
Unit -2	
Video Sampling – Basics of the Lattice theory, Sampling of Video Signals, Conversion of Signals Sampled on Different Lattices, Sampling Rate Conversion of Video Signals	**13**
Unit – 3	
Video Modeling-Camera model, Illumination model, Object model and Scene model, Two dimensional models. **Two Dimensional Motion Estimation**-Types, Optical Flow, Pixel Based Motion, Block matching Algorithm.	**13**
Unit – 4	
Waveform Based Video Coding - Predictive coding, Video coding using Temporal prediction and transform coding, Content Dependent Video Coding – Two dimensional shape coding, Texture coding for Arbitrarily shaped Regions	**13**
Unit – 5	
Video Compression Standards - Standardization- Video Telephony with H.261 and H.263- Multimedia content description with MPEG7	**13**

Course outcomes:

1. Understand the formation of video, its perception and representation and characterization of video in frequency domain
2. Understand the concept of Lattice theory and sampling of video signals
3. Modeling of the video signal in different methods and understand the different motion estimation algorithms
4. Coding of video in different approaches / algorithms
5. Knowledge in Video compression standards

Text Books:

1. Video Processing and Communication – 1st edition - Yao Wang, J.Ostermann, Ya Zhang, Prentice Hall, 2001.

Reference Books:

1. Image processing, analysis, and machine vision, 2nd Edition,- Sonka M, Hlavac V, Boyle R. Brooks Cole publishing, 1999.
2. Multidimensional, signal, image and video processing and coding, -Woods, Elsevier, Academic press, 2006.

ADAPTIVE SIGNAL PROCESSING POOL-4			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	SS,DSP	Credits – 04	

Course Objectives:

This course will enable the students to:

- Study of different algorithms to develop the adaptive filter theory
- Application of adaptive filter theory for different problems
- Study of RLS & Kalman Filtering

Unit -1	**Hours**
Introduction to Adaptive Systems: Adaptive Systems: Definitions, Characteristics, Applications, Example of an Adaptive System. The Adaptive Linear Combiner - Description, Weight Vectors, Desired Response, Performance function - Gradient & Mean Square Error.	**12**
Unit -2	
Development of Adaptive Filter Theory & Searching the Performance surface: Introduction to Filtering - Smoothing and Prediction – Linear Optimum Filtering, Problem statement, Principle of Orthogonality - Minimum Mean Square Error, Wiener- Hopf equations, Error Performance surface Searching the performance surface – Methods.	**13**
Unit – 3	
Ideas of Gradient Search methods, Gradient Searching Algorithm & its Solution, Stability& Rate of convergence, Learning Curve. **Steepest Descent Algorithms:** Gradient Search by Newton's Method, Method of Steepest Descent, Comparison of Learning Curves.	**13**
Unit – 4	
LMS Algorithm & Applications: Overview - LMS Adaptation algorithms, Stability & Performance analysis of LMS Algorithms - LMS Gradient & Stochastic algorithms - Convergence of LMS algorithm. **Applications:** Noise cancellation – Cancellation of Echoes in long distance telephone circuits, Adaptive Beam forming.	**13**
Unit – 5	
RLS & Kalman Filtering : Introduction to RLS Algorithm, Statement of Kalman filtering problem, The Innovation Process, Estimation of State using the Innovation Process- Expression of Kalman Gain, Filtering Examples using Kalman filtering	**13**

Course Outcomes:

1. Review the Adaptive Systems and Understand the various measures to be opted for developing adaptive system.
2. Study of different algorithms to develop the adaptive filter theory.
3. Application of adaptive filter theory for different problems.
4. Study of RLS & Kalman Filtering.

Text Books:

1. Adaptive Signal Processing - Bernard Widrow, Samuel D. Strearns, 2005, PE.
2. Adaptive Filter Theory - Simon Haykin-, 4th Ed., 2002, PE Asia.

Reference Books

1. Optimum signal processing: An introduction – Sophocles .J. Orfamadis, 2nd Ed., 1988, McGraw-Hill, New York
2. Adaptive signal processing-Theory and Applications - S.Thomas Alexander, 1986, Springer –Verlag.
3. Signal analysis – Candy, McGraw Hill Int. Student Edition,2008
4. James V. Candy - Signal Processing: A Modern Approach, McGraw-Hill, International Edition, 1988.

BIO- MEDICAL SIGNAL PROCESSING POOL-4			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	DSP,BME	Credits – 04	

Course Objectives:

This course will enable the students to:

- Understand different types of biomedical signal.
- Identify and analyze different biomedical signals.
- Find applications related to biomedical signal processing

Unit -1	**Hours**
Acquisition, Generation of Bio-signals, Origin of bio-signals, Types of bio-signals, Study of diagnostically significant bio-signal parameters	**12**
Unit -2	
Electrodes For Bio-Physiological Sensing And Conditioning, Electrode-electrolyte interface, polarization, electrode skin interface and motion artefact, biomaterial used for electrode, Types of electrodes (body surface, internal, array of electrodes, microelectrodes), Practical aspects of using electrodes, Acquisition of bio-signals (signal conditioning) and Signal conversion (ADC's DAC's) Processing, Digital filtering	**13**
Unit – 3	
Bio-Medical Signal Processing by Fourier analysis, Biomedical signal processing by wavelet (time-frequency) analysis, Analysis (Computation of signal parameters that are diagnostically significant)	**13**
Unit – 4	
Classification of Signals and Noise, Spectral analysis of deterministic, stationary random signals and non-stationary signals, Coherent treatment of various biomedical signal processing methods and applications	**13**
Unit – 5	
Principal component analysis, Correlation and regression, Analysis of chaotic signals Application areas of Bio–Signals analysis Multi resolution analysis (MRA) and wavelets, Principal component analysis(PCA), Independent component analysis(ICA). Pattern classification– supervised and unsupervised classification, Neural networks, Support vector Machines, Hidden Markov models. Examples of biomedical signal classification examples.	**13**

Course outcomes:

1. Understand different types of biomedical signal.
2. Identify and analyze different biomedical signals.
3. Find applications related to biomedical signal processing

Text Books:

1. W. J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall,1993.
2. Eugene N Bruce, "Biomedical Signal Processing and Signal Modeling", John Wiley & Son's publication,2001.

References:

1. Myer Kutz, "Biomedical Engineering and Design Handbook, Volume I", McGraw Hill, 2009.
2. D C Reddy, "Biomedical Signal Processing", McGraw Hill,2005.
3. Katarzyn J. Blinowska, Jaroslaw Zygierewicz, "Practical Biomedical Signal Analysis Using MATLAB", 1st Edition, CRC Press,2011

DSP PROCESSORS AND ARCHITECTURES POOL-4			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	DSP	Credits – 04	

Course Objectives:

This course will enable the students to:

- Able to distinguish between the architectural features of general purpose processors and DSP processors.
- Understand the architectures of TMS320C54xx devices and ADSP 2100 DSP devices.
- Able to write simple assembly language programs using instruction set of TMS320C54xx.
- Can interface various devices to DSP Processors.

Unit -1	**Hours**
Introduction to Digital Signal Processing: Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation. Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.	**13**
Unit -2	
Architectures for Programmable DSP Devices: Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing.	**12**
Unit – 3	
Programmable Digital Signal Processors: Commercial digital signal processing devices, Data Addressing modes of TMS320C54XX DSPs, data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX processors, program control. **TMS320C54XX Instructions and Programming**, On-Chip Peripherals, Interrupts of TMS320C54XX processors, pipeline Operation of TMS320C54XX Processors.	**13**
Unit – 4	
Analog Devices Family of DSP Devices: Analog Devices Family of DSP Devices ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP 2100, ADSP2181 high performance processor. Introduction to Blackfin Processor- The Blackfin Processor, Introduction to Micro signal Architecture, Overview of Hardware Processing Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals.	**13**
Unit – 5	
Analog Devices Family of DSP Devices: Analog Devices Family of DSP Devices ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP 2100, ADSP2181 high performance processor. Introduction to Blackfin Processor- The Blackfin Processor, Introduction to Micro signal Architecture,	**13**

Overview of Hardware Processing Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals.	

Course outcomes:

1. Understand the basics of Digital Signal Processing and transforms.
2. Able to distinguish between the architectural features of general purpose processors and DSP processors.
3. Understand the architectures of TMS320C54xx devices and ADSP 2100 DSP devices.
4. Able to write simple assembly language programs using instruction set of TMS320C54xx.
5. Can interface various devices to DSP Processors.

Text Books:

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. A Practical Approach To Digital Signal Processing - K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, New Age International, 2006/2009
3. Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-Seng Gan, Sen M. Kuo, Wiley-IEEE Press, 2007

Reference Books

1. Digital Signal Processors, Architecture, Programming and Applications–B. Venkata ramani and M. Bhaskar, 2002, TMH.
2. DSP Processor Fundamentals, Architectures & Features – Lapsley et al., S. Chand & Co
3. Digital Signal Processing Applications Using the ADSP-2100 Family, Amy Mar, PHI
4. The Scientist and Engineer's Guide to Digital Signal Processing by Steven W. Smith, California Technical Publishing
5. Embedded Media Processing, David J. Katz and Rick Gentile , Embedded Technology Series, 2005.

WAVELET THEORY

POOL-4			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite		Credits – 04	

Course Objectives:
This course will enable the students to:

Unit -1	**Hours**
The Age of Wavelets –Introduction-The Origins of Wavelets-Are They Fundamentally NewWavelets and Other Reality Transforms, Managing Heisenberg's Uncertainty Ghost. History of Wavelet from Morlet to Daubechies Via Mallat , Different Communities of Wavelets, Different Families of Wavelets within Wavelet Communities, Interesting Recent Developments, Wavelets in the Future	**12**
Unit -2	
Introduction-Vector spaces – bases, orthonormality, projection, functions and function spaces, orthogonal functions, orthonormal functions, function spaces, orthogonal basis functions, orthonormality and the method of finding the coefficients, complex fourier series, orthogonality of complex exponential bases	**13**
Unit – 3	
Continuous Wavelet and Short time Fourier Transform-Wavelet Transform, mathematical preliminaries, continuous time frequency representation of signals, the windowed Fourier transform(Short Time Fourier Transform), The uncertainty principle and time frequency timing, properties of wavelets used in Continuous Wavelet Transform, Continuous Versus Discrete Wavelet Transform	**13**
Unit – 4	
Discrete Wavelet Transform-Haar scaling functions and function spaces, Nested Spaces, Haar Wavelet Function, Normalization of Haarbases at different scales, Standardizing the Notations, Refinement Relation with Respect to Normalized Bases, Support of a wavelet system, Daubechies Wavelets	**13**
Unit – 5	
Biorthogonal Wavelets-Biorthogonality in vector space, Biorthogonal Wavelet Systems, Signal Representation using Biorthogonal Wavelet System, Biorthogonal Analysis, Biorthogonal Synthesis, Construction of Biorthogonal Wavelet Systems.	**13**

Course outcomes:
1. Understand windowed Fourier transform and difference between windowed Fourier Transform and wavelet transform.
2. Understand wavelet basis and characterize continuous and discrete wavelet transforms
3. Understand multire solution analysis and identify various wavelets and evaluate their Time-frequency resolution properties
4. Implement discrete wavelet transforms with multirate digital filters and can under stand Wavelet packets
5. Design certain classes of wavelets to specification and justify the basis of the application of wavelet transforms to different fields

Text Books:

1. Insight into Wavelets: From theory to practice by K.P.Soman, Ramachandran, Resmi, PHI Learning PVT Ltd,2010
2. L.Prasad & S.S.Iyengar, Wavelet Analysis with Applications to Image Processing, CRC Press, 1997.

Reference Books

1. Wavelet Transforms - Introduction to Theory and Applications, Raghuveer M.Rao, Ajit Bopardikar, Pearson Education, Asia
2. Fundaments of Wavelets - Theory, Algorithms and Applications, Jaideva C.Goswami, Andrew K. Chan, John Wiley & Sons.

MULTIRATE SYSTEMS AND FILTER BANKS POOL-4			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	Communication Systems	Credits – 04	

Course Objectives:

This course will enable the students to:

- Describe the applications of multi-rate systems
- Study of various filter banks
- Analyze the efforts of quantization
- Explain the overall multi-rate systems and filter banks

Unit -1	**Hours**
Fundamentals of Multirate Systems: Basic Multirate Operations, Interconnection of Building Blocks, The Polyphase representation, Multistage Implementations, Some Applications of Multirate Systems, Special Filters and Filter Banks	**12**
Unit -2	
Maximally Decimated Filter Banks: Errors created in the QMF Bank, A Simple Alias Free QMF System, Power Symmetric QMF Banks, M-Channel Filter Banks, Polyphase representation, Perfect Reconstruction Systems, Alias Free Filter Banks, Tree Structured Filter Banks, Trans-Multiplexers	**13**
Unit – 3	
Para unitary Perfect Reconstruction (PR) Filter Banks: Lossless Transfer Matrices, Filter Bank Properties Induced by Para unitariness. **Two channel FIR Para unitary QMF Banks**, The Two channel Para unitary QMF Lattice, Transform Coding and the LOT.	**13**
Unit – 4	
Cosine Modulated Filter Banks: The Pseudo QMF Bank, Design of Pseudo QMF Bank, Efficient Polyphase Structures, Deeper Properties of Cosine Matrices, Cosine Modulated Perfect Reconstruction Systems.	**13**
Unit – 5	
Cosine Modulated Filter Banks: The Pseudo QMF Bank, Design of Pseudo QMF Bank, Efficient Polyphase Structures, Deeper Properties of Cosine Matrices, Cosine Modulated Perfect Reconstruction Systems.	**13**

Course outcomes:

1. Understand the concepts multi-rate systems
2. Describe the applications of multi-rate systems
3. Study of various filter banks
4. Analyze the efforts of quantization
5. Explain the overall multi-rate systems and filter banks

Text Books:

1. P.P.Vaidyanathan , PTR Prentice Hall, Englewood Cliffs , New Jersey,Multirate System and Filter Banks.
2. N.J.Fliege , John Wiley and Sons, Multirate Digital Signal Processing.

Reference Books

1. Raghuveer Rao, Ajit Bopardikar, Pearson Education Asia,Wavelet Transforms Introduction to Theory and Application.

2. C. Sidney Burrus , R.A.Gopianath , Pretice Hall, Introduction to wavelet and wavelet Transform.

MATHEMATICAL METHODS FOR SIGNAL PROCESSING POOL-4			
Subject Code	21ETETHXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	SS	Credits – 04	

Course Objectives:

This course will enable the students to:

- Solve the problem associated with linear algebra
- Understand probability theory and conditional probability
- Summarize the concepts associated with multiple random variables and to solve the problems associated with power spectral density of the output of the system.
- Recognize the usage of random process in signal processing and to solve the corresponding problems.

Unit -1	**Hours**
Vectors: Representation and Dot products, Matrices: Matrix Multiplication, Transposes, Inverses, Gaussian Elimination, factorization, rank of a matrix, Vector spaces: Column and row spaces, Solving Ax=0 and Ax=b, Independence, basis, dimension, linear transformations, Orthogonality: Orthogonal vectors and subspaces, projection and least squares, Gram Schmidt Orthogonalization.	**12**
Unit -2	
Determinants: Determinant formula, cofactors, inverses and volume, Eigenvalues and Eigenvectors: characteristic polynomial, Diagonalization, Hermitian and Unitary matrices.	**13**
Unit – 3	
Determinants: Spectral theorem, Change of basis, Positive definite matrices and singular value decomposition, Linear transformations. **Review of Probability:** Basic set theory and set algebra, basic axioms of probability, Conditional Probability, Bayes theorem/Law of total probability	**13**
Unit – 4	
Random variables PDF/PMF/CDF Properties, random vectors marginal/joint/conditional density functions, transformation of Random Variables, characteristic/moment generating functions, Random sums of Random variables, Law of Large numbers (strong and Weak), Limit theorems convergence types, Inequalities Chebyshev/Markov/Chernoff bounds.	**13**
Unit – 5	
Random Processes: classification of random processes, wide sense stationary processes, autocorrelation function and power spectral density and their properties. Examples of random process models - Gaussian/Markov Random process, Random processes through LTI systems.	**13**

Course Outcomes:

1. Understand and solve the problems associated with Vectors
2. Solve the problem associated with linear algebra
3. Understand probability theory and conditional probability
4. Summarize the concepts associated with multiple random variables and to solve the problems associated with power spectral density of the output of the system.
5. Recognize the usage of random process in signal processing and to solve the corresponding problems.

Text Books:

1. Introduction to linear algebra - Gilbert Strang, SIAM, 2016.

2. Introduction to probability - Bertsekas and Tsitsiklis, Athena, 2008

Reference Books

1. Probability and Random processes for Electrical Engineers, Leon Garcia Addison Wesley, 2nd edition, 1994
2. Probability and Random Processes, Geoffrey Grimmett, David Stirzaker, 3rd Edition, Oxford University Press, 2001.
3. Probability and Stochastic Process, Roy D Yates, David J Goodman, 2nd edition Wiley, 2010

GENERAL MINOR TRACKS

S. No.	Subject Code	Subject	L-T-P	Credits
1	21ETETMXXX	Cellular and Mobile Communication	3-1-0	4
2	21ETETMXXX	Switching Theory and Logic Design	3-1-0	4
3	21ETETMXXX	Digital Data Communications	3-1-0	4
4	21ETETMXXX	Signals and systems	3-1-0	4
5	21ETETMXXX	Electromagnetic Waves and Radiating Systems	3-1-0	4
6	21ETETMXXX	Antenna Theory	3-1-0	4
7	21ETETMXXX	Linear IC Applications	3-1-0	4
8	21ETETMXXX	Digital Signal processing	3-1-0	4
9	21ETETMXXX	Analog Communication	3-1-0	4
10	21ETETMXXX	Microwave and Radar engineering	3-1-0	4
In addition to any of the four subjects, MOOCs/NPTEL Courses for 04 credits (02 courses@ 2 credits each) are compulsory in the domain of Electronics and Communication Engineering				

Cellular and Mobile Communication

Minors

Subject Code	21ETETMXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	Communication	Credits – 04	

Course Objectives:

This course will enable the students to:

- Understand the basic cellular concepts like frequency reuse, cell splitting, cell sectoring etc., and various cellular systems.
- Understand the different types of interferences influencing cellular and mobile communications.
- Understand the concept of propagation model and the different types antennas used at cell site and mobile
- Understand the frequency management, channel assignment, various propagation effects in cellular environment and the concepts of handoff and types of handoffs.
- Understand the architectures of GSM and 3G cellular systems.

Unit -1	**Hours**
CELLULAR MOBILE RADIO SYSTEMS: Introduction to Cellular Mobile System, uniqueness of mobile radio environment, operation of cellular systems, consideration of the components of Cellular system, Hexagonal shaped cells, Analog and Digital Cellular systems **CELLULAR CONCEPTS:** Evolution of Cellular systems, Concept of frequency reuse, frequency reuse ratio, Number of channels in a cellular system, Cellular traffic: trunking and blocking, Grade of Service; Cellular structures: macro, micro, pico and femto cells; Cell splitting, Cell sectoring	**12**
Unit -2	
INTERFERENCE: Types of interferences, Introduction to Co-Channel Interference, real time Co-Channel interference, Co-Channel measurement, Co-channel Interference Reduction Factor, desired C/I from a normal case in a Omni directional Antenna system, design of Antenna system, antenna parameters and their effects, diversity receiver, nonco channel interference-different types.	**13**
Unit – 3	
CELL COVERAGE FOR SIGNAL AND TRAFFIC: Signal reflections in flat and hilly terrain, effect of human made structures, phase difference between direct and reflected paths, straight line path loss slope, and general formula for mobile propagation over water and flat open area, near and long-distance propagation, antenna height gain, form of a pointto-point model. **CELL SITE AND MOBILE ANTENNAS:** Sum and difference patterns and their synthesis, Omni directional antennas, directional antennas for interference reduction, space diversity antennas, umbrella pattern antennas, minimum separation of cell site antennas, high gain antennas.	**13**
Unit – 4	
FREQUENCY MANAGEMENT AND CHANNEL ASSIGNMENT: Numbering and grouping, setup access and paging channels, channel assignments to cell sites and mobile units: fixed channel and non-fixed channel assignment, channel sharing and borrowing, overlaid cells.	**13**

HANDOFF STRATEGIES: Concept of Handoff, types of handoff, handoff initiation, delaying handoff, forced handoff, mobile assigned handoff, intersystem handoff, vehicle locating methods, dropped call rates and their evaluation.	
Unit – 5	
DIGITAL CELLULAR NETWORKS: GSM architecture, GSM channels, multiple access schemes; TDMA, CDMA, OFDMA; architecture of 3G cellular systems.	**13**

Course outcomes:

The student will be able to

I. Explain the fundamentals of cellular radio system design and its basic elements.
II. Analyse the concepts of different co-channel, non-co-channel interference and cellular coverage on signal & traffic of a designed system.
III. Identify the various types of antenna system design suitable for mobile communications.
IV. Distinguish the number of radio channels, channel assignment and frequency management used in mobile communications and analyse the different hand off & cell splitting techniques and dropped call rate at cell site area.
V. Summarize the different types of second generation system architectures such as GSM, TDMA and CDMA for mobile communication systems

Text Books:

1. Mobile Cellular Telecommunications – W.C.Y. Lee, Tata McGraw Hill, 2rd Edn. 2006.
2. Principles of Mobile Communications – Gordon L. Stuber, Springer International 2nd Edition, 2007.

Reference Books

1. Wireless Communications – Theodore. S. Rapport, Pearson education, 2ndEdn., 2002.
2. Mobile Cellular Communication – G Sasibhushana Rao Pearson

Switching Theory and Logic Design
(Minors)

Subject Code	21ETETMXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	Bolean Algebra	Credits – 04	

Course Objectives:

This course will enable the students to:

- To solve a typical number base conversions and analyze new error coding techniques
- To optimize logic gates for digital circuits using various techniques
- To understand concepts of Adders and Sub tractors and analyze different types of decoders, encoders, code converters, multiplexers and comparators.
- To understand the basic concept flip flops and analyze basic counters and shift registers
- To understand the basic concepts of PLDs

Unit -1	**Hours**
Number Systems and Codes: Number systems, binary number system, signed binary numbers, binary arithmetic, floating point representation of numbers, 1's, 2's, 9's and 10's complement arithmetic, BCD, octal and hexadecimal number system, weighted & non weighted binary codes, error detecting and correcting codes. **Logic Gates and Logic Families**: Digital signals, basic logic gates, NAND and NOR operations, Exclusive-OR and Exclusive NOR operations, bipolar logic families, MOS families, characteristics of logic families, RTL, DTL, HTL, TTL, ECL, I2L, MOS, CMOS and BiCMOS logic families.	**12**
Unit -2	
Boolean Algebra and Minimization Techniques: Basic laws and fundamental theorems of Boolean algebra, canonical (SOP and POS) forms, minterm and maxterm expansions, Karnaugh-maps, simplification of logic functions using K-Map, don't care conditions, design examples, EX-OR and EX-NOR simplifications of K-Maps, Quine McCluskey minimization technique.	**13**
Unit – 3	
Combinational Logic circuits: Adders and their use as subtractors, parallel binary adder, carry look ahead adder, BCD adder, binary multiplier and divider, multiplexers, demultiplexers, decoders, encoders, code converters, parity circuits, comparators and their applications.	**13**
Unit – 4	
Sequential Logic circuits: Classification, latches and flip-flops: SR-latch, D-latch, D flip flop, JK flip-flop T flip-flop, conversion and applications of flip-flops, registers and counters, shift registers, ripple counters, synchronous counter design using D, T, and JK flip flops, asynchronous sequential circuits.	**13**
Unit – 5	
Memories and Programmable Logic Devices: Classification of memories, RAM, types of RAM, ROM, EEPROM, ROM as PLD, Programmable Logic Array, Programmable Array Logic, qualitative theoretical/architectural concepts of Complex Programmable Logic Devices and Field-Programmable Gate Array.	**13**

Course outcomes:

At the end of the course students will be able to

i. Classify different number systems and apply to generate various codes.

ii. Use the concept of Boolean algebra in minimization of switching functions

iii. Design different types of Adders and Subtractors

iv. Design different types of decoders, encoders, code converters, multiplexers and comparators

v. Understand the concept of Memories and Programmable Logic Devices

Text Books:

1. Digital Design - Morris. M. Mano, Michael D. Ciletti - Fourth Edition - PrenticeHall India, 2008.

2. Modern Digital Electronics – R.P.Jain - Fourth Edition – Tata McGraw Hill Education Private Limited, 2010.

Reference Books

1. Digital Design: Principles and Practices - J.F. Wakerly - Fourth Edition - Prentice Hall, 2005.

2. Fundamentals of Logic Design - Charles. H. Roth - Fifth Edition - Thomson Brooks/ Cole, 2005.

Digital Data Communications (Minors)			
Subject Code	21ETETMXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	SS	Credits – 04	

Course Objectives:

This course will enable the students to:

Student able to learn the
Digital Modulation Schemes
Basic Concepts of Data Communications, Interfaces and Modems
Error Correction
Multiplexing
Multiple Access Techniques

Unit -1	**Hours**
Digital Modulation Schemes: BPSK, QPSK, 8PSK, 16PSK, 8QAM, 16QAM, DPSK – Methods, Band Width Efficiency, Carrier Recovery, Clock Recovery.	**12**
Unit -2	
Basic Concepts of Data Communications, Interfaces and Modems: Data Communication Networks, Protocols and Standards, UART, USB, Line Configuration, Topology, Transmission Modes, Digital Data Transmission, DTE-DCE interface, Categories of Networks – TCP/IP Protocol suite and Comparison with OSI mode	**13**
Unit – 3	
Error Correction: Types of Errors, Vertical Redundancy Check (VRC), LRC, CRC, Checksum, Error Correction using Hamming code **Data Link Control**: Line Discipline, Flow Control, Error Control **Data Link Protocols:** Asynchronous Protocols, Synchronous Protocols, Character Oriented Protocols, Bit-Oriented Protocol, and Link Access Procedures	**13**
Unit – 4	
Multiplexing: Frequency Division Multiplexing (FDM), Time Division Multiplexing (TDM), Multiplexing Application, and DSL. **Local Area Networks:** Ethernet, Other Ether Networks, Token Bus, Token Ring, FDDI. **Metropolitan Area Networks**: IEEE 802.6, SMDS **Switching:** Circuit Switching, Packet Switching, Message Switching. **Networking and Interfacing Devices**: Repeaters, Bridges, Routers, Gateway, Other Devices.	**13**
Unit – 5	
Multiple Access Techniques: Frequency- Division Multiple Access (FDMA), Time - Division Multiple Access (TDMA), Code - Division Multiple Access (CDMA), OFDM and OFDMA. Random Access, AlohaCarrier Sense Multiple Access (CSMA)- Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA), Controlled Access- Reservation- Polling- Token Passing, Channelization.	**13**

Course outcomes:

1. Understand working of waveform coding techniques and analyse their performance.
2. Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.

Text Books:

1. Data Communication and Computer Networking - B. A.Forouzan, 2nd Ed., 2003, TMH.
2. Advanced Electronic Communication Systems - W. Tomasi, 5th Ed., 2008, PEI

SIGNAL ANALYSIS Minors			
Subject Code	21ETETMXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite		Credits – 04	

I. To introduce the terminology of signals and systems.
ii. To introduce Fourier tools through the analogy between vectors and signals.
iii. To introduce the concept of sampling and reconstruction of signals.
iv. To analyze the linear systems in time and frequency domains.
v. To study Laplace transform and z-transform to analyze signals and systems.

Unit -1	**Hours**
Introduction: Definition of Signals and Systems, Classification of Signals, Classification of Systems, Operations on signals: time-shifting, time-scaling, amplitude-shifting, amplitude-scaling. Problems on classification and characteristics of Signals and Systems. Complex exponential and sinusoidal signals, Singularity functions and related functions: impulse function, step function signum function and ramp function. Analogy between vectors and signals, orthogonal signal space, Signal approximation using orthogonal functions, Mean square error, closed or complete set of orthogonal functions, Orthogonality in complex functions.	**12**
Unit -2	
Fourier series: Fourier series representation of continuous time periodic signals, properties of Fourier series, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series, Complex Fourier spectrum. **Fourier Transform :**Deriving Fourier transform from Fourier series, Fourier transform of arbitrary signal, Fourier transform of standard signals, Fourier transform of periodic signals, properties of Fourier transforms, Fourier transforms involving impulse function and Signum function. Introduction to Hilbert Transform.	**13**
Unit – 3	
Sampling: Graphical and analytical proof for Band Limited Signals, impulse sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, effect of under sampling – Aliasing, Introduction to Band Pass sampling	**11**
Unit – 4	
Analysis Of Linear Systems: Linear system, impulse response, Response of a linear system, Linear time invariant (LTI) system, Linear time variant (LTV) system, Concept of convolution in time domain and frequency domain, Graphical representation of convolution, Transfer function of a LTI system. Filter characteristics of linear systems. Distortion less transmission through a system, Signal bandwidth, system bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Poly-Wiener criterion for physical realization, relationship between bandwidth and rise time. **Correlation and Convolution:** Introduction to Cross-correlation and auto-correlation of functions, properties of correlation function, Energy density spectrum, Parseval's theorem, Power density spectrum, Relation between auto correlation function and energy/power spectral density function. Relation between convolution and correlation, Detection of periodic signals in the presence of noise by correlation, Extraction of signal from noise by filtering.	**13**
Unit – 5	

Laplace Transforms : Review of Laplace transforms, Partial fraction expansion, Inverse Laplace transform, Concept of region of convergence (ROC) for Laplace transforms, constraints on ROC for various classes of signals, Properties of L.T's, Relation between L.T's, and F.T. of a signal. Laplace transform of certain signals using waveform **synthesis. Z–Transforms :** Fundamental difference between continuous-time and discrete-time signals, discrete time signal representation using complex exponential and sinusoidal components, Periodicity of discrete time using complex exponential signal, Concept of Z- Transform of a discrete sequence. Distinction between Laplace, Fourier and Z transforms. Region of convergence in Z-Transform, constraints on ROC for various classes of signals, Inverse Z-transform, properties of Z-transforms.	**13**
Course outcomes:	
Text Books: 1. Signals, Systems & Communications - B.P. Lathi, BS Publications, 2003. 2. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawab, PHI, 2nd Edn.	
Reference Books: 1. Signals & Systems - Simon Haykin and Van Veen, Wiley, 2nd Edition. 2. Principles of Linear Systems and Signals – BP Lathi, Oxford University Press, 2015 3. Fundamentals of Signals and Systems- Michel J. Robert, MGH International Edition, 2008. 4. Signals and Systems – T K Rawat , Oxford University press, 2011	

Electromagnetic Waves and Radiating Systems Minors			
Subject Code	21ETETMXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	Engineering Physics, Vector algebra	Credits – 04	

Course Objectives:

This course will enable the students to:

- Understand vector analysis and co-ordinate systems
- Gain knowledge on coulomb's law and boundary conditions
- Learn magneto statics and parameters
- Analyze Maxwell's equations and plot the smith chart

Unit -1	**Hours**
Vectors analysis: Vector algebra, vector calculus - divergence, gradient, curl, Laplacian; Coordinate systems - Cartesian, cylindrical and spherical;	**12**
Unit -2	
Electrostatics: Coulomb's law, Gauss's law, electric scalar potential, Laplace and Poisson's equations, conduction and polarization, boundary conditions, resistance and capacitance;	**13**
Unit – 3	
Magnetostatics : Biot-Savart law, Ampere's law, magnetic vector potential, Lorentz force, magnetization, boundary conditions, magnetic energy and inductance;	**13**
Unit – 4	
Electrodynamics : Maxwell's equations, Faraday's induction, displacement current, Plane wave propagation in free space and in materials; Poynting vector, reflection and transmission of plane waves at media boundary, Transmission lines, Smith chart;	**13**
Unit – 5	
Advanced Topics: Antenna fundamentals, dipole antenna, Microstrip transmission lines, Waves along guiding structures	**13**

Course outcomes:

1. Understand the concept of vector analysis and different co-ordinate systems.
2. Understand the Electrostatics and boundary conditions
3. Understand the Magnetostatics and Lorentz force equation
4. Analyze the maxwell's equations , Faraday's induction and smith chart preparation
5. Analyze advanced antenna fundamentals like microstrip antenna, wave guide structures

Text Books:

1. J. D. Kraus and D. A. Fleisch, "Electromagnetics: with Applications," McGraw Hill, 1999.
2. D. K. Cheng, 'Field and Wave Electromagnetics,' Addison-Wesley series, 1989.

Reference Books:

1. W. H. Hayt, "Engineering Electromagnetic", 5th Ed., TMH, 1999.
2. J. A. Edminister, "Schaum's Outline of Theory and Problems in Electromagnetics," 1984.

Antenna Theory

Minors

Subject Code	21ETETMXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	EMTL	Credits – 04	

Course Objectives:

This course will enable the students to:

- Understand the fundamental concepts of antennas and parameters.
- Understand antenna arrays and Dolph-Chebyshev arrays.
- Understand broad band antenna and broad cast antennas.
- Analyze aperture and reflector antennas , Huygen's principle, printed antennas.

Unit -1	**Hours**
Fundamental Concepts: Physical concept of radiation, retarded potentials, Hertzian dipole; Antenna parameters: Radiation pattern, gain, directivity, effective aperture, and reciprocity; Radiation from dipoles of arbitrary length.	**12**
Unit -2	
Antenna Arrays: Arrays of point sources, endfire and broadside arrays, pattern multiplication, synthesis of binomial and Dolph-Chebyshev arrays.	**13**
Unit – 3	
Broadband Antennas: Log-periodic and Yagi antennas, frequency independent antennas, broadcast antennas.	**13**
Unit – 4	
Aperture and Reflector Antennas: Huygens' principle, radiation from apertures in an infinite ground plane, slot and horn antennas, parabolic reflector antennas.	**13**
Unit – 5	
Printed Antennas: Radiation from rectangular and circular patches, feeding techniques.	**13**

Course outcomes:

1. Understand concept of radiation, and various antenna parameters.
2. Understand antenna arrays, synthesis of binomial and Dolph-Chebyshev arrays.
3. Analyze frequency independent antennas and broadcast antennas.
4. Understand Huygens' principle, radiation from apertures in an infinite ground plane.
5. Understand the significance of printed antennas and feeding techniques.

Text Books:

1. Balanis, C.A., "Antenna Theory and Design", 3rd Ed., John Wiley & 2005 Sons.
2. Kraus, J.D. and Fleisch, D.A., "Electromagnetics with Applications", McGraw-Hill.1999

Reference Books:

1. Stutzman, W.L. and Thiele, H.A., "Antenna Theory and Design", 2nd 1998 Ed., John Wiley & Sons.
2. Elliot, R.S., "Antenna Theory and Design", Revised edition, Wiley-IEEE Press.2003

Linear IC Applications

Minors

Subject Code	21ETETMXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	EDC,STLD	Credits – 04	

Course Objectives:

This course will enable the students to:

- To understand the basic operation &performance parameters of differential amplifiers.
- To understand & learn the measuring techniques of performance parameters of OP-AMP
- To learn the linear and non-linear applications of operational amplifiers and the analysis & design of different types of active filters using opamps
- To learn the internal structure, operation and applications of different analog ICs
- To Acquire skills required for designing and testing integrated circuits

Unit -1	**Hours**
INTEGRATED CIRCUITS: Differential Amplifier- DC and AC analysis of Dual input Balanced output Configuration, Properties of other differential amplifier configuration (Dual Input Unbalanced Output, Single Ended Input – Balanced/ Unbalanced Output), DC Coupling and Cascade Differential Amplifier Stages, Level translator.	**12**
Unit -2	
Characteristics of OP-Amps, Integrated circuits-Types, Classification, Package Types and Temperature ranges, Power supplies, Op-amp Block Diagram, ideal and practical Opamp Specifications, DC and AC characteristics, 741 op-amp & its features, Op-Amp parameters & Measurement, Input & Out put Off set voltages & currents, slew rate, CMRR, PSRR, drift, Frequency Compensation techniques.	**13**
Unit – 3	
LINEAR and NON-LINEAR APPLICATIONS OF OP-AMPS: Inverting and Non-inverting amplifier, Integrator and differentiator, Difference amplifier, Instrumentation amplifier, AC amplifier, V to I, I to V converters, Buffers. NonLinear function generation, Comparators, Multivibrators, Triangular and Square wave generators, Log and Anti log Amplifiers, Precision rectifiers. **ACTIVE FILTERS, ANALOG MULTIPLIERS AND MODULATORS**: Design & Analysis of Butterworth active filters – 1st order, 2nd order LPF, HPF filters. Band pass, Band reject and all pass filters. Four Quadrant Multiplier, IC 1496, Sample & Hold circuits.	**13**
Unit – 4	
TIMERS & PHASE LOCKED LOOPS: Introduction to 555 timer, functional diagram, Monostable and Astable operations and applications, Schmitt Trigger; PLL - introduction, block schematic, principles and description of individual blocks, 565 PLL, Applications of PLL – frequency multiplication, frequency translation, AM, FM & FSK demodulators. Applications of VCO (566).	**13**
Unit – 5	
DIGITAL TO ANALOG AND ANALOG TO DIGITAL CONVERTERS : Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, and IC 1408 DAC, Different types of ADCs – parallel Comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC.DAC and ADC Specifications, Specifications AD 574 (12 bit ADC).	**13**

Course outcomes:

1. Design circuits using operational amplifiers for various applications.
2. Analyze and design amplifiers and active filters using Op-amp.
3. Diagnose and trouble-shoot linear electronic circuits.
4. Understand the gain-bandwidth concept and frequency response of the amplifier configurations. Understand thoroughly the operational amplifiers with linear integrated circuits.

Text Books:

1. Linear Integrated Circuits – D. Roy Choudhury, New Age International (p) Ltd, 2nd Edition,2003.
2. Op-Amps & Linear ICs - Ramakanth A. Gayakwad, PHI,1987.

Reference Books:

1. Operational Amplifiers & Linear Integrated Circuits –Sanjay Sharma ;SK Kataria &Sons;2nd Edition,2010
2. Design with Operational Amplifiers & Analog Integrated Circuits – Sergio Franco, McGraw Hill, 1988.
3. OP AMPS and Linear Integrated Circuits concepts and Applications, James M Fiore, Cenage Learning India Ltd
4. Operational Amplifiers & Linear Integrated Circuits–R.F.Coughlin & Fredrick Driscoll, PHI, 6th Edition.
5. Operational Amplifiers & Linear ICs – David A Bell, Oxford Uni. Press, 3rd Edition
6. Operational Amplifiers–C.G. Clayton, Butterworth & Company Publ. Ltd./Elsevier, 1971

Digital Signal Processing
Minors

Subject Code	21ETETMXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	Signals and System	Credits – 04	

Course Objectives:

This course will enable the students to:

- Analyze the Discrete Time Signals and Systems
- Know the importance of FFT algorithm for computation of Discrete Fourier Transform
- Learn the IIR Filter design procedures and Understand the various implementations of digital filter structures
- Learn the FIR Filter design procedures and Understand the various implementations of digital filter structures
- Learn the concepts of DSP Processors

Unit -1	**Hours**
INTRODUCTION: Introduction to Digital Signal Processing: Discrete time signals & sequences, Classification of Discrete time systems, stability of LTI systems. Response of LTI systems to arbitrary inputs. Solution of Linear constant coefficient difference equations. Frequency domain representation of discrete time signals and systems. Review of Z-transforms, solution of difference equations using Z-transforms, System function.	**12**
Unit -2	
DISCRETE FOURIER SERIES &FOURIER TRANSFORMS: Properties of discrete Fourier series, DFS representation of periodic sequences, Discrete Fourier transforms: Properties of DFT, linear filtering methods based on DFT, Fast Fourier transforms (FFT) - Radix-2 decimation in time and decimation in frequency FFT Algorithms, Applications of FFT.	**13**
Unit – 3	
DESIGN OF IIR DIGITAL FILTERS& REALIZATIONS: Analog filter approximations – Butter worth and Chebyshev, Design of IIR Digital filters from analog filters, Design Examples, Analog and Digital frequency transformations. Basic structures of IIR systems, Transposed forms.	**13**
Unit – 4	
DESIGN OF FIR DIGITAL FILTERS & REALIZATIONS: Characteristics of FIR Digital Filters, frequency response. Design of FIR Digital Filters using Window Techniques and Frequency Sampling technique, Comparison of IIR & FIR filters. Basic structures of FIR systems.	**13**
Unit – 5	
INTRODUCTION TO DSP PROCESSORS: Introduction to programmable DSPs: Multiplier and Multiplier Accumulator, Modified bus structures and memory access schemes in P-DSPs ,Multiple Access Memory, Multiported memory, VLIW architecture, Pipelining, Special addressing modes, On-Chip Peripherals. Architecture of TMS320C5X: Introduction, Bus Structure, Central Arithmetic Logic Unit.	**13**

Course outcomes:

After going through this course the student will be able to

1. Apply the difference equations concept in the anayziation of Discrete time systems
2. Use the FFT algorithm for solving the DFT of a given signal

3. Design a Digital filter (IIR) from the given specifications Realize the IIR structures from the designed digital filter.
4. Design a Digital filter (FIR) from the given specifications Realize the FIR structures from the designed digital filter
5. Apply the signal processing concepts on DSP Processor.

Text Books:

1. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, Dimitris G.Manolakis, Pearson Education / PHI, 2007.
2. Discrete Time Signal Processing – A.V.Oppenheim and R.W. Schaffer, PHI

Reference Books:

1. Digital Signal Processing: Andreas Antoniou, TATA McGraw Hill , 2006
2. Digital Signal Processing Paperback – 16 December 2014 by Tarun Kumar Rawat (Author), Publisher : Oxford University Press (16 December 2014)
3. DSP Primer - C. Britton Rorabaugh, Tata McGraw Hill, 2005.
4. Fundamentals of Digital Signal Processing using Matlab – Robert J. Schilling, Sandra

Analog communications **Minors**			
Subject Code	21ETETMXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	Signal and Systems	Credits – 04	

Course Objectives:

This course will enable the students to:

- i. Familiarize with the fundamentals of analog communication systems
- ii. Familiarize with various techniques for analog modulation and demodulation of signals
- iii. Distinguish the figure of merits of various analog modulation methods
- iv. Develop the ability to classify and understand various functional blocks of radio transmitters and receivers
- v. Familiarize with basic techniques for generating and demodulating various pulse modulated signals

Unit -1	**Hours**
. **AMPLITUDE MODULATION :** Introduction to communication system, Need for modulation, Frequency Division Multiplexing , Amplitude Modulation, Definition, Time domain and frequency domain description, single tone modulation, power relations in AM waves, Generation of AM waves, square law Modulator, Switching modulator, Detection of AM Waves; Square law detector, Envelope detector.	**12**
Unit -2	
DSB & SSB MODULATION: Double side band suppressed carrier modulators, time domain and frequency domain description, Generation of DSBSC Waves, Balanced Modulators, Ring Modulator, Coherent detection of DSB-SC Modulated waves, COSTAS Loop. Frequency domain description, Frequency discrimination method for generation of AM SSB Modulated Wave, Time domain description, Phase discrimination method for generating AM SSB Modulated waves. Demodulation of SSB Waves, Vestigial side band modulation: Frequency description, Generation of VSB Modulated wave, Time domain description, Envelope detection of a VSB Wave pulse Carrier, Comparison of AM Techniques, Applications of different AM Systems.	**13**
Unit – 3	
. **ANGLE MODULATION :** Basic concepts, Frequency Modulation: Single tone frequency modulation, Spectrum Analysis of Sinusoidal FM Wave, Narrow band FM, Wide band FM, Constant Average Power, Transmission bandwidth of FM Wave - Generation of FM Waves, Direct FM,. Detection of FM Waves: Balanced Frequency discriminator, Zero crossing detector, Phase locked loop, Comparison of FM & AM	**13**
Unit – 4	
NOISE: Review of noise and noise sources, noise figure, Noise in Analog communication Systems, Noise in DSB& SSB System, Noise in AM System, Noise in Angle Modulation Systems, Threshold effect in Angle Modulation System, Pre-emphasis & de-emphasis	**13**

Unit – 5	
TRANSMITTERS & RECEIVERS: Radio Transmitter - Classification of Transmitter, AM Transmitter, Effect of feedback on performance of AM Transmitter, FM Transmitter – Variable reactance type and phase modulated FM Transmitter, frequency stability in FM Transmitter. **Radio Receiver** - Receiver Types - Tuned radio frequency receiver, Superhetrodyne receiver, RF section and Characteristics - Frequency changing and tracking, Intermediate frequency, AGC, FM Receiver, Comparison with AM Receiver, Amplitude limiting. Communication Receivers, extensions of super heterodyne principle and additional circuits.	**13**
Course outcomes: i. Explain the basic elements of communication system, need for modulation and elaborately about amplitude modulation. ii. Describe the time and frequency domain representation, generation and demodulation of DSBSC, SSB and VSB modulation schemes. iii. Discuss the concepts of angle modulation. iv. Explain various issues in radio transmitters and receivers v. Describe pulse modulation schemes and estimate the noise in analog modulation schemes	
Text Books: 1. Communication Systems - Simon Haykin, John Wiley, 2ndEd.,. 2. Modern digital and analog communication systems , 4th edition B.P.Lathi, Ding, Gupta oxford publishers	
Reference Books: 1. Principles of Communication Systems – H Taub& D. Schilling, GautamSahe, TMH, 2007 3rd Edition. 2. Analog and digital Communication Systems – B.P. Lathi, BS Publication, 2006	

Microwave and Radar Engineering **Minors**			
Subject Code	21ETETMXXX	Internal Marks	30
L-T-P	3-1-0	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Pre-requisite	EMTL,Communication	Credits – 04	

Course Objectives:

This course will enable the students to:

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Unit -1	**Hours**
Microwave Components: Rectangular cavity resonators; Q of a cavity resonator; Re-entrant cavities; Slow-wave structure; Microwave hybrid circuits; S-parameters and their properties; Waveguide tees ; Hybrid ring; Waveguide corners bends and twists; Two hole directional coupler; S- Matrix; Circulators and Isolators; Hybrid couplers.	**12**
Unit -2	
Microwave Linear Beam and Crossed-Field Tubes: Failure of conventional tube at high frequency; Klystron-Velocity modulation; Bunching; output power and loading; Reflex klystron-Velocity modulation; power output and efficiency and electronic admittance; Helix travelling wave tubes; amplification process; Conventional current; Electric field wave modes; Basic principle of coupled cavity; Magnetron-Types and Principles of operation; Modes of oscillation; Strapping; pi-mode separation.	**13**
Unit – 3	
. Microwave Devices: Transistors, Tunnel Diodes and Microwave FETs: Structure; Operation; Characteristics and Power frequency limitations of microwave transistors; Tunnel diodes and FieldEffect Transistors. Transfer Electron Devices: Gunn diode; Gunn effect; Principle and Mode of operation; Microwave generation and amplification Tunnel Diode; PIN diode and Crystal diode. Modulator; Switches, Avalanche Transit- Time Devices: Physical Structure; Principle of operation; Characteristics; Power output and Efficiency of IMPATT, TRAPATT and BARITT diodes; Parametric amplifiers.	**13**
Unit – 4	
. **Microwave Measurement:** Microwave bench; Precautions; Power measurement; Bolometric method; Attenuation; VSWR; Impedance, Frequency and Q of the Cavity.	**13**
Unit – 5	
Principles and Applications of Radar: Basic Radar, Radar Block Diagram, Radar Frequencies, Applications of Radar, Radar Range Equation, MTI and Pulse Doppler Radar: Introduction to Doppler and MTI Radar, delay line cancellers, staggered PRF. Range gated Doppler filter, limitations to MTI performance. Tracking with Radar, Monopulse Tracking, Conical Scan and Sequential Lobing, Limitations to Tracking Accuracy, Low Angle Tracking, Tracking in range, Comparison of Trackers.	**13**

Course outcomes:

Text Books:

1. Microwave Devices and Circuits by Samuel Y. Liao, 3rd Ed., Pearson Education.
2. Foundations of Microwave Engineering by R .E. Collin, TMH Pub.
3. Introduction to Radar Systems by M.I Skolnik, TMH Pub. Co.

Reference Books

1. Microwave Principles by Reich.
2. Microwaves, Gupta, New Age International Publishers.
3. Microwave and Radar Engg., M. Kulkarni, Umesh Publication.