B. Tech (R20) UCEV (Autonomous) *w.e.f* 2020-21

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

VIZIANAGARAM-535003, ANDHRA PRADESH, INDIA

B.Tech COURSE STRUCTURE (2020 Admitted batch)

R 20 Course Structure

I B. Tech – I SEMESTER

S. No	Course Code	Course Title	L	T	P	C
1	R2011BS01	Calculus and Differential Equations	3	0	0	3
2	R2011BS04	Applied Physics	3	0	0	3
3	R2011ES15	Problem solving and programming using C	3	0	0	3
4	R2011ES06	Engineering Drawing	1	0	4	3
5	R2011HS01	Communicative English	3	0	0	3
6	R2011HS01A	English Communication Skills Lab	0	0	3	1.5
7	R2011BS04A	Applied Physics lab	0	0	3	1.5
8	R2011ES15A	Problem solving and programming using C Lab	0	0	3	1.5
9	R2011MC01	Environmental Science	2	0	0	0
		Total	**15**	**0**	**13**	**19.5**

Category	Credits
Basic Science Course **(BS)**	7.5
Engineering Science Courses **(ES)**	7.5
Humanities & Social Science **(HS)**	4.5
Total Credits	19.5

I B. Tech – II SEMESTER

S. No	Course Code	Course Title	L	T	P	C
1	R2012BS02	Linear Algebra and Numerical Methods	3	0	0	3
2	R2012BS06	Applied Chemistry	3	0	0	3
3	R2012ES14	Network Analysis and synthesis	3	0	0	3
4	R2012ES03	Basic Electrical Machines	3	0	0	3
5	R2012ES12	Electronic Devices	3	0	0	3
6	R2012BS06A	Applied Chemistry Lab	0	0	3	1.5
7	R2012ES03A	Basic Electrical Machines Lab	0	0	3	1.5
8	R2012ES12A	Electronic Devices Lab	0	0	3	1.5
		Total	**15**	**0**	**13**	**19.5**

Category	Credits
Basic Science Course **(BS)**	7.5
Engineering Science Courses **(ES)**	9+3=12
Total Credits	19.5

II B. Tech I Semester

S. No	Course Code	Course Title	L	T	P	C
1	R2021BS01	Complex Variables And Statistical Methods	3	0	0	3
2	R202104PC01	Signals and Systems	3	0	0	3
3	R202104PC02	Analog Electronics	3	0	0	3
4	R202104PC03	Digital Electronics	3	0	0	3
5	R202104PC04	Random Variables and Stochastic Process	3	0	0	3
6	R202104PC01A	Signals and Systems Lab	0	0	3	1.5
7	R202104PC02A	Analog Electronics Lab	0	0	3	1.5
8	R202104PC03A	Digital Electronics Lab	0	0	3	1.5
9	R202104SC01	Electronic Circuit Design-(SC)	1	2	0	2
10	R2021MC01	Mandatory course- (AICTE suggested)- Constitution of India	2	0	0	0
Total						**21.5**

II B. Tech II Semester

S. No	Course Code	Course Title	L	T	P	C
1	R202204PC01	Control Systems	3	0	0	3
2	R202204PC02	Analog Communications	3	0	0	3
3	R202204PC03	Linear Circuits & Analog IC design	3	0	0	3
4	R202204ES01	Digital IC Design	3	0	0	3
5	R2022HS01	Managerial Economics and Financial Analysis	3	0	0	3
6	R202204PC02A	Analog Communications Lab	0	0	3	1.5
7	R202204PC03A	Linear circuits &Analog IC design Lab	0	0	3	1.5
8	R202204ES01A	Digital IC Design Lab	0	0	3	1.5
9	R202204SC01	Simulation Tools(Python Programming, R programming)- (SC)	1	2	0	2
Total						**21.5**
Internship 2 Months (Mandatory) during summer vacation						
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)			4	0	0	4

SKILL ORIENTED COURSES	MANDATORY COURSE
1. Electronic circuit design 2. Simulation tools (Python Programming, R programming)- 3. Communication skills 4. Advances in Communications and signal processing 5. Sensors based Instrumentation	1. Constitution of India 2. Indian Traditional Knowledge 3. Research Methodology

III B. Tech I Semester

S. No	Course Code	Course Title	L	T	P	C
1	R203104PC01	Micro Processors and Micro Controllers	3	0	0	3
2	R203104PC02	Digital Communications	3	0	0	3
3	R203104PC03	Electro Magnetic Theory and applications	3	0	0	3
4	R203104OE01	Computer Architecture and Organization	3	0	0	3
5	R203104PE01	Sensors and Instrumentation	3	0	0	3
6	R203104PC01A	Micro Processors and Micro Controllers Lab	0	0	3	1.5
7	R203104PC02A	Digital Communications Lab	0	0	3	1.5
8	R203104SC01	English Communication skills (SC)	1	0	2	2
9	R2031MC01	Mandatory course (AICTE suggested)- Indian Traditional Knowledge	2	0	0	0
	Summer Internship 2 Months (Mandatory) after second year (to be evaluated during V semester		0	0	0	1.5
Total						**21.5**
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)			4	0	0	4

III B. Tech II Semester

S. No	Course Code	Course Title	L	T	P	C
1	R203204PC01	Digital Signal Processing	3	0	0	3
2	R203204PC02	Micro Waves, Waveguides and Antennas	3	0	0	3
3	R203204PC03	VLSI Design	3	0	0	3
4	R203204OE01	Information Theory and Coding	3	0	0	3
5	R203204PE01	Optical and Quantum Communications	3	0	0	3
6	R203204PC01A	Digital Signal Processing Lab	0	0	3	1.5
7	R203204PC02A	Micro Wave and Optical Communications Lab	0	0	3	1.5
8	R203204PC03A	VLSI Design Lab	0	0	3	1.5
9	R203204SC01	Sensors based Instrumentation -(SC)	1	0	2	2
10	R2032MC01	Mandatory course (AICTE suggested)- Research Methodology	2	0	0	0
Total						**21.5**
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)			4	0	0	4
Industrial/Research Internship (Mandatory) 2 Months during summer vacation						

Professional Elective -I	Professional Elective –II	Open Elective-I	Open Elective-II
1. Sensors and Instrumentation 2.Tele communications and switching Networks 3. Design of Fault Tolerant Systems	1. Optical and quantum communications 2. Global Positioning System 3. Advanced Digital Communication Techniques	1. Computer Architecture and Organization 2. Mobile Computing 3. Programming With Arduino	1. Information Theory and Coding 2. Soft computing techniques 3. Antenna Theory: Analysis And Design

IV B. Tech I Semester

S. No	Course Code	Course Title	L	T	P	C
1	R204104PE01	Biomedical Instrumentation	3	0	0	3
2	R204104PE02	Digital Image and Video Processing	3	0	0	3
3	R204104PE03	Embedded Systems	3	0	0	3
4	R204104OE01	Cellular Mobile Communications	3	0	0	3
5	R204104OE02	Radar and Satellite Communications.	3	0	0	3
6	R204104HS01	Universal Human Values 2: Understanding Harmony	3	0	0	3
7	R204104SC01	Advances in Communications and signal processing (SC)	1	0	2	2
8	**Industrial/Research Internship 2 Months (Mandatory) after third year (to be evaluated during VII semester**		0	0	0	3
Total						**23**
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)			4	0	0	4

Professional Elective –III	Professional Elective –IV	Professional Elective -V
1. Biomedical Instrumentation 2. Low Power VLSI 3. RF MEMS	1. Digital Image And Video Processing 2. Speech And Audio Processing 3. Multicarrier Communication Systems	1. Embedded Systems 2. Digital Data Communications 3. MIMO Communication Systems

Open Elective-III	Open Elective-IV
1. Cellular Mobile Communications 2. Wireless Communications & Networks 3. Introduction To Space Technology	1. Radar and Satellite Communications. 2. RF Circuit Design 3. Air Transportation Systems

IV B. Tech II Semester

S. No	Category	Code	Course	Hours per week			C
1	Major Project	R204204PR01	Project Project work, seminar and internship in industry	0	0	0	12
	INTERNSHIP (6 MONTHS)						
Total							**12**

I Year-I Semester

L	T	P	C
3	0	0	3

NAME OF THE SUBJECT: CALCULUS AND DIFFERENTIAL EQUATIONS

\(Common to all branches)

Course Objectives:

(i) This course will illuminate the students in the concepts of calculus.
(ii) To enlighten the learners in the concept of differential equations and multivariable calculus.
(iii) To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

UNIT I: Sequences, Series and Mean value theorems: (10 hrs)

Sequences and Series: Convergence and divergence – Ratio test – Comparison tests – Integral test – Cauchy's root test – Alternate series – Leibnitz's rule.
Mean Value Theorems (without proofs): Rolle's Theorem – Lagrange's mean value theorem – Cauchy's mean value theorem – Taylor's and Maclaurin's theorems with remainders.

UNIT II: Differential equations: (15 hrs)

Linear differential equations – Bernoulli's equations – Exact equations and equations reducible to exact form
Non-homogeneous 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^nV(x) – Method of Variation of parameters- Euler-Cauchy equation and Legender's equation
Applications: Orthogonal trajectories – Electrical circuits (RL, RC, RLC) – Simple Harmonic motion.

UNIT III: Partial differentiation: (10 hrs)

Introduction – Homogeneous function – Euler's theorem – Total derivative – Chain rule – Jacobian – Functional dependence – Taylor's and Mac Laurin's series expansion of functions of two variables.
Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method (with constraints).

UNIT IV: Multiple integrals: (8 hrs)

Double integrals – Change of order of integration - Double integrals in polar coordinates- Areas enclosed by plane curves- Triple integrals – Volume of solids – Change of variables to polar, spherical and cylindrical co-ordinates.

Applications: Finding Areas and Volumes.

UNIT V: Beta and Gamma functions: (5 hrs)

Introduction to Improper Integrals-Beta and Gamma functions- Properties - Relation between Beta and Gamma functions- Evaluation of improper integrals.

Course Outcomes: At the end of the course, the student will be able to

(i) Utilize mean value theorems to real life problems (L3)
(ii) Solve the differential equations related to various engineering fields (L3).
(iii) Familiarize with functions of several variables which are useful in optimization (L3)
(iv) Apply double and triple integration techniques in evaluating areas and volumes bounded by region (L3)
(v) Conclude the use of Beta and Gamma functions in evaluating improper integrals (L4)

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 43rd 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, 14th Edition, Pearson.
3. **Lawrence Turyn,** Advanced Engineering Mathematics, CRC Press, 2013.
4. **Srimantha Pal, S C Bhunia,** Engineering Mathematics, Oxford University Press.

	L	T	P	C
I Year- I / II Semester	**3**	**0**	**0**	**3**

NAME OF THE SUBJECT: APPLIED PHYSICS
(Common to CSE, ECE, EEE & IT)

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. To identify the importance of the optical phenomenon i.e. interference, diffraction and polarization related to its Engineering applications.
ii. Understand the mechanism of emission of light, utilization of lasers as coherent light sources for low and high energy applications, study of propagation of light through optical fibers and their implications in optical communications.
iii. Enlightenment of the concepts of Quantum Mechanics and to provide fundamentals of deBroglie matter waves, quantum mechanical wave equation and its application, the importance of free electron theory for metals and band theory for crystalline solids. Metals- Semiconductors-Insulators concepts utilization of transport phenomenon of charge carriers in semiconductors.
iv. To explain the significant concepts of dielectric and magnetic materials that leads to potential applications in the emerging micro devices.
v. To Understand the physics of Semiconductors and their working mechanism. To give an impetus on the subtle mechanism of superconductors using the concept of BCS theory and their fascinating applications.

UNIT - I: Wave Optics **12 hrs**

Interference: Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Colors in thin films- Newton's Rings- Determination of wavelength and refractive index.

Diffraction: Introduction - Fresnel and Fraunhofer diffraction - Fraunhofer diffraction due to single slit, double slit - N-slits (Qualitative) – Diffraction Grating - resolving power of Grating(Qualitative).

Polarization: Introduction-Types of polarization - Polarization by reflection and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

UNIT-II: Lasers and Fiber optics **8hrs**

Lasers: Introduction – Characteristics of laser – Spontaneous and Stimulated emissions of radiation – Einstein's coefficients and their relation – Population inversion – Lasing action - Pumping mechanisms – Ruby laser – He-Ne laser-Semiconductor laser - Applications of lasers.

Fiber optics: Introduction –Principle of optical fiber- Acceptance Angle - Numerical Aperture -Classification of optical fibers based on refractive index profile and modes –Block diagram of fiber optic communication.

UNIT - III: Quantum Mechanics, Free Electron Theory and Band theory **10hrs**

Quantum Mechanics: Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well-Quantum tunnellinng effect (qualitative).

Free Electron Theory: Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory– Fermi energy-Equation for electrical conductivity based on quantum free electron theory –Fermi-Dirac distribution.

UNIT - IV: Dielectric and Magnetic Materials **8hrs**

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility and Dielectric constant - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field- Clausius-Mossotti equation.

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability - Origin of permanent magnetic moment - Classification of magnetic materials: Dia, para, Ferro, antiferro & Ferri magnetic materials - Domain concept for Ferromagnetism (Qualitative) - Hysteresis - soft

and hard magnetic materials-Applications.

UNIT - V: Semiconductors and Superconductors **10hrs**

Semiconductors: Introduction-Classification of solids - Intrinsic semiconductors – Density of charge carriers – Electrical conductivity – Fermi level – extrinsic semiconductors – density of charge carriers –Drift and diffusion currents – Einstein's equation- Hall effect – Hall coefficient –Applications of Hall effect.
Superconductors: Introduction – Properties of superconductors – Meissner effect – Type I and Type II superconductors – BCS theory (Qualitative) – Josephson effects (AC and DC) – SQUIDs.
Course Outcomes:
The students should be able to:

i. **understand** the concepts of physical optics through the wave nature of light and **discuss** the phenomenal differences between interference, diffraction and polarization.
ii. **Describe** the basic laser physics, working of lasers, and principle of propagation of light in optical fibers.
iii. **Apply** the knowledge of basic quantum mechanics, to set up onedimensional Schrodinger's wave equation and **summarize** the importance of free electrons in determining the properties of metals.
iv. **explain** the basics of dielectric and magnetic materials to synthesize new materials as per needs of engineering applications.
v. gain the **knowledge** of semiconductor bonding, semiconductor carrier properties and henomenological **describe** the phenomenon of superconduction

Text books:
1. M. N. Avadhanulu, P.G.Kshirsagar & TVS Arun Murthy" A Text book of Engineering Physics"- S.Chand Publications, 11th Edition 2019.
2. Engineering Physics" by D.K.Bhattacharya and Poonam Tandon, Oxford press (2015).
3. Applied Physics by P.K.Palanisamy SciTech publications.
Reference Books:
1. Fundamentals of Physics – Halliday, Resnick and Walker, John Wiley &Sons
2. Engineering Physics by M.R.Srinivasan, New Age international publishers (2009).
3. Shatendra Sharma, Jyotsna Sharma, " Engineering Physics", Pearson Education, 2018
4. Engineering Physics - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press
5. Semiconductor physics and devices- Basic principle – Donald A, Neamen, Mc Graw Hill
6. B.K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Learning

	L	T	P	C
I Year-I Semester	**3**	**0**	**0**	**3**

NAME OF THE SUBJECT: PROBLEM SOLVING AND PROGRAMMING USING C

(Common to ALL)

Course Objectives:

The objectives of this course is to acquire knowledge on the

- To impart adequate knowledge on the need of programming languages and problem-solving techniques and develop programming skills.
- To enable effective usage of Control Structures and Implement different operations on arrays.
- To demonstrate the use of Strings and Functions.
- To impart the knowledge of pointers and understand the principles of dynamic memory allocation.
- To understand structures and unions and illustrate the file concepts and its operations.
- To impart the Knowledge Searching and Sorting Techniques.

UNIT-I

Introduction to Computer Problem Solving: Programs and Algorithms, Computer Problem Solving Requirements, Phases of Problem Solving, Problem. Solving Strategies, Top-Down Approach, Algorithm Designing, Program Verification, Improving Efficiency, Algorithm Analysis and Notations.

UNIT-II

Introduction to C Programming: Introduction, Structure of a C Program. Comments, Keywords, Identifiers, Data Types, Variables, Constants, Input/output Statements. Operators, Type Conversion.

Control Flow, Relational Expressions: Conditional Branching Statements: if, if-else, if-else—if, switch. Basic Loop Structures: while, do-while loops, for loop, nested loops, The Break and Continue Statements, goto statement.

UNIT-III

Arrays: Introduction, Operations on Arrays, Arrays as Function Arguments, Two dimensional Arrays, Multi dimensional arrays.

Pointers: Concept of a Pointer, Declaring and Initializing Pointer Variables, Pointer Expressions and Address Arithmetic, Null Pointers, Generic Pointers, Pointers as Function Arguments, Pointers and Arrays, Pointer to Pointer, Dynamic Memory Allocation, Dangling Pointer, Command Line Arguments,

UNIT-IV

Functions: Introduction, Function Declaration, Function Definition, Function Call, Categories of Functions, Passing Parameters to Functions, Scope of Variables, Variable Storage Classes. Recursion.

Strings: String Fundamentals, String Processing with and without Library
Functions, Pointers and Strings.

UNIT-V

Structures, Unions, Bit Fields: Introduction, Nested Structures, Arrays of Structures, Structures and Functions, Self-Referential Structures, Unions, Enumerated Data Type —Enum variables, Using Typedef keyword, Bit Fields.

Data Files: Introduction to Files, Using Files in C, Reading from Text Files, Writing to Text Files, Random File Access.

Course Outcomes:

At the end of the Course, Student should be able to:

i. Illustrate the Fundamental concepts of Computers and basics of computer programming.
ii. Use Control Structures and Arrays in solving complex problems.

iii. Develop modular program aspects and Strings fundamentals.
iv. Demonstrate the ideas of pointers usage.
v. Solve real world problems using the concept of Structures, Unions and File operations.

Text Books:

i. How to solve it by Computer, R. G. Dromey, and Pearson Education.
ii. Computer Programming. Reema Thareja, Oxford University Press
iii. Let us C , Yaswanth Kanetkar, 16th Edition,BPB Publication.

Reference Books:

i. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill.
ii. Programming In C A-Practia1 Approach. Ajay Mittal, Pearson.
iii. C Programming — A Problem Solving Approach, Forouzan, Gilberg, Cengage.
iv. The C Programming Language, Dennis Richie And Brian Kernighan, Pearson Education.
v. Programming In C, Ashok Kamthane, Second Edition, Pearson Publication.

Web Links:

- http://www.c4learn.com/
- http://www.geeksforgeeks.org/c/
- http://nptel.ac.in/courses/122104019/
- http://www.learn-c.org/
- https://www.tutorialsyoint.com/cprogramming/

	L	T	P	C
I Year-I Semester	**1**	**0**	**4**	**3**

NAME OF THE SUBJECT: ENGINEERING DRAWING

(Common to CE, ECE and MET)

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. To introduce the students to use drawing instruments and to draw engineering curves.

ii. To introduce the students to use orthographic projections, projections of points & simple lines. To make the students draw the projections of the lines inclined to both the planes.

iii. The objective is to make the students draw the projections of the plane objects in different positions with the reference planes.

iv. The objective is to make the students draw the projections of the various types of solids in different positions inclined to one of the planes.

v. The objective is to represent the object in 3D view through isometric views. The student will be able to represent and convert the isometric view to orthographic view.

UNIT - I:

Curves: Parabola, Ellipse and Hyperbola by general and special methods, cycloids, tangents & normals for the curves.

Scales: Plain scales, diagonal scales and vernier scales

UNIT - II:

Orthographic Projections: Reference plane, importance of reference lines, projections of points in various quadrants, projections of lines, line parallel to both the planes, line parallel to one plane and inclined to other plane.

Projections of straight lines inclined to both the planes, determination of true lengths, angle of inclination and traces.

UNIT - III:

Polygons: Constructing regular polygons by general methods.

Projections of planes: regular planes perpendicular/parallel to one reference plane and inclined to the other reference plane; inclined to both the reference planes.

UNIT - IV:

Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to one plane-Auxiliary views.

UNIT - V:

Conversion of isometric views to orthographic views and Conversion of orthographic views to isometric views.

Course Outcomes:

The students should be able to:

i. To make the student familiar with the techniques used for drawing various geometric elements used in engineering practice.

ii. The student can apply orthographic projections and project the points and lines parallel to one plane and inclined to both the planes.

iii. Prepare the drawings for construction of regular polygons and the projection of the planes inclined to both the planes.

iv. The student can prepare the drawings for the projections of the various types of solids in different positions inclined to one of the planes.

v. Ability to use the concepts of isometric views to orthographic views and vice-versa.

Text Books:

i. Engineering Drawing by N.D. Bhatt, Chariot Publications
ii. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers

Reference Books:

i. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers
ii. Engineering Graphics for Degree by K.C. John, PHI Publishers
iii. Engineering Graphics by PI Varghese, McGrawHill Publishers
iv. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age

	L	T	P	C
I Year-I / II Semester	**3**	**0**	**0**	**3**

NAME OF THE SUBJECT: COMMUNICATIVE ENGLISH

(Common to all branches)

Course Objectives

(i) Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers

(ii) Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials

(iii) Help improve speaking skills through participation in activities such as role plays, discussions and structured talks/oral presentations

(iv) Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information

(v) Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

UNIT I:

A Drawer full of happiness

Listening: Listening to short audio texts and identifying the topic. Listening to prose, prose and conversation.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests. Self introductions and introducing others.

Reading: Skimming text to get the main idea. Scanning to look for specific pieces of information.

Reading for Writing: Paragraph writing (specific topics) using suitable cohesive devices; linkers, sign posts and transition signals; mechanics of writing - punctuation, capital letters.

Vocabulary: Technical vocabulary from across technical branches (20) GRE Vocabulary (20) (Antonyms and Synonyms, Word applications) Verbal reasoning and sequencing of words.

Grammar: Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countables and uncountables; singular and plural basic sentence structures; simple question form - wh-questions; word order in sentences.

Pronunciation: Vowels, Consonants, Plural markers and their realizations

UNIT II:

Nehru's letter to his daughter Indira on her birthday

Listening: Answering a series of questions about main idea and supporting ideas after listening to audio texts, both in speaking and writing.

Speaking: Discussion in pairs/ small groups on specific topics followed by short structured talks. Functional English: Greetings and leave takings. **Reading**: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

Reading for Writing: Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions.

Vocabulary: Technical vocabulary from across technical branches (20 words). GRE Vocabulary Analogies (20 words) (Antonyms and Synonyms, Word applications)

Grammar: Use of articles and zero article; prepositions.

Pronunciation: Past tense markers, word stress-di-syllabic words

UNIT III:

Stephen Hawking-Positivity 'Benchmark'

Listening: Listening for global comprehension and summarizing what is listened to, both in speaking and

writing.
Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed. Functional English: Complaining and Apologizing.
Reading: Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension. Critical reading.
Reading for Writing: Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions. Letter writing-types, format and principles of letter writing.E-mail etiquette, Writing CV's.
Vocabulary: Technical vocabulary from across technical branches (20 words). GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Association, sequencing of words
Grammar: Verbs - tenses; subject-verb agreement; direct and indirect speech, reporting verbs for academic purposes.
Pronunciation: word stress-poly-syllabic words.

UNIT IV:
Liking a Tree, Unbowed: Wangari Maathai-biography
Listening: Making predictions while listening to conversations/ transactional dialogues without video (only audio); listening to audio-visual texts.
Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions. Functional English: Permissions, Requesting, Inviting.
Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicative process or display complicated data.

Reading for Writing: Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs/tables.Writing SOP, writing for media.
Vocabulary: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Cloze Encounters.
Grammar: Quantifying expressions - adjectives and adverbs; comparing and contrasting; degrees of comparison; use of antonyms

Pronunciation: Contrastive Stress

UNIT V:
Stay Hungry-Stay foolish

Listening: Identifying key terms, understanding concepts and interpreting the concepts both in speaking and writing.
Speaking: Formal oral presentations on topics from academic contexts - without the use of PPT slides. Functional English: Suggesting/Opinion giving.
Reading: Reading for comprehension. RAP Strategy Intensive reading and Extensive reading techniques.
Reading for Writing: Writing academic proposals- writing research articles: format and style.
Vocabulary: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Coherence, matching emotions.
Grammar: Editing short texts – identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)
Pronunciation: Stress in compound words
Course Outcomes:
At the end of the module, the learners will be able to
(i) Understand social or transactional dialogues spoken by native speakers of English and identify the context, topic, and pieces of specific information
(ii) Ask and answer general questions on familiar topics and introduce oneself/others
(iii) Employ suitable strategies for skimming and scanning to get the general idea of a text and locate specific information
(iv) Recognize paragraph structure and be able to match beginnings/endings/headings with paragraphs
(v) Form sentences using proper grammatical structures and correct word forms

Prescribed text books:

(i) "**Infotech English**", Maruthi Publications. (Detailed)

Reference Books

1. Bailey, Stephen. *Academic writing: A handbook for international students*. Routledge, 2014.
2. Chase, Becky Tarver. *Pathways: Listening, Speaking and Critical Thinking.* Heinley ELT; 2nd Edition, 2018.
3. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
4. Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012
5. Martin Hewings , Advanced English Grammar, Cambridge university press
6. William Strunk JR. and E B White, Elements of Style, 4th Edition, Pearson
7. *Language and Life: A Skills Approach* Board of Editors, Orient Black Swan Publishers, India. 2018.
8. *Practical English Usage*, Michael Swan. OUP. 1995.
9. *Remedial English Grammar*, F.T. Wood. Macmillan.2007
10. *On Writing Well*, William Zinsser. Harper Resource Book. 2001
11. *Study Writing*, Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
12. *Communication Skills*, Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
13. *Exercises in Spoken English*, Parts. I-III. CIEFL, Hyderabad. Oxford University Press.
14. *Advanced English Grammar*, Martin Hewings. Cambridge University Press. 2016
15. *Elements of Style*, William Strunk and EB White. Pearson. 1999.

I Year-I / II Semester

L	T	P	C
0	0	3	1.5

NAME OF THE LAB: ENGLISH COMMUNICATION SKILLS LAB
(Common to all branches)

Course Objectives

(i) To impart grammar as well as communication through pronunciation. By introduction, pure vowels, consonants, diphthongs, phonetic transcription, common errors in pronunciation.
(ii) To impart better knowledge on Stress. Stress of kinds- mono syllabic, di syllabic, poly syllabic, strong and weak forms of stress along with contrastive stress.
(iii) To impart learner grammar as well as communication through compound words, rhythm, intonation and accent neutralization
(iv) To impart learner grammar as well as communication through listening, by identifying the context and specific pieces of information to answer a series of questions in speaking
(v) To improve the spoken skills of students by making them read news papers in order to understand and identify key terms context they read .

UNIT I:
Vowels, Consonants, Pronunciation, Phonetic Transcription, Common Errors in Pronunciation,

UNIT II:
Word stress-di-syllabic words, poly-syllabic words, weak and strong forms, contrastive stress (Homographs)

UNIT III:
Stress in compound words, rhythm, intonation, accent neutralisation.

UNIT IV:
Listening to short audio texts and identifying the context and specific pieces of information to answer a series of questions in speaking.

UNIT V:
Newspapers reading; Understanding and identifying key terms and structures useful for writing reports.

Course Outcomes:
At the end of the module, the learners will be able to
(i) The learner will improve phonetic understanding, transcription, common errors both in pronunciation and written English.
(ii) The learner will improve syllabic division, and how to use right stress in their pronunciation.
(iii) The learner will improve speaking skills with right intonation and rhythm and intonation and how to reduce mother tongue influence in English.
(iv) The learner will Improve speaking skills as well as listening skills by listening through the audio clips prescribed.
(v) The learner will Improve speaking skills along with reading skills.

Prescribed text book:
(i) "**InfoTech English**", Maruthi Publications.

References:

1. Exercises in Spoken English Part 1,2,3,4, OUP and CIEFL.
2. English Pronunciation in use- Mark Hancock, Cambridge University Press.
3. English Phonetics and Phonology-Peter Roach, Cambridge University Press.
4. English Pronunciation in use- Mark Hewings, Cambridge University Press.

5. English Pronunciation Dictionary- Daniel Jones, Cambridge University Press.
6. English Phonetics for Indian Students- P. Bala Subramanian, Mac Millan Publications.

	L	T	P	C
I Year-I / II Semester	**0**	**0**	**3**	**1.5**

NAME OF THE LAB: APPLIED PHYSICS LAB

(Common to CSE, ECE, EEE & IT)

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. To **impart skills** in measurements with accurate error propagation.
ii. To **plan** the experimental procedure, **design** and to record and **analysis** results.
iii. To reach non trivial conclusions of significant of the experiments.
iv. To **develop** the skills to handle different instruments without taking erroneous readings and ability to enhance the skills to fabricate engineering and technical equipments.

List of experiments:

1. Determination of thickness of thin object by wedge method.
2. Determination of radius of curvature of a given plano convex lens by Newton's rings.
3. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
4. V-I Characteristics of a P-N Junction diode.
5. Determination of dielectric constant for different materials.
6. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
7. Determination of numerical aperture and acceptance angle of an optical fiber.
8. Determination of wavelength of Laser light using diffraction grating.
9. Estimation of Planck's constant using reverse photoelectric effect.
10. V-I Characteristics of a zener diode.
11. To determine the energy gap of a semiconductor using p-n junction diode.
12. Magnetic field along the axis of a current carrying circular coil by Stewart & Gee's Method.
13. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall Effect.
14. Measurement of resistance of a semiconductor with varying temperature.
15. Resistivity of a Superconductor using four probe method & Meissner effect.

Course Outcomes:

The students should be able to:

i. **Describe** the methodology of science and the relationship between observation and theory.
ii. **Develop** scientific problem solving skills, including organization of given information, identification and application of pertinent principles, quantitative solutions, interpreting results, and evaluating the validity of results.
iii. **Discover** of physics concepts in other disciplines such as mathematics, computer science, engineering, and chemistry.
iv. **Learn** to minimize contributing variables and recognize the limitations of equipment.
v. **Apply** conceptual understanding of the physics to general real-world situations.
vi. **Develop** interpersonal and communication skills including communicating in small groups, writing, working effectively with peers.

Reference Books:

i. S. Balasubramanian, M.N. Srinivasan "A Text Book of Practical Physics"- S Chand Publishers, 2017.

	L	T	P	C
I Year-I Semester	**0**	**0**	**3**	**1.5**

NAME OF THE LAB: PROBLEM SOLVING AND PROGRAMMING USING C LAB

(Common to ALL)

Course Objectives:

The objectives of this course is to acquire knowledge on the

- To impart knowledge on basic Linux commands, various Editors, Raptor.
- To make the students understand the concepts of C programming.
- To nurture the students on Control Structures and develop different operations on arrays.
- To make use of String fundamentals and modular programming constructs.
- To implement programs using dynamic memory allocation.
- To explain the concepts of Structure, Unions and files for solving various problems.

List of Experiments:

1. Introduction to Algorithms and Flowcharts

1.1) Implement Algorithm Development for Exchange the values of Two numbers.
1.2) Given a set of n student's examination marks (in the range 0-100) make a count of the number of students that passed the examination. A Pass is awarded for all of 50 and above.
1.3) Given a set of n numbers design an algorithm that adds these numbers and returns the resultant sum. Assume N is greater than or equal to zero.

2. Introduction to C Programming

2.1) Basic Linux Commands.
2.2) Exposure to Turbo C, Vi, Emacs, Code Blocks IDE, Dev C++.
2.3) Writing simple programs using printf(), scanf() .

3. Raptor

3.1) Installation and Introduction to Raptor.
3.2) Draw a flow chart to find the Sum of 2 numbers.
3.3) Draw a flow chart to find Simple interest.

4. Basic Math

4.1) Write a C Program to convert Celsius to Fahrenheit and vice versa.
4.2) Write a C Program to find largest of three numbers using ternary operator.
4.3) Write a C Program to Calculate area of a Triangle using Heron's formula.

5. Control Flow- I

5.1) Write a C Program to Find Whether the Given Year is a Leap Year or not.
5.2) Write a C program to find the roots of a Quadratic Equation.
5.3) Write a C Program to make a simple Calculator to Add, Subtract, Multiply or Divide Using Switch...case.

6. Control Flow- II

6.1) Write a C Program to Find Whether the Given Number is Prime number or not.
6.2) Write a C Program to Find Whether the Given Number is Armstrong Number or not.
6.3) Write a C program to print Floyd Triangle.

7. Control Flow- III

7.1) Write a C program to find the sum of individual digits of a positive integer.
7.2) Write a C program to check whether given number is palindrome or not.

7.3) Write a C program to read two numbers, x and n, and then compute the sum of the geometric progression $1+x+x'+x^3+\ldots\ldots\ldots\ldots+x^n$.

8. Arrays

8.1) Write a C program to search an element in the given array (Linear Search).
8.2) Write a C program to perform matrix addition.
8.3) Write a C program to perform matrix multiplication.

9. Pointers

9.1) Write a C Program to Perform Addition. Subtraction, Multiplication and Division of two numbers using Command line arguments.
9.2) Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc () function.
9.3) Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc () function.

10. Functions, Array & Pointers

10.1) Write a C Program to demonstrate parameter passing in Functions.
10.2) Write a C Program to find Fibonacci. Factorial of a number with recursion and without recursion.
10.3) Write a C Program to find the sum of given numbers with arrays and pointers.

11. Strings

11.1) Implementation of string manipulation operations with library function:

a. copy
b. concatenate
c. length
d. compare

I 1.2) Implementation of string manipulation operations without library function:

a. copy
b. concatenate
c. length
d. compare

12. Structures

12.1) Write a C Program to Store Information of a book Using Structure.
12.2) Write a C Program to Add Two Complex Numbers by Passing Structure to a Function.

13. Files

13.1) Write a C program to open a file and to print the contents of the file on screen.
13.2) Write a C program to copy content of one file to another file.
13.3) Write a C program to merge two files and store content in another file.

14. Application

Creating structures to capture the student's details save them in file in proper record format. search and prints the student details requested by the user.

Note: Draw the flowcharts using Raptor from Experiment 3 to Experiment 6.

Course Outcomes:

- Implement basic programs in C and design flowcharts in Raptor.
- Use Conditional and Iterative statements to solve real time scenarios in C.
- Implement the concept of Arrays and Modularity and Strings.
- Apply the Dynamic Memory Allocation functions using pointers.

- Develop programs using structures, and Files.

Text Books:

i. Let us C , Yaswanth Kanetkar, 16th Edition,BPB Publication.
ii. How to solve it by Computer, R. G. Dromey, and Pearson Education.
iii. Computer Programming. Reema Thareja, Oxford University Press

Reference Books:

i. Programming in C A-Practical Approach Ajay Mittal. Pearson Education.
ii. The C programming Language, Dennis Richie and Brian Kernighan, Pearson Education.
iii. Problem solving using C , K Venugopal,3'd Edition,TMG Publication.

Web Links:

1. https://www.hackerrank.com/
2. https://www.codechef.com/
3. https://www.topcoder.com/
4. https://code-cracker.github.io/
5. https://raptor.martincar1is1e.com/
6. httos://npte1.ac.in/courses/106105055/2

	L	T	P	C
I Year-I/II Semester	**2**	**0**	**0**	**0**

NAME OF THE SUBJECT: ENVIRONMENTAL SCIENCE

(Common to All branches)

Course Objectives:

The objectives of this course is to acquire knowledge on the

(i) The natural resources and their sustenance of the life and recognize the need to conserve the natural resources.

(ii) The concepts of ecosystem and its functions in the environment. The need for protecting the producers and consumers and their role in the food web.

(iii) The biodiversity of India and the threats to biodiversity, and the conservation practices to protect the biodiversity.

(iv) Various attributes of the pollution and their impacts and measures to reduce or control the pollution along with waste management.

(v) Social issues both rural and urban environment and the possible means to combat the challenges.

UNIT - I: MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES 7hrs

Definition, Scope and Importance - Need for public Awareness.

Natural Resources : Renewable and non-renewable resources - Natural resources and associated problems - Forest resources - Use and over - exploitation, deforestation,– Timber extraction - Mining, dams and other effects on forest and tribal people - Water resources - Use and over utilization of surface and ground water - dams – benefits and problems - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources,Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modem agriculture, fertilizer-pesticide problems, water logging, salinity.

UNIT - II: ECOSYSTEMS, BIODIVERSITY AND ITS CONSERVATION 7hrs

Ecosystems: Concept of an ecosystem. - Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the ecosystems.

Biodiversity and its Conservation : Definition: genetic, species and ecosystem diversity – Bio geographical classification of India - Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values - Biodiversity at global, National and local levels - India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT - III ENVIRONMENTAL POLLUTION AND SOLID WASTE MANAGEMENT 6hrs

Environmental pollution: Definition, Cause, effects and control measures of: Air Pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, nuclear hazards.

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes -Role of an individual in prevention of pollution, Disaster management: floods, earthquake, cyclone and landslides.

UNIT - IV: SOCIAL ISSUES AND THE ENVIRONMBNT 6hrs

Social Issues and the Environment: From Unsustainable to Sustainable development - Urban problems related to energy - Water conservation, rain water harvesting, Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions - Climate change, global warming, acid rain and ozone layer depletion, Wasteland reclamation – Consumerism and waste products. - Environment Protection Act. - Air (Prevention and Control of Pollution) Act. -Water (prevention and control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act.

UNIT - V: HUMAN POPULATION AND THE ENVIRONMENT 6hrs

Human population and the Environment: Population growth, variation among nations' Population explosion - Family Welfare programme. - Environment and human health - Human Rights - Value Education - HIV/AIDS - Women and Child Welfare - Role of information Technology in Environment and human health.

Field Work: Visit to a local area to document environmental assets River/forest

Grassland/hill/mountain - Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds - river, hill slopes.

Course Outcomes:

The students should be able to:

(i)Gain a higher level of personal involvement and interest in understanding and solving environmental problems.

(ii)Comprehend environmental problems from multiple perspectives with emphasis on human modern lifestyles and developmental activities.

(iii)Demonstrate knowledge relating to the biological systems involved in the major global environmental problems of the 2lst century.

(iv) Influence their society in proper utilization of goods and services, Recognize the interconnectedness of human dependence on the earth's ecosystems.

(v)Learn the management of environmental hazards and to mitigate disasters and have a clear understanding of environmental concerns and follow sustainable development practices.

Text Books:

(i)Text book of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission, Universities Press.

(ii)Environmental Studies by Palaniswamy - Pearson education.

(iii)Environmental Studies by Dr.S.Azeem Unnisa, Academic Publishing Company.

Reference Books:

(i)Textbook of Environmental Science by Deeksha Dave and E.Sai Baba Reddy, Cengage Publications.

(ii)Text book of Environmental Sciences and Technology by M.Anji Reddy, BS Publication.

(iii)Comprehensive Environmental studies by J.P.Sharma, Laxmi publications.

(iv) Environmental sciences and engineering - J. Glynn Henry and Gary W. Heinke – Prentice hall India Private limited.

(v) A Text Book of Environmental Studies by G.R.Chatwal, Himalaya Publishing House.

(vi) Introduction to Environmental engineering and science by Gilberl M. Masters and Wendell P.Ela - Prentice hall of India Private limited.

I Year-II Semester

L	T	P	C
3	0	0	3

NAME OF THE SUBJECT: LINEAR ALGEBRA AND NUMERICAL METHODS

(Common to all branches)

Course Objectives:

The objectives of this course is to acquire knowledge on the

(i) To instruct the concept of Matrices in solving linear algebraic equations
(ii) To elucidate the different numerical methods to solve nonlinear algebraic equations
(iii) To disseminate the use of different numerical techniques for carrying out numerical integration.
(iv) To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications

UNIT – I: Systems of linear equations, Eigen values and Eigen vectors: (10 hrs)

Rank of a matrix by echelon form and normal form – Solving system of homogeneous and non-homogeneous linear equations – Gauss Elimination method – Eigenvalues and Eigen vectors and their properties.
Applications: Free vibration of a two-mass system.

UNIT – II: Cayley-Hamilton theorem and Quadratic forms: (10 hrs)

Cayley-Hamilton theorem (without proof) – Finding inverse and power of a matrix by Cayley-Hamilton theorem –Reduction to Diagonal form– Quadratic forms and nature of the quadratic forms – Reduction of quadratic form to canonical forms by orthogonal transformation.

Singular values of a matrix, singular value decomposition (Ref. Book – 1).

UNIT – III: Iterative methods: (8 hrs)

Introduction– Solutions of algebraic and transcendental equations : Bisection method–Secant method – Method of false position– Iteration method – Newton-Raphson method (One variable and simultaneous Equations)
Solutions of system of equations - Jacobi and Gauss-Seidel methods
Evaluation of largest eigenvalue –eigenvector using Power Method.

UNIT – IV: Interpolation: (10 hrs)

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– Newton's divide difference formula.

UNIT–V: Numerical integration and solution of differential equations with initial conditions: (10 hrs)

Trapezoidal rule– Simpson's $1/3^{rd}$ and $3/8^{th}$ rule– Solution of differential equations with initial conditions by Taylor's series– Picard's method of successive approximations– Euler's method –Runge-Kutta method (second and fourth order) – Milne's Predictor and Corrector Method.

Course Outcomes: The student will be able to

(i) Develop the use of matrix algebra techniques that is needed by engineers for practical applications (L6)

(ii) Solve system of linear algebraic equations using Gauss elimination, Gauss Jordan, Gauss Seidel (L3)

(iii) Evaluate approximating the roots of polynomial and transcendental equations by different algorithms (L5)

(iv) Apply Newton's forward & backward interpolation and Lagrange's formulae for equal and unequal intervals (L3)

(v) Apply different algorithms for approximating the solutions of ordinary differential equations to its analytical computations (L3)

Text Books:

(i) **B. S. Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.

(ii) **B. V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

(i) **David Poole,** Linear Algebra- A modern introduction, 4th Edition, Cengage.

(ii) **Steven C. Chapra,** Applied Numerical Methods with MATLAB for Engineering and Science, Tata Mc. Graw Hill Education.

(iii) **M. K. Jain, S. R. K. Iyengar and R. K. Jain,** Numerical Methods for Scientific and Engineering Computation, New Age International Publications.

(iv) **Lawrence Turyn,** Advanced Engineering Mathematics, CRC Press.

	L	T	P	C
I Year-I / II Semester	**3**	**0**	**0**	**3**

NAME OF THE SUBJECT: APPLIED CHEMISTRY

(Common to EEE,ECE,CSE,IT)

Knowledge of basic concepts of Chemistry for Engineering students will help them as professional engineers later in design and material selection, as well as utilizing the available resources.

Course Objectives:

- ***Importance*** of usage of plastics in household appliances and composites (FRP) in aerospace and automotive industries.
- ***Outline*** the basics for the construction of electrochemical cells, batteries and fuel cells. Understand the mechanism of corrosion and how it can be prevented.
- ***Explain*** the preparation of semiconductors and nanomaterials, engineering applications of nanomaterials, superconductors and liquid crystals.
- ***Recall*** the increase in demand for power and hence alternative sources of power are studied due to depleting sources of fossil fuels. Advanced instrumental techniques are introduced.
- ***Outline*** the basics of computational chemistry and molecular switches

.

UNIT I: POLYMER TECHNOLOGY **8 hrs**

Polymerisation:- Introduction, methods of polymerization (emulsion and suspension), mechanical properties.

Plastics: Compounding, fabrication (compression, injection, blown film and extrusion), preparation, properties and applications (PVC, polycarbonates and Bakelite), mention some examples of plastic materials used in electronic gadgets, recycling of e-plastic waste (waste to wealth).

Elastomers:- Introduction, preparation, properties and applications (Buna S, thiokol and polyurethanes).

Composite materials: Fiber reinforced plastics, conducting polymers, biodegradable polymers, biopolymers, biomedical polymers

UNIT II: ELECTROCHEMICAL CELLS AND CORROSION **10 hrs**

Single electrode potential, electrochemical series and uses of series, standard hydrogen electrode, calomel electrode, construction of glass electrode, batteries (Dry cell, Li ion battery and zinc air cells), fuel cells (H_2-O_2, CH_3OH-O_2, phosphoric acid and molten carbonate).

Corrosion:-Definition, theories of corrosion (chemical and electrochemical), galvanic corrosion, differential aeration corrosion, stress corrosion, galvanic series, factors influencing rate of corrosion, corrosion control (proper designing and cathodic protection), Protective coatings (surface preparation, cathodic coatings, anodic coatings, electroplating and electroless plating [nickel]), Paints (constituents, functions and special paints).

UNIT III: MATERIAL CHEMISTRY **10 hrs**

Part I *: Non-elemental semiconducting materials*:- Stoichiometric, controlled valency & chalcogen photo/semiconductors-preparation of semiconductors (distillation, zone refining, Czochralski crystal pulling, epitaxy, diffusion, ion implantation) - Semiconductor devices (p-n junction diode as rectifier, junction transistor).

Insulators & magnetic materials: electrical insulators-ferro and ferri magnetism-Hall effect and its applications.

Part II:

Nano materials:- Introduction, sol-gel method, characterization by (Brunauer Emmet Teller [BET]), (scanning electron microscopy [SEM]) and (transmission electron microscopy [TEM]), applications of graphene and fullerenes, carbon nanotubes (types, preparation and applications)

Liquid crystals:- Introduction-types-applications.

Super conductors:-Type –I, Type II-characteristics and applications

UNIT IV: SPECTROSCOPIC TECHNIQUES & NON-CONVENTIONAL ENERGY SOURCES 10 hrs

Part A: **SPECTROSCOPIC TECHNIQUES**

Electromagnetic spectrum-UV (laws of absorption, instrumentation, theory of electronic spectroscopy, Frank-condon principle, chromophores and auxochromes, intensity shifts, applications), FT-IR [instrumentation and differentiation of sp, sp^2, sp^3 and IR stretching of functional groups (alcohols, carbonyls, amines) applications], magnetic resonance imaging and CT scan (procedure & applications).

Part B*:* 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.

UNIT V: ADVANCED CONCEPTS/TOPICS IN CHEMISTRY 8 hrs

Computational chemistry: Introduction to computational chemistry, molecular modelling and docking studies and its applications.

***Molecular switches*:** characteristics of molecular motors and machines, Rotaxanes and Catenanes as artificial molecular machines, prototypes – linear motions in rotaxanes, an acid-base controlled molecular shuttle, a molecular elevator, an autonomous light-powered molecular motor

Course Outcomes

At the end of this unit, the students will be able to

(i) ***Analyze*** the different types of composite plastic materials and ***interpret*** the mechanism of conduction in conducting polymers.

(ii) ***Utilize*** the theory of construction of electrodes, batteries and fuel cells in redesigning new engineering products and categorize the reasons for corrosion and study methods to control corrosion.

(iii)***Synthesize*** nanomaterials for modern advances of engineering technology. Summarize the preparation of semiconductors; analyze the applications of liquid crystals and superconductors.

(iv)***Analyze*** the principles of different analytical instruments and their applications. Design models for energy by different natural sources.

(v) ***Obtain*** the knowledge of computational chemistry and molecular machines

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).

Reference Books:

1. K. Sesha Maheshwaramma 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)
4. B. S. Murthy, P. Shankar and others, "**Textbook of Nanoscience and Nanotechnology**", University press (latest edition)

	L	T	P	C
I Year- II Semester	**3**	**0**	**0**	**3**

NAME OF THE SUBJECT: NETWORK ANALYSIS AND SYNTHESIS

COURSE OBJECTIVES:

The main objectives of the course are

1. Understand and apply basic concepts of networks
2. Practicing network theorems to solve two port networks
3. Analysis of AC circuits using Time Domain and Frequency Domain
4. Calculation of network functions
5. Synthesis of RC,RL and LC networks

UNIT-1

Basic Circuit Fundamentals:

Fundamental concepts of R, L and C elements, Electric charge and current, Electric energy and potential, , DC circuits, series and parallel circuits, Ideal, Non-ideal, Independent and dependent sources, Source transformation,-Kirchhoff's laws, Mesh and Nodal Analysis - Super-mesh and Super-Node Analysis, Source transformation, Duality Principal , Star to Delta Conversion.

UNIT-2

Network Theorems:

Thevinin's, Norton's, Milliman's, Reciprocity, Compensation, Substitution, Superposition, Max Power Transfer, Tellegens- problem solving using dependent sources also.

Two Port Networks:

Z, Y, h and ABCD parameters, analysis of interconnected (magnetically coupled) two ports, three terminal networks. 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.

UNIT-3

Steady State Analysis of A.C Circuits:

Response to sinusoidal excitation - pure resistance, pure inductance, pure capacitance, impedance concept, phase angle, series R-L, R-C, R-L-C circuits

Time and Frequency Domain Analysis:

Initial conditions, Procedure for evaluating initial conditions, Transient analysis of DC & AC circuits. Laplace transform of standard signals, Shifting theorem, initial and final value theorem, Solution of circuit equations by Laplace transform, Evaluation of circuit response for various signals.

UNIT-4

Network Functions:

Calculation of network functions, Poles and Zeros of network functions and their restriction, time domain behavior from pole - zero plot.

UNIT-5

Network Synthesis:

Hurwitz Polynomial, Properties of positive real function, necessary and sufficient conditions, basic synthesis procedure, synthesis of L-C, R-L and R-C driving point functions.

RL & RC Network Synthesis:

Synthesis of one-port networks, transfer function synthesis, basics of filter design.

Text Books

1. Hayt W. H., Kemmerly J. E. and Durbin S. M., “Engineering Circuit Analysis”, 6th Ed., Tata McGraw-Hill Publishing Company Ltd.,2008.
2. M.E. Van Valkenburg, “Network Synthesis,” PHI 2007.
3. A. Chakrabarti , Circuit Theory- Analysis and Synthesis, Dhanpat Rai & Co.
4. F.F. Kuo, “Network analysis and Synthesis”, Wiley International Edition, 2008.

Reference Books

1. M.E. Van Valkenburg, “Network Analysis”, 3rd ed., Pearson, 2006.
2. B.S.Nair and S.R.Deepa, “Network analysis and Synthesis”, Elsevier, 2012.

COURSE OUTCOMES:

Students are able to

1. Apply the knowledge of basic circuital law and simplify the network using reduction techniques
2. Analyze the circuit using Kirchhoff’s law and Network simplification theorems
3. Infer and evaluate transient response, Steady state response, network functions and evaluate two-port network parameters
4. Obtain the maximum power transfer to the load , and Analyze the series resonant and parallel resonant circuit
5. Synthesis of RC,RL and LC networks

I Year – II Semester	L	T	P	C
	3	0	0	3

NAME OF THE SUBJECT: BASIC ELECTRICAL MACHINES

Course objectives:

The objectives of this course is to acquire knowledge on

i. the principle of operation and construction of DC generators and DC motors, characteristics of DC generators.
ii. speed control methods, starting and performance characteristics of DC shunt motor
iii. principle of operation, construction of AC machines (transformers, synchronous machines and 3-phase &1-phase induction motors)
iv. performance characteristics of transformers & 3-phase Induction motors and regulation of transformer and alternators

UNIT - I

DC Machines

Principle of operation of DC generator – EMF equation – types of DC machines – OCC & load characteristics of DC shunt generator - Principle of operation of DC motor - torque equation - speed control methods – losses and efficiency – three point starter - applications – Swinburne's test - brake test - numerical problems.

UNIT – II

Transformers

Principle of operation and construction of single phase transformer – EMF equation – Losses - OC & SC tests - efficiency and voltage regulation of transformer – Numerical Problems.

UNIT - III

Synchronous Machines

Principle of operation and construction of alternators- types of alternators – EMF equation - regulation of alternator by synchronous impedance method (EMF Method) - principle of operation and construction of synchronous motor – applications.

UNIT IV

Three-Phase Induction Motors

Principle of operation – construction – revolving magnetic field - types of three-phase induction motors – slip-torque characteristics - maximum, starting and running toques - losses and efficiency - starting methods – brake test on 3-phase induction motor.

UNIT V

Special Machines:

Principle of operation of single phase induction motor - different types of single phase induction motors (split-phase motor, capacitor-start motor, capacitor-start capacitor-run motor, shaded-pole motor) – Linear induction motor – stepper motor - universal motor.

Course Outcomes:

The student should be able to:

i. understand the operation and characteristics of DC machines
ii. acquire the skills to analyze the starting and speed control methods of DC shunt motors.
iii. able to explain the operation of synchronous machines and determine regulation using synchronous impedance method

iv. understand the principle, speed-torque characteristics, performance and starting methods of 3-phase induction motor

v. understand the operation of various special machines.

Text books:

i. Principles of Electrical Machines by V.K. Mehta & Rohit Mehta, S.Chand publications

ii. Theory & performance of Electrical Machines by J.B.Guptha, S.K.Kataria & Sons

iii. Electrical Machinery by P.S. Bhimbra, Khanna Publishers.

Reference books:

i. Basic Electrical Engineering by M.S.Naidu & S.Kamakshiah, TMH Publications

ii. Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications, 2nd edition

iii. Basic Electrical Engineering by Nagsarkar, Sukhija, Oxford Publications, 2nd edition

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	L	T	P	C
I Year – II SEMESTER	**3**	**0**	**0**	**3**

NAME OF THE SUBJECT: ELECTRONIC DEVICES

Course Objectives:

The main objectives of the course are

1. The basic concepts of Electron Dynamics in Electric & Magnetic fields are reviewed.
2. The physical phenomena such as conduction, transport mechanism and electrical characteristics of different diodes are studied.
3. The application of diode such as Rectifiers operation and characteristics with and without filters are discussed.
4. The principle of operation of Bipolar Junction Transistor and Field Effect Transistor with their V-I characteristics is explained.
5. Advance topic such as CMOS and Bi-CMOS logic is introduced.

Chapter 1: Electron Ballistics

Introduction, Charged Particles, Force, Field Intensity, Potential and Energy, Motion of an Electron in Electric and Magnetic Fields, Cathode Ray Oscilloscope - Operation and Applications, Electrostatic and Magnetic Deflection in Cathode Ray Tube, Comparison Between Electric and Magnetic Deflection Systems.

Chapter 2: Junction Diode Characteristics

Review on Semiconductors, Variation in Semiconductor Parameters with Temperature, Continuity Equation, Open Circuited p-n Junction, The current components in a p-n Diode, Diode Current Equation, The Volt-ampere Characteristics of p-n Diode and Temperature dependence, Diode Resistance and Diode Capacitance **,** Junction-diode Switching times.

p-n Junction Diode as a Rectifier, Quantitative Analysis of Half-Wave and Full-wave Rectifiers, Qualitative Analysis of Filter Circuits.

Chapter 3: Special Diode Characteristics

Breakdown Mechanisms, Zener diode ,Zener diode as a Regulator, Tunnel diode, Varactor diode, LED, Photo diode, Schottkey diode, Gunn diode, Impatt diode, PIN diode, PIN-Photo diode, Avalanche Photo Diode (APD), LASER diode, SCR, UJT -Construction, operation and characteristics of the diodes are required to be considered.

Chapter 4: BJT Characteristics

The Junction Transistor, Transistor Current Components, Transistor construction, Characteristics of Common-Base, Common Emitter and Common-Collector Configurations, Transistor Current equation, The Transistors as an Amplifier, Punch through/Reach through, Comparison of Transistor Configurations, Typical Transistor-Junction Voltages, Analytical Expressions for Transistor Characteristics, The Ebers-Moll Model of a Transistor, The Photo Transistor.

Chapter 5: FET Characteristics

The Junction Field-effect Transistor-Types, Construction and operation, The Pinch-off Voltage, The JFET Volt-Ampere Characteristics, JFET parameters, JFET applications, The comparison between BJT and JFET, The Metal-oxide-Semiconductor FET (MOSFET) - Types, Construction, Operation and Characteristics, The comparison between JFET and MOSFET. Introduction to CMOS and Bi-CMOS Logic.

TEXT BOOKS:

1. Integrated Electronics – Jacob Millman, C. Halkias, C.D.Parikh , Tata Mc-Graw Hill, Second Edition, 2011.

2. Electronic Devices and Circuits- J. Millman, C. Halkias, Tata Mc-Graw Hill, Second Edition.

REFERENCES:

1. Electronic Devices and Circuits- S Salivahanan, N Suresh Kumar, Tata Mc-Graw Hill, Third Edition, 2012.

2. Electronic Devices and Circuit Theory-R.L. Boylestad and LouisNashelsky, Pearson Publications, Tenth Edition.

Course Outcomes (COs):

At the end of this course the student can able to :

1. Acquire the knowledge on Electron Dynamics in Electric & Magnetic fields and operation of CRO.
2. Understand the construction, working principle and electrical characteristics of Junction Diode and Special Diodes
3. Analyse operation of Rectifiers with and without filters along with relevant expressions and necessary comparisons.
4. Compare the principle of operation for both BJT and FET with their V-I characteristics in different configurations and understand the concept of transistor as an amplifier.
5. Know the Basics of CMOS and Bi-CMOS logic.

I Year-I/II Semester

L	T	P	C
0	0	3	1.5

NAME OF THE LAB: APPLIED CHEMISTRY LAB
(Common to EEE,ECE,CSE,IT)

Course Objectives:

The objectives of this course is to acquire knowledge on the

(i) Normality , molaritiy ,theory of indicators used in different volumetric and chemical analysis.

(ii) Alkalinity and hardness of water by E DTA method.

(iii) Volumetric analysis-Red-Ox titrations of different chemical compounds.

(iv) Determination of concentration of acids and bases using conductometer and potentiometer

(v) Determination of P^H and color metric analysis

Introduction to Chemistry laboratory – Molarities, normality, primary, secondary standard solutions, Volumetric titrations, quantitative analysis

1. Determination of HCl using standard Na_2CO_3 solution.
2. Determination of alkalinity of a sample containing Na_2CO_3 and NaOH.
3. Determination of Mn^{+2} using standard oxalic acid solution.
4. Determination of ferrous iron using standard $K_2Cr_2O_7$ solution.
5. Determination of Cu^{+2} using standard hypo solution.
6. Determination of temporary and permanent hardness of water using standard EDTA solution.
7. Determination of Fe^{+3} by a colorimetric method.
8. Determination of the concentration of acetic acid using sodium hydroxide (pH-metry method).
9. Determination of iso-electric point of amino acids using pH-metry method/conductometric method.
10. Determination of the concentration of strong acid vs strong base (by conductometric method).
11. Determination of strong acid vs strong base (by potentiometric method).
12. Determination of Mg^{+2} present in an antacid.
13. Determination of $CaCO_3$ present in an egg shell.
14. Estimation of Vitamin C.
15. Determination of phosphoric content in soft drinks.
16. Adsorption of acetic acid by charcoal.
17. Preparation of nylon-6, 6 and Bakelite (demonstration only).
18. Determination of Lead in drinking water.

19. Determination of percentage of copper in Brass.

Of the above experiments at-least 10 assessment experiments should be completed in a semester.

Course Outcomes:

(i) Student is exposed to volumetric titrations acquires some volumetric skills.

(ii) Student is able to analyze hard and soft water.

(iii) Student is exposed to volumetric skills of red-ox titrations with different indicators

(iv) Students can handle the instruments like conductometer, potentiometer in determinening the concentrations of acids and bases.

(v) Student is able to analyze the different chemical concentrations using colorimeter and P^H meter.

Reference Books

1. A Textbook of Quantitative Analysis, Arthur J. Vogel.
2. Engineering Chemistry by Jain and Jain; Dhanpat Rai Publicating Co. Latest edition

I Year – II Semester

L	T	P	C
0	0	3	1.5

NAME OF THE LAB: BASIC ELECTRICAL MACHINES LAB

Course objectives:

The objectives of this course is to acquire knowledge on the

i. To plot the magnetizing characteristics of DC shunt generator and understand the mechanism of self-excitation.
ii. To control the speed of DC motors.
iii. To determine and predetermine the performance of DC machines.
iv. To predetermine the efficiency and regulation of transformers and assess their performance.
v. To analyze performance of three phase induction motor.
vi. To understand the significance of regulation of an alternators using synchronous impedance method.

Any 10 of the following experiments are to be conducted

1. Magnetization characteristics of DC shunt generator.
2. Speed control of DC shunt motor.
3. Brake test on DC shunt motor.
4. Swinburne's test on DC machine
5. Load test on DC shunt generator.
6. Load test on DC series generator.
7. Separation of losses of DC Machine.
8. OC & SC tests on Single-phase transformer.
9. Load test on Single-phase transformer
10. Brake test on 3-phase Induction motor.
11. Regulation of alternator by EMF method

Course Outcomes:

The Student should be able to

i. Determine and predetermine the performance of DC machines.
ii. Control the speed of DC motor.
iii. Determine and predetermine the performance of Transformers.
iv. Perform tests on 3-phase induction motor and alternator to determine their performance

Text Books:

i. Electrical Machinery by P.S. Bhimbra, Khanna Publishers.
ii. Electrical Machines –I.J.Nagarath, D.P.Kotari, McGraw Hill

References Books:

Laboratory courses in Electrical Engineering, S.G.Tarnekar, P.K.Kharbanda, S.B.Bodkhe, S.D.Naik, D.J.Dahgaonkar, S.Chand and Company Ltd.

	L	T	P	C
I Year – II SEMESTER	**0**	**0**	**3**	**1.5**

NAME OF THE LAB : ELECTRONIC DEVICES LAB

Course Objectives:

1. To observe experimentally the characteristics of PN junction diode & zener diode.
2. To find ripple factor of half and full wave rectifiers with and without filter.
3. To observe experimentally the characteristics of BJT in CB, CE and CC configuration and observe experimentally the characteristics of JFET.
4. To observe experimentally the characteristics SCR and UJT.
5. To measure the voltage, time period and phase using CRO

Lab Practice:

The Students are required to study and acquire the Prerequisite knowledge from the manuals on the following to carry out the list of experiments mentioned below.

i. Identification and specifications of Passive (R, L, C) Components (Colour Codes),

ii. Identification and utility of bread boards.

iii. Study and operation of Voltmeters, Ammeters and Multi-meters (Analog and Digital)

iv. Study and operation of Regulated Power Supplies.

v. Identification, Specifications and Testing of Active Devices-Diodes & Transistors.

vi. Soldering practice – simple circuits using active and passive components.

LIST OF EXPERIMENTS:

1. P-N Junction Diode V-I Characteristics
2. Zener Diode V-I Characteristics
3. Zener Diode Regulation Characteristics.
4. LED Characteristics
5. Half-wave Rectifier (Without Filters & With C-Filter)
6. Full-wave Rectifier(Without Filters & With C-Filter)
7. BJT Characteristics (CE/CC Configuration)
8. FET Characteristics (CS/CD Configuration)
9. Tunnel Diode Characteristics
10. SCR Characteristics
11. UJT Characteristics
12. CRO Operation and Applications

Course Outcomes:

At the end of the course the student will be able to:

1. Draw the characteristics of PN Diode and Zener Diode.
2. Find the ripple factor of half and full wave rectifiers with and without filter.

3. Explain the characteristics of transistor in CB, CE and CC configurations and Compute the characteristics of JFET.
4. Explain the SCR and UJT.
5. Determine the voltage, current and frequency using CRO.

II Year - I Semester R2021BS01

L	T	P	C
3	0	0	3

COMPLEX VARIABLES AND STATISTICAL METHODS

Course Objectives:

i. To familiarize the complex variables.
ii. To familiarize the students with the foundations of probability and statisticalmethods.
iii. To equip the students to solve application problems in their disciplines.
iv. To understand the basic concept of sampling theory
v. To understand the concept of hypothesis testing

UNIT-I: Functions of a complex variable and Complex integration:
Introduction – Continuity – Differentiability – Analyticity – Properties – Cauchy-Riemann equations in Cartesian and polar coordinates – Harmonic and conjugate harmonic functions – Milne – Thompson method.
Complex integration: Line integral – Cauchy's integral theorem – Cauchy's integral formula – Generalized integral formula (all without proofs).

UNIT-II: Series expansions and Residue Theorem:
Radius of convergence – Expansion in Taylor's series, Maclaurin's series and Laurent series.
Types of Singularities: Isolated – pole of order m – Essential – Residues – Residue theorem (without proof) – Evaluation of real integral of the type $\int_{-\infty}^{\infty} f(x)dx$

UNIT – III: Probability and Distributions:
Review of probability and Baye's theorem – Random variables – Discrete and Continuous random variables – Distribution function – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

UNIT – IV: Sampling Theory:
Introduction – Population and samples – Sampling distribution of Means and Variance (definition only) – Central limit theorem (without proof) – Introduction to t, X^2 and F-distributions – Point and Interval estimations – Maximum error of estimate.

UNIT – V: Tests of Hypothesis:
Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Tests concerning one mean and two means (Large and Small samples) – Tests on proportions.

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **Miller and Freund's,** Probability and Statistics for Engineers, 7/e, Pearson, 2008.

Reference Books:

1. **S. C. Gupta and V. K. Kapoor**, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.
2. **Jay l. Devore,** Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage.

Course Outcomes: At the end of the course students will be able to

i. apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic
ii. find the differentiation and integration of complex functions used in engineering problems
iii. make use of the Cauchy residue theorem to evaluate certain integrals
iv. Apply discrete and continuous probability distributions.
v. design the components of a classical hypothesis test and infer the statistical inferential methods based on small and large sampling tests

II Year - I Semester	R202104PC01	L	T	P	C
		3	0	0	3

Signals and Systems

Course Objectives:

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- I:

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.

UNIT –II:

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.

UNIT-III:

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.

UNIT –IV:

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.

UNIT –V:

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.

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

Course Outcomes: At the end of the course students will be able to

i. Characterize the signals and systems and principles of vector spaces, Concept of orthgonality.
ii. Analyze the continuous-time signals and continuous-time systems using Fourier transform and Laplace transform.
iii. Apply sampling theorem to convert continuous-time signals to discrete-time signal and reconstruct back.
iv. Understand the relationships among the various representations of LTI systems
v. Understand the Concepts of convolution, correlation, Energy and Power density spectrum and their relationships. And Apply z-transform to analyze discrete-time signals and systems.

II Year - I Semester R202104PC02

L	T	P	C
3	0	0	3

Analog electronics

Course Objectives:

i. The need of transistor biasing and its significance is explained. The quiescent point or operating point is explained.
ii. Small signal equivalent circuit analysis of BJT and FET transistor amplifiers in different configuration is explained.
iii. Cascading of single stage amplifiers is discussed. Expressions for overall voltage gain are derived.
iv. The concept of feedback is introduced. Effect of negative and positive feedback on amplifier characteristics is explained and necessary equations are derived.
v. Power amplifiers Class A, Class B, Class C, Class AB and different types of tuned amplifier circuits are analysed.

UNIT-I

Transistor Biasing and Thermal Stabilization: Need for biasing, operating point, load line analysis, BJT biasing- methods, fixed bias, collector to base bias, self-bias, Stabilization against variations in V_{BE}, I_C, and β, Stability factors, (S, S', S''), Bias compensation, Thermal runaway, Thermal stability, FET Biasing Methods.

UNIT- II:

Small Signal Low Frequency BJT & FET Amplifier Models: Two port network, Transistor hybrid model, determination of h-parameters, conversion of h-parameters, generalized analysis of transistor amplifier using h-parameters, Analysis of CB, CE and CC amplifiers using exact and approximate analysis, Comparison of BJT transistor amplifiers, FET small signal model, analysis of CG, CS and CD amplifiers, comparison of FET amplifiers.

Small Signal High Frequency BJT & FET Amplifier Models: Transistor at high frequencies, Hybrid- π model, Hybrid π conductance's, Hybrid π capacitances, Hybrid π parameters in terms of h-parameters, CE short circuit current gain, current gain with resistive load, cut-off frequencies, frequency response and gain bandwidth product, analysis of FET common source and common drain amplifier circuits at high frequencies.

UNIT-III

Multistage Amplifiers: Classification of amplifiers, distortion in amplifiers, frequency response of an amplifier, step response of an amplifier, band pass of cascaded stages, methods of coupling**,** analysis of cascaded transistor amplifier, two stage RC coupled amplifier, Darlington pair amplifier, Boot-strap emitter follower and Cascode amplifiers.

UNIT -IV

Feedback Amplifiers: Classification basic amplifiers**,** Feedback concept, types of feedback, feedback topologies, characteristics of negative feedback amplifiers, generalized analysis of feedback amplifiers, performance comparison of feedback amplifiers, and method of analysis of feedback amplifiers.

Oscillators: Oscillator principle, condition for oscillations, types of oscillators, RC-phase shift and Wein bridge oscillators using BJT and FET, generalized analysis of LC oscillators, Hartley and Colpitt's oscillators using BJT and FET, frequency stability of oscillators.

UNIT-V

Power Amplifiers: Classification of amplifiers, Class A power Amplifiers, harmonic distortions, Class B amplifier, Push-pull amplifier, and Complementary symmetry push pull amplifier, Class AB amplifier, Class-C amplifier, thermal stability and heat sink, distortion in power amplifiers.

Tuned Amplifiers: Introduction, Q-Factor, small signal tuned amplifiers, effect of cascading single tuned and doubled tuned amplifiers on band width, stagger tuned amplifiers, comparison of tuned amplifiers, large signal tuned amplifiers, stability of tuned amplifiers.

TEXT BOOKS:

1. Electronic Devices and Circuits -J.Millman, C.C. Halkias&S.Jit,TMH,4thEdition,2015.
2. Electronic Devices and Circuits- S.Salivahanan & N.Suressh Kumar,TMH,3rd Edition, 2012.

REFERENCES:

1. Integrated Electronics- Jacob Millman, C. Halkies&C.D.Parikh, TMH, 2nd Edition,2010.
2. Electronic Devices and Circuits – A.K.Maini&V.Agarawal, Wiley India Pvt.Ltd., First Edition, 2009.

Course Outcomes: At the end of the course students will be able to

i. Know the need of transistor biasing, various biasing techniques for BJT and FET and stabilization concepts with necessary expressions.
ii. Perform the analysis of small signal low and high frequency transistor amplifier circuits using BJT and FET indifferent configurations.
iii. Design and analysis of multi stage amplifiers using BJT and FET.
iv. Derive the expressions for frequency of oscillation and condition for oscillation of RC and LC oscillators and their amplitude and frequency stability concept.
v. Know the classification of the power and tuned amplifiers and their analysis with performance comparison.

II Year - I Semester R202104PC03

L	T	P	C
3	0	0	3

Digital Electronics

Course Objectives:

i. To solve a typical number base conversions and analyze new error coding techniques
ii. To optimize logic gates for digital circuits using various techniques
iii. To understand concepts of Adders and Sub tractors and analyze different types of decoders, encoders, code converters, multiplexers and comparators.
iv. To understand the basic concept flip flops and analyze basic counters and shift registers
v. To understand the basic concepts of PLDs

UNIT-I

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, I^2L, MOS, CMOS and BiCMOS logic families.

UNIT-II

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.

UNIT-III

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.

UNIT-IV

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.

UNIT-V

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.

TEXT BOOKS

1. Digital Design - Morris. M. Mano, Michael D. Ciletti - Fourth Edition - Prentice-Hall India, 2008.
2. Modern Digital Electronics – R.P.Jain - Fourth Edition – Tata McGraw Hill Education Private Limited, 2010.

REFERENCES

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.

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

II Year - I Semester R202104PC04

L	T	P	C
3	0	0	3

Random Variables and Stochastic Process

Course Objectives:

i. To give students an introduction to elementary probability theory, in preparation for courses on statistical analysis, random variables and stochastic processes.
ii. To mathematically model the random phenomena with the help of probability theory concepts.
iii. To introduce the important concepts of random variables and stochastic processes.
iv. To analyze the LTI systems with stationary random process as input.
v. To introduce the types of noise and modelling noise sources.

UNIT I

THE RANDOM VARIABLE : 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, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Conditional Distribution, Conditional Density, Properties.

UNIT II

OPERATION ON SINGLE 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, Nonmonotonic Transformations of Continuous Random Variable.

UNIT III

MULTIPLE RANDOM VARIABLES:

Vector Random Variables, Joint Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Conditional Distribution and Density, 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, And Jointly Gaussian Random Variables: Two Random Variables case, N Random Variables case, Properties, Transformations of Multiple Random Variables, and Linear Transformations of Gaussian Random Variables.

UNIT IV

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 Function and its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process.

UNIT V:

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: System Response – 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.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Probability Theory and Stochastic Processes – B. Prabhakara Rao, BS Publications
2. Probability and Random Processes with Applications to Signal Processing, Henry Stark and John W. Woods, Pearson Education, 3^{rd} Edition.

Course Outcomes: At the end of the course students will be able to

i. Mathematically model the random phenomena and solve simple probabilistic problems.
ii. Identify different types of random variables and compute statistical averages of single random variable.
iii. Understand multiple random variable concepts, compute statically average of multiple random variables
iv. Characterize the random processes in the time
v. Characterization in frequency domain and analyze the LTI systems with random inputs.

II Year - I Semester R202104PC01A

L	T	P	C
0	0	3	1.5

Signals and Systems Lab

Course Objectives:

i. Apply the knowledge of linear algebra topics like vector space, basis, dimension, inner product, norm and orthogonal basis to signals.
ii. Analyze the spectral characteristics of continuous-time periodic and aperiodic signal using Fourier analysis and understand the process of sampling and the effects of under sampling.
iii. Develop input output relationship for linear systems and Classify systems based on their properties and determine the response of LTI system using convolution
iv. Apply the Laplace transform for analyze of continuous-time signals and systems.
v. Apply the Z- transform for analyze of discrete-time signals and systems

List of Experiments :(Minimum of Ten Experiments has to be performed)

1. Familiarization with MATLAB
   i. Matrix Operations & Plotting using MATLAB
   ii. Relational Operators, Loops & Functions using MATLAB
2. To explore the commutation of even and odd symmetries in a signal with algebraic operations.
3. To explore the effect of transformation of signal parameters (amplitude-scaling, time-scaling and time-shifting).
4. To identify a given system as linear or non-linear.
5. To explore the time variance and time invariance property of a given system.
6. To explore causality and non-causality property of a system.
7. Generation of Signals & Signal Operations Synthesis of signals using Fourier Series
8. Convolution on Continuous Time Signals
9. To demonstrate the convolution and correlation of two discrete-time signals.
10. To demonstrate the sampling in frequency domain (Discrete Fourier Transform).
11. To demonstrate the time domain sampling of band limited signals (Nyquist theorem).
12. Study of Laplace Transforms using MATLAB
13. Study of Z Transforms using MATLAB

Course Outcomes: At the end of the course students will be able to

i. Apply the knowledge of linear algebra topics like vector space, basis, dimension, inner product, norm and orthogonal basis to signals.
ii. Analyze the spectral characteristics of continuous-time periodic and aperiodic signal using Fourier analysis and understand the process of sampling and the effects of under sampling.
iii. Develop input output relationship for linear systems and Classify systems based on their properties and determine the response of LTI system using convolution
iv. Apply the Laplace transform for analyze of continuous-time signals and systems.
v. Apply the Z- transform for analyze of discrete-time signals and systems

II Year - I Semester R202104PC02A

L	T	P	C
0	0	3	1.5

Analog Electronics lab

Course Objectives:

i. To Design feedback amplifier circuits.
ii. To Analyze the oscillators design
iii. Modelling of cascade amplifier circuits using BJT and FET
iv. Aanalysis and design of power amplifiers
v. Interpret the tuned amplifiers and tuned cascaded networks functionality

LISTOFEXPERIMENTS

1. Frequency Response Of CE Amplifier
2. Two Stage R-C Coupled Amplifier
3. Frequency Response Of Common Source FET Amplifier
4. Parameters Calculation Of a Current Series Feedback Amplifier
5. Frequency Response Of Voltage Shunt Amplifier
6. Tuned Voltage Amplifier
7. Colpitts Oscillator
8. Hartley Oscillator
9. RC-Phase Shift Oscillator
10. Wien Bridge Oscillator
11. Class A Power amplifier and Class B Power amplifier
12. Class AB amplifier
13. Class C amplifier

Course Outcomes: At the end of the course students will be able to

i. Comprehend the fundamental concepts in feedback amplifier circuits.
ii. Analyze the oscillators design, frequency responses calculations with the help of mathematical expressions.
iii. Describe the various cascade amplifier circuits using BJT and FET models
iv. Apply the h-parameter model to power amplifiers circuit design and Discriminate the concepts quality factor, form-factor in small signal tuned amplifier analysis and design.
v. Interpret the tuned amplifiers and tuned cascaded networks functionality

II Year - I Semester R202104PC03A

L	T	P	C
0	0	3	1.5

Digital Electronics lab

Course Objectives:

i. To Verify the truth tables of logic gates
ii. To Design and verify the operation of combinational circuits.
iii. To Design and verify the operation of sequential circuits
iv. To Verify the operation of Johnson/ring counter and different types shift register
v. To Verify the operation of RAM and ALU

The students are required to design and draw the internal structure of the following Digital Integrated Circuits and to it is required to verify the logic with necessary hardware.

List of Experiments:

1. Realization of Logic gates
2. Implementation of function using logic gates
3. 3 to 8 decoder-74138
4. Multiplexer-74151,De multiplexer-74155
5. Implementation of function using Multiplexer
6. 4-Bit Comparator -7485
7. D Flip-flop- 7474
8. Decade counter- 7490
9. 4 Bit Counter -7493
10. Shift Register-7495
11. Universal Shift Register -74194\195
12. Ram (16*4) -74189(read and write operations)
13. ALU

Equipments Required:

1. Power supply
2. Integrated Circuits
3. Trainer Kits

Course Outcomes:

At the end of the course the student will be able to:

i. Distinguish logic gates for design of digital circuits
ii. Design different types of Combinational logic circuits
iii. Analyze the operation of flip-flops
iv. Apply knowledge of flip-flops in designing of Registers and Counters
v. Analyze the operation of RAM and ALU

II Year - I Semester

R202104SC01

	L	T	P	C
Skill Oriented Course	**1**	**2**	**3**	**2**

Electronic Circuit Design

Course Objectives:

i. To acquire the knowledge of basic components and instruments
ii. To interpret the signal and the measuring components
iii. To experience the working of different electronic equipment
iv. To acquire the knowledge of basic switching devices
v. Expertise in designing the circuit

List of Experiments:

1. Identification and specifications of R, L, C Components (Colour Codes) and potentiometers.
2. Study of cathode ray oscilloscope (CRO).
3. Measurement of voltage, current and frequency using cathode ray oscilloscope (CRO
4. Identification and utility of bread boards and single layer and multi layer PCBs.
5. Study and operation of voltmeters and ammeters and multimeters (Analog and Digital).
6. Study and operation of regulated power supplies.
7. Study and operation of function generators.
8. Identification, Specifications and Testing of Active Devices: Diodes, BJTs, JFETs, SCR and UJT.
9. Identification and working of switches (SPDT, DPDT, and DIP), relays, microphones and loud speakers.
10. PCB making –drawing and etching based on given circuit
11. Soldering practice – simple circuits using active and passive components.
12. PCB design based on given circuit using selective active and passive components

Equipments Required:

1. PCB maker with samples
2. Soldering kit
3. Etching equipment
4. Passive and active elements
5. CRO,FG,RPS

Reference:

1. R.J.King “”Electronic Design: Course notes and lab manual “ rev.3.jan 2003

Course Outcomes:

At the end of the course the student will be able to:

i. Have knowledge of basic components and instruments and their usage
ii. To handle measuring devices
iii. To work with different supply devices
iv. Design basic switching circuits
v. Experience circuit designing

		L	T	P	C
II Year - I Semester	R2021MC01 **Mandatory Course (AICTE Suggested)** **Constitution of India**	**2**	**0**	**0**	**0**

Course Objectives:

i. To Enable the student to understand the importance of constitution
ii. To understand the structure of executive, legislature and judiciary
iii. To understand philosophy of fundamental rights and duties
iv. To understand the autonomous nature of constitutional bodies like Supreme Court and high court controller and auditor general of India and election commission of India.
v. To understand the central and state relation financial and administrative.

UNIT-I

Introduction to Indian Constitution: Constitution meaning of the term, Indian Constitution - Sources and constitutional history, Features - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT-II

Union Government and its Administration Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, LokSabha, RajyaSabha, The Supreme Court and High Court: Powers and Functions;

UNIT-III

State Government and its Administration Governor - Role and Position - CM and Council of ministers, State Secretariat: Organisation, Structure and Functions

UNIT-IV

Local Administration - District's Administration Head - Role and Importance, Municipalities – Mayor and role of Elected Representative - CEO of Municipal Corporation PachayatiRaj: FunctionsPRI: ZilaPanchayat, Elected officials and their roles, CEO ZilaPanchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials – Importance of grass root democracy

UNIT-V

Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission:, Functions of Commissions for the welfare of SC/ST/OBC and women

References Books:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd.. NewDelhi
2. SubashKashyap, Indian Constitution, National Book Trust
3. J.A. Siwach, Dynamics of Indian Government & Politics
4. D.C. Gupta, Indian Government and Politics
5. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
6. J.C. Johari, Indian Government and Politics Hans
7. J. Raj Indian Government and Politics
8. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd.. New Delhi
9. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012

E-resources:

1. nptel.ac.in/courses/109104074/8
2. nptel.ac.in/courses/109104045/
3. nptel.ac.in/courses/101104065/
4. www.hss.iitb.ac.in/en/lecture-details
5. www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

Course Outcomes: At the end of the course students will be able to

i. Understand historical background of the constitution making and its importance for building ademocratic India.
ii. Understand the functioning of three wings of the government i.e., executive, legislative and judiciary.
iii. Understand the value of the fundamental rights and duties for becoming good citizen of India.
iv. Analyze the decentralization of power between central, state and local self-government.
v. Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.

1. Know the sources, features and principles of Indian Constitution.
2. Learn about Union Government, State government and its administration.
3. Get acquainted with Local administration and Pachayati Raj.
4. Be aware of basic concepts and developments of Human Rights.
5. Gain knowledge on roles and functioning of Election Commission

II Year - II Semester	R2022BS01	L	T	P	C
		3	0	0	3

CONTROL SYSTEMS

Course objectives

i. To introduce the concepts of open loop and closed loop systems, mathematical models of mechanical and electrical systems, and concepts of feedback
ii. To study the characteristics of the given system in terms of the transfer function and introducing various approaches to reduce the overall system for necessary analysis
iii. To analyze the system in terms of absolute stability and relative stability by different approaches
iv. To design different control systems for different applications as per given specifications
v. To introduce the concepts of state variable analysis, design and also the concepts of controllability and observability

UNIT-I

Introduction

System Control System, Open Loop Control System, Closed loop Control System, Different Examples

Mathematical models of Physical Systems

Differential equations of physical systems, Transfer functions, Block diagram Algebra, Signal flow graphs with illustrative examples

Effects of Feedback

Feedback Characteristics and its advantages, Linearizing effect of feedback

UNIT-II

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, AC Position Control Systems

Time Response Analysis

Standard test Signals, Time response of first and second order systems, steady state errors and error constants, Effect of adding a zero to a system, Design specifications of second order systems, Performance indices

UNIT-III

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

UNIT-IV

Frequency response analysis

Introduction, Correlation between time and frequency response, Polar Plots, Bode Plots, Nyquist Stability Criterion

UNIT-V:

Introduction to Design

The design problem, Preliminary consideration of classical design, Realization of basic Compensators, Cascade compensation in time domain and frequency domain, Tuning of PID Controllers

State Variable Analysis and Design

Introduction, Concepts of State, State Variables and State models, State models for linear continuous-time systems, State variables and linear discrete-time systems, Solution of state equations and Concepts of Controllability and Observability.

Text Book

i. I.J.Nagarath and M.Gopal, " **Control System Engineering,"** New Age International Publishers, Fifth Edition
ii. Benjamin C. Kuo, FraridGolnaraghi, " Automatic Control Systems," Wiley Student Edition, Eight Edition

Reference Books

1. Katsuhiko Ogata, "Modern Control Engineering," Pearson, Fifth Edition
2. S. Salivahanan, R. Rengaraj, and G. R. Venkata Krishnan, " Control Systems Engineering," Pearson, First Impression

Course Outcomes

i. This course introduces the concepts of feedback and its advantages to various control systems
ii. The performance metrics to design the control system in time-domain and frequency domain are introduced.
iii. Understand the Concept of stability and different analysis
iv. Control systems for various applications can be designed using in time-domain and frequency domain analysis.
v. In addition to the conventional approach, the state space approach for the analysis of control systems is also introduced.

II Year - II Semester R202204PC01

L	T	P	C
3	0	0	3

Analog Communications

Course Objectives:

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 fuctional blocks of radio transmitters and receivers
v. Familiarize with basic techniques for generating and demodulating various pulse modulated signals

UNIT I

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.

UNIT II

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.

UNIT III

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

UNIT IV

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

UNIT V

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.

TEXT BOOKS:

1. Communication Systems - Simon Haykin, John Wiley, 2nd Ed.,.
2. Modern digital and analog communication systems , 4th edition B.P.Lathi, Ding, Gupta oxford publishers

REFERENCES:

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.

Course Outcomes:

At the end of the course the student will be able to:

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

II Year - II Semester R202204PC02

L	T	P	C
3	0	0	3

Linear Circuits & Analog IC design

Course Objectives:

i. Student will able to understand different wave shaping circuits
ii. Students will able to understand operation and characteristics of op-amp
iii. Able to design filters, oscillators and non linear applications using op-amp
iv. Able to understand the operations of different analog IC & their applications
v. Understand the concepts of CMOS basic circuits.

UNIT-I

LINEAR AND NONLINEAR WAVE SHAPING: High pass, low pass RC circuits, their response for sinusoidal, step, pulse, square and ramp inputs. RC network as differentiator and integrator, Diode clippers, Transistor as a switch, Transistor clippers, clipping at two independent levels, Transfer characteristics of clippers, Emitter coupled clipper,

UNIT-II

Operational Amplifier (Op-Amp) Characteristics: Differential Amplifier using BJT,Op-Amp block diagram,DC and AC characteristics of Op-Amp, ideal and practical Op-Amp specifications, IC741 Op-Amp & its features, Inverting and Non-inverting Op-Amps.

Linear Applications using Op-Amp:

DC and AC amplifiers, summing, scaling & averaging amplifiers, instrumentation amplifier, V to I, I to V converters, integrator, differentiator.

UNIT-III

Active Filters and Oscillators using Op-Amp:

Active filters, first and second order low-pass and high-pass Butterworth filters, band-pass and band-reject and all-pass filters, phase shift and wien bridge oscillators, square-wave, triangular-wave and sawtooth-wave generators, VCO.

Non-Linear Applications using Op-Amp:

Basic comparator, zero-crossing detector, Schmitt trigger, comparator characteristics, V to F and F to V converters, sample-and-hold circuit.

UNIT-IV

Specialized IC Applications:

VCO using IC 566, astable and mono stable multivibrators using IC 555 timer & IC 741 and their applications, PLL using IC 565 and its applications, D/ A and A/ D converters, weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, parallel comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC. DAC and ADC Specifications.

UNIT-V

Analog CMOS Basic Circuits: MOS switches, MOS active resistors, MOS diode, current sources and sinks, passive and active current mirrors- basic, Cascode and active current mirrors, current and voltage references, temperature independent reference.

TEXT BOOKS

1. Pulse, Digital and Switching Waveforms - J. Millman and H. Taub and MS Prakash Rao, McGraw-Hill, 2007.
2. Op-Amps and Linear Integrated Circuits - Ramakanth A. Gayakwad, PHI Private Limited, 2002.
3. Design of Analog CMOS Integrated Circuits - BehzadRazavi, TMH Edition, 2006.

REFERENCES

1. Linear Integrated Circuits - D. Roy Choudhury, ShailB.Jain, New Age International Publishers, 2nd Edition, 2006.
2. CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010

Course Outcomes: At the end of the course the student will be able to:

i. To realize the linear and non linear wave shaping circuits
ii. To able to understand operation & characteristics of op-amp
iii. To realize the design of active filters, oscillators and non linear applications using op-amp
iv. Realize the operations and applications of different analog IC
v. To know about the basic cmos circuits

II Year - II Semester	R202204ES01	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Digital IC design

Course Objectives:

i. To understand the concept of modeling in VHDL
ii. To design combinational circuits using VHDL program
iii. To design sequential circuits using VHDL program
iv. To analyze the combinational circuits using MOS logic circuits
v. To analyze the sequential circuits using MOS logic circuits

UNIT-I

Hardware Description Languages.

VHDL: Introduction to VHDL, entity declaration, architecture, data-flow, behavioural and structural style of modelling, data types, data objects, configuration declaration, package, generic, operators and identifiers, PROCESS, IF, CASE & LOOP statements, VHDL libraries.

Verilog HDL: Introduction to Verilog HDL, data types, data operators, module statement, wire statement, if-else statement, case-end case statement, Verilog syntax and semantics(qualitative approach)

UNIT-II

Combinational Logic Design: Parallel binary adder, carry look ahead adder, BCD adder, Multiplexers and demultiplexers and their use in combinational logic design, ALU, digital comparators, parity generators, code converters, priority encoders.(Qualitative approach of designing and modeling the mentioned combinational logic circuits with relevant digital ICs using HDL)

UNIT-III

Sequential Logic Design: Registers, applications of shift registers, ripple or asynchronous counters, synchronous counters, synchronous and asynchronous sequential circuits, hazards in sequential circuits.(Qualitative approach of designing and modeling the mentioned sequential logic circuits with relevant digital ICs using HDL)

UNIT-IV

Combinational MOS Logic Circuits: Introduction, MOS logic circuits with depletion nMOS loads: two-input NOR gate, generalized NOR structure with multiple inputs, transient analysis of NOR gate, two-input NAND gate, generalized NAND structure with multiple inputs, transient analysis of NAND gate, CMOS logic circuits: CMOS NOR2 gate, CMOS NAND2 gate, complex logic circuits, complex CMOS logic gates, AOI and OAI gates, Pseudo-nMOS gates, CMOS full-adder circuit, CMOS transmission gates (Pass Gates), complementary pass-transistor logic.

UNIT-V

Sequential MOS Logic Circuits: Introduction, behaviour of bistable elements, SR latch circuit, clocked latch and flip-flop circuits: clocked SR latch, clocked JK latch, master-slave flip-flop, CMOS D-latch and Edge-triggered flip-flop, Schmitt trigger circuit, basic principles of pass transistor circuits.

TEXT BOOKS

1. Modern Digital Electronics – R.P.Jain - Fourth Edition – Tata McGraw Hill Education Private Limited, 2010.
2. CMOS Digital Integrated Circuits-Analysis and Design – Sung-Mo Kang & Yusuf Leblebici- Tata McGraw Hill Publishing Company Limited, 2006.
3. VHDL/Verilog Primer - J. Bhasker, Pearson Education/ PHI, 3rd Edition.

REFERENCES

1. Digital Design Principles & Practices - John F. Wakerly, PHI/ Pearson Education Asia, 3rd Edition, 2005.
2. Fundamentals of Digital Logic with VHDL Design- Stephen Brown, ZvonkoVranesic, McGrawHill, 3rd Edition.

Course Outcomes: At the end of the course the student will be able to:

i. Understand different modeling in VHDL program
ii. Design combinational circuits using VHDL program
iii. Design sequential circuits using VHDL program
iv. Apply knowledge of MOS technology to design combinational circuits
v. Analyze and apply CMOS technology to sequential circuits

II Year - II Semester	R2022HS01	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Managerial Economics and Financial Analysis

Course Objectives:

i. The Learning objectives of this paper are to understand the concept and nature of Managerial Economics and its relationship with other disciplines and also to understand the Concept of Demand and Demand forecasting.
ii. To familiarize about the Production function, Input Output relationship, Cost - Output relationship and Cost-Volume-Profit Analysis.
iii. To understand the nature of markets, Methods of Pricing in the different market structures and to know the different forms of Business organization and the concept of Business Cycles.
iv. To learn different Accounting Systems, preparation of Financial Statement and uses of different tools for performance evaluation.
v. Finally, it is also to understand the concept of Capital, Capital Budgeting and the techniques used to evaluate Capital Budgeting proposals.

Unit-I

Introduction to Managerial Economics and demand Analysis:

Definition of Managerial Economics –Scope of Managerial Economics and its relationship with other subjects –Concept of Demand, Types of Demand, Determinants of Demand- Demand schedule, Demand curve, Law of Demand and its limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement- Demand forecasting and Methods of forecasting, Concept of Supply and Law of Supply.

Unit – II:

Theories of Production and Cost Analyses:

Theories of Production function- Law of Variable proportions-Isoquants and Isocosts and choice of least cost factor combination-Concepts of Returns to scale and Economies of scale-Different cost concepts: opportunity costs, explicit and implicit costs-Fixed costs, Variable Costs and Total costs –Cost –Volume- Profit analysis-Determination of Breakeven point(problems)-Managerial significance and limitations of Breakeven point.

Unit – III:

Introduction to Markets, Theories of the Firm & Pricing Policies:

Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features – Price and Output Determination – Managerial Theories of firm: Marris and Williamson's models – other Methods of Pricing: Average cost pricing, Limit Pricing, Market Skimming Pricing, Internet Pricing: (Flat Rate Pricing, Usage sensitive pricing) and Priority Pricing, Business Cycles : Meaning and Features– PhasesofaBusinessCycle.FeaturesandEvaluationofSoleTrader,Partnership,JointStockCompany– State/Public Enterprises and their forms.

Unit – IV:

Introduction to Accounting & Financing Analysis:

Introduction to Double Entry System, Journal, Ledger, Trail Balance and Preparation of Final Accounts with adjustments – Preparation of Financial Statements-Analysis and Interpretation of Financial Statements-Ratio Analysis – Preparation of Funds flow and cash flow analysis (Problems)

Unit – V:

Capital and Capital Budgeting: Capital Budgeting: Meaning of Capital- Capitalization-Meaning of Capital Budgeting-Time value of money- Methods of appraising Project profitability: Traditional Methods(pay back period, accounting rate of return) and modern methods(Discounted cash flow method, Net Present Value method, Internal Rate of Return Method and Profitability Index)

TEXT BOOKS:

1. A R Aryasri, Managerial Economics and Financial Analysis, The McGraw – Hill companies.
2.Varshney R.L, K.L Maheswari, Managerial Economics, S. Chand &CompanyLtd,

REFERENCES:

1. JL Pappas and EF Brigham, Managerial Economics, Holt, R & W; New edition
2. N.P Srinivasn and M. SakthivelMurugan, Accounting for Management, S. Chand &CompanyLtd,

Course Outcomes:

i. The Learner is equipped with the knowledge of estimating the Demand and demand elasticities for a product.
ii. The knowledge of understanding of the Input-Output-Cost relationships and estimation of the least cost combination of inputs.
iii. The pupil is also ready to understand the nature of different markets and Price Output determination under various market conditions and also to have the knowledge of different Business Units.
iv. The Learner is able to prepare Financial Statements and the usage of various Accounting tools for Analysis.
v. The Learner can able to evaluate various investment project proposals with the help of capital budgeting techniques for decision-making.

II Year - II Semester R202204PC01A

L	T	P	C
0	0	3	1.5

Analog Communications Lab

Course Objectives:

i. Various analog modulation and demodulation schemes
ii. Verify sampling theorem
iii. Analyze various modulated schemes by using spectrum analyzer
iv. Various associated circuits of analog modulation schemes
v. Demonstrate the action of PLL

List of Experiments (Twelve experiments to be done- **The students have to calculate the relevant parameters**) - (a. Hardware, b. MATLAB Simulink, c. MATLAB Communication tool box)

1. Amplitude Modulation - Mod. &Demod.
2. AM - DSB SC - Mod. &Demod.
3. Spectrum Analysis of Modulated signal using Spectrum Analyzer
4. Diode Detector
5. Pre-emphasis & De-emphasis
6. Frequency Modulation - Mod. &Demod.
7. AGC Circuits
8. Sampling Theorem
9. Pulse Amplitude Modulation - Mod. &Demod.
10. PWM , PPM - Mod. &Demod.
11. PLL
12. Radio receiver characteristics

Equipments & Software required: Software:

i.) Computer Systems with latest specifications
ii) Connected in Lan (Optional)
iii) Operating system (Windows XP)
iv) Simulations software (Simulink & MATLAB)

Equipment:

1. RPS - 0 – 30 V
2. CRO - 0 – 20 M Hz.
3. Function Generators - 0 – 1 M Hz
4. Components
5. Multimeters
6. Spectrum Analyzer

Course Outcomes:

At the end of the course the student will be able to:

i. Integrate and test AM and FM modulators and demodulators
ii. Illustrate sampling theorem in different conditions
iii. Analyze AM and FM signals using Spectrum analyzer
iv. Test associated circuits such as AGC, pre-emphasis and de-emphasis
v. Integrate and test various pulse modulation and demodulation schemes and Estimate lock range and capture range of PLL

II Year - II Semester R202204PC02A

L	T	P	C
0	0	3	1.5

Linear Circuits and Analog IC design Lab

Course Objectives:

i. Introduce filters design using passive components
ii. To introduce different applications of operational amplifiers.
iii. To design amplifiers , active filters
iv. To introduce skills required for designing and testing integrated circuits
v. To introduce timer circuits

LISTOFEXPERIMENTS

1. Observe the process of the linear wave shaping for LP-R C and HP-RC.
2. Observe the process of the non linear wave shaping for Clipper and Clamper.
3. Measurement Of Op–Amp Parameters & Applications
4. Operational Amplifier As Integrator And Differentiator
5. Design and testing of Active LPF&HPF using op-amp.
6. Design of Schmitt Trigger using op-amp and IC 555
7. IC 741 Oscillator Circuits – Phase Shift and Wien Bridge Oscillators.
8. IC 555 Timer – Monostable Operation Circuit
9. IC 555 Timer – Astable Operation Circuit.
10. IC 565 – PLL Applications
11. IC 566 – VCO Applications.
12. 4 bit DAC using OP AMP.
13. Operation of R-2R ladder DAC and flash type ADC.

Course Outcomes:

At the end of the course the student will be able to:

i. To know the responses of first order RC low pass and high pass filters for standard inputs
ii. Design circuits using operational amplifiers for various applications.
iii. Analyze and design amplifiers and active filters using Op-amp and Design and understand the integrated circuits related to communications
iv. Acquires kills required for designing and testing integrated circuits
v. Able to design clock generating timer circuits Able to design clock generating timer circuits

II Year - II Semester	R202204ES01A	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

Digital IC design Lab

Course Objectives

i. To understand the concept of modeling in VHDL
ii. To design combinational circuits using VHDL program
iii. To design sequential circuits using VHDL program
iv. To design memory and arithmetic logic units
v. Introduce to FPGA environment

The students are required to design and draw the internal structure of the following Digital Integrated Circuits and to develop VHDL source code, perform simulation using relevant simulator and analyze the obtained simulation results using necessary synthesizer. Further, it is required to verify the logic with necessary hardware.

List of Experiments:

1. Realization of Logic Gates
2. 3 to 8 Decoder- 74138
3. 8*1 Multiplexer-74151 and 2*1 De-multiplexer-74155
4. 4-Bit Comparator-7485.
5. D Flip-Flop- 7474
6. Decade Counter- 7490
7. 4 Bit Counter-7493
8. Shift Register-7495
9. Universal shift register-74194/195
10. Ram (16*4)-74189 (read and write operations)
11. ALU

Equipment Required:

1. Xilinix ISE software-latest version
2. Personal computer with necessary peripherals
3. Hardware kits- Various FPGA families.

Course Outcomes:

At the end of the course the student will be able to:

i. Understand the concepts of Hardware description language and the concepts of VHDL modelling and implementations using Integrated circuits.
ii. Design and analyze any Digital design in real time applications.
iii. Design and simulate the Combinational digital circuits using hardware description language.
iv. Design and simulate the Sequential digital circuits using hardware description language.
v. Implement a circuit in FPGA environment

II Year - II Semester	R202204SC01	**L**	**T**	**P**	**C**
		1	**2**	**0**	**2**

Simulation tools(Python Programming, R programming)- (SC)

Course Objectives:

The aim of Python Programming Lab is

i. To acquire programming skills in core Python.
ii. To acquire Object Oriented Skills in Python
iii. To develop the skill of designing Graphical user Interfaces in Python
iv. To develop the ability to write database applications in Python

List of Experiments: Exercise 1 - Basics

i. Running instructions in Interactive interpreter and a Python Script
ii. Write a program to purposefully raise Indentation Error and Correct it

Exercise 2 - Operations

i. Write a program to compute distance between two points taking input from the user (Pythagorean Theorem)
ii. Write a program add.py that takes 2 numbers as command line arguments and prints its sum.

Exercise - 3 Control Flow

i. Write a Program for checking whether the given number is an even number or not.
ii. Using a for loop, write a program that prints out the decimal equivalents of 1/2, 1/3, 1/4, ..., 1/10.
iii. Write a program using a for loop that loops over a sequence. What is sequence?
iv. Write a program using a while loop that asks the user for a number, and prints a countdown from that number to zero.

Exercise 4 - Control Flow - Continued

i. Find the sum of all the primes below two million.
ii. Each new term in the Fibonacci sequence is generated by adding the previous two terms. By starting with 1 and 2, the first 10 terms will be:1, 2, 3, 5, 8, 13, 21, 34, 55, 89, ...
iii. By considering the terms in the Fibonacci sequence whose values do not exceed four million, find the sum of the even-valued terms.

Course Outcomes:

By the end of this lab, the student is able to

i. Write, Test and Debug Python Programs
ii. Use Conditionals and Loops for Python Programs
iii. Use functions and represent Compound data using Lists, Tuples and Dictionaries
iv. Use various applications using python

IIIYear - I Semester R203104PC01

L	T	P	C
3	0	0	3

Micro Processors and Micro Controllers

COURSE OBJECTIVES:

i. To understand learn concepts of microprocessor, different addressing modes and programming of 8086.
ii. Understand interfacing of 8086, with memory and other peripherals.
iii. To learn concepts of PPI, DMA and programmable interrupt controller.
iv. Study the features of advanced processors, Pentium processors.
v. Study the features of 8051 Microcontroller, its instruction set and also other controllers like PIC controllers.

UNIT-I:

8086 ARCHITECTURE: Main features, pin diagram/description, 8086 microprocessor family, 8086 internal architecture, bus interfacing unit, execution unit, interrupts and interrupt responses, 8086 system timing, minimum mode and maximum mode configuration.

8086 PROGRAMMING: Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools.

UNIT-II:

8086 INTERFACING : Semiconductor memories interfacing (RAM,ROM), 8254 software programmable timer/counter, Intel 8259 programmable interrupt controller, software and hardware interrupt applications, Intel 8237a DMA controller, Intel 8255 programmable peripheral interface, keyboard interfacing, alphanumeric displays (LED,7-segment display, multiplexed 7-segment display, LCD), Intel 8279 programmable keyboard/display controller, stepper motor, A/D and D/A converters.

UNIT-III:

80386 and 80486 MICROPROCESSORS: Introduction, programming concepts, special purpose registers, memory organization, moving to protected mode, virtual mode, memory paging mechanism, architectural differences between 80386 and 80486 microprocessors. Introduction to Pentium and ARM Processors.

UNIT-IV:

Intel 8051 MICROCONTROLLER: Architecture, hardware concepts, input/output ports and circuits, external memory, counters/timers, serial data input/output, interrupts.
Assembly language programming: Instructions, addressing modes, simple programs. Interfacing: keyboard, displays (LED, 7-segment display unit), A/D and D/A converters.

UNIT-V:

PIC MICROCONTROLLER: Introduction, characteristics of PIC microcontroller, PIC microcontroller families, memory organization, parallel and serial input and output, timers, Interrupts, PIC 16F877 architecture, instruction set of the PIC 16F877.

TEXT BOOKS:

1. Microprocessors and Interfacing – Programming and Hard ware by Douglas V Hall, SSSP Rao, Tata McGrawHill Education Private Limited, 3rd Edition.
2. The 8051 Microcontroller & Embedded Systems Using Assembly and C by Kenneth J.Ayala, DhananjayV.Gadre,CengageLearninbg , India Edition.

REFERENCES:

1. The Intel Microprocessors-Architecture, Programming, and Interfacing by Barry B.Brey,Pearson, Eighth Edition-2012.
2. Microprocessors and Microcontrollers-Architecture, Programming and System Design by Krishna Kant, PHI Learning Private Limited, Second Edition, 2014.

COURSE OUTCOMES:

On successful completion of the course module students will be able to

i. Develop the assembly language programs for different addressing modes.
ii. Perform 8086 interfacing with different peripherals and implement programs.
iii. Describe the key features serial and parallel communication.
iv. Design Microcontroller for simple Applications.
v. Distinguish between architectures of various processors and controllers.

III Year - I Semester R203104PC02

L	T	P	C
3	0	0	3

Digital Communications

Course Objectives:

i. Understand different pulse digital modulation techniques and their comparison.
ii. Familiarize various digital modulation techniques.
iii. Learn the calculation of their error probabilities of different digital modulation techniques.
iv. Understand the concept of entropy and different source coding techniques.
v. To understand the concept of different source and channel coding techniques.

UNIT I: PULSE DIGITAL MODULATION:
Elements of digital communication systems, advantages of digital communication systems, Elements of PCM: Sampling, Quantization & Coding, Quantization error, Companding in PCM systems. Differential PCM systems (DPCM). Delta modulation, its draw backs, adaptive delta modulation, comparison of PCM and DM systems, noise in PCM and DM systems.

UNIT II: DIGITAL MODULATION TECHNIQUES:
Introduction, ASK, FSK, PSK, DPSK, DEPSK, QPSK, M-ary PSK, ASK, FSK, similarity of BFSK and BPSK.

UNIT III: 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, BFSK,QPSK.

UNIT IV:
INFORMATION THEORY: Discrete messages, concept of amount of information and its properties. Average information, Entropy and its properties. Information rate, Mutual information and its properties.
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, state, tree and trellis diagram decoding using viterbi algorithm.

UNIT V:
LINEAR BLOCK CODES: Linear clock codes, systematic codes and its encoding circuit, syndrome and error detection, minimum distance, error detecting and correcting capabilities of block code, decoding circuit, probability of undetected error for linear block code in BSC , Hamming code and their applications.

CYCLIC CODES AND BCH CODES: Basic properties of cyclic codes, generator and parity check matrix of cyclic codes. Encoding and decoding circuits, syndrome computation and error detection, cyclic hamming codes encoding and decoding of BCH codes, error location and correction, convolution codes.

TEXT BOOKS:

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

REFERENCES:

1. Digital Communications – John Proakis, TMH, 1983.
2. Communication Systems Analog & Digital – Singh & Sapre, TMH, 2004.

Course Outcomes:

After undergoing the course students will be able to:

i. Determine the performance of different waveform coding techniques
ii. Generate the digital representation of the signals.
iii. Determine the probability of error for various digital modulation schemes
iv. Analyze the prosperities viz., mutual information, entropy information rate, average information.
v. Calculate different parameters of source coding techniques

III Year - I Semester R203104PC03

L	T	P	C
3	0	0	3

Electro Magnetic Theory and applications

OBJECTIVES:

The main objectives of this course are to understand:

i. Fundamentals of steady electric and magnetic fields using various laws
ii. The concept of static and time varying Maxwell equations and power flow using pointing theorem
iii. Wave characteristics in different media for normal and oblique incidence
iv. Various concepts of transmission lines and impedance measurements
v. Concept of smith chart and stub matching

UNIT I:

Review of Co-ordinate Systems, **Electrostatics:**, Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss Law and Applications, Electric Potential, Maxwell's Two Equations for Electrostatic Fields, Energy Density, Illustrative Problems. Convection and Conduction Currents, Dielectric Constant, Continuity Equation, Relaxation Time, Poisson's and Laplace's Equations; Capacitance – Parallel Plate, Coaxial Capacitors, Illustrative Problems.

UNIT II:

Magneto Statics : Biot-Savart Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Two Equations for Magneto static Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere's Force Law, Inductances and Magnetic Energy. Illustrative Problems**. [1,5]**

UNIT III:

Maxwell's Equations (Time Varying Fields): Faraday's Law and Transformer emf, Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's Equations in Different Final Forms and Word Statements. Conditions at a Boundary Surface: Dielectric-Dielectric and Dielectric-Conductor Interfaces. Illustrative Problems. **[1,2]**

UNIT IV:

EM Wave Characteristics - I: Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves – Definition, All Relations Between E & H, Sinusoidal Variations, Wave Propagation in Lossy dielectrics, lossless dielectrics, free space, wave propagation in good conductors, skin depth, Polarization & Types. Illustrative Problems.
EM Wave Characteristics – II: Reflection and Refraction of Plane Waves – Normal and Oblique Incidences, for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance. Poynting Vector and Poynting Theorem – Applications, Power Loss in a Plane Conductor. Illustrative Problems. **[2,3,4]**

UNIT V:

Transmission Lines - I : Types, Parameters, T&π Equivalent Circuits, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line, Lossless lines, distortion less lines, Loading - Types of Loading. Illustrative Problems. **[1,7]**
Transmission Lines – II: Input Impedance Relations, SC and OC Lines, Reflection Coefficient, VSWR. Low loss radio frequency lines and UHF Transmission lines, UHF Lines as Circuit Elements; Impedance Transformations λ/4, λ /2, λ/8 Lines –. Smith Chart – Construction and Applications, Quarter wave transformer, Stub Matching-single & double, Illustrative Problems. **[1,7]**

TEXT BOOKS:

1. Elements of Electromagnetic – Matthew N.O. Sadiku, Oxford Univ. Press, 3rd ed., 2001.
2. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd Edition, 2000.

REFERENCE BOOKS:

1. Electromagnetic Field Theory and Transmission Lines –GSN Raju, Pearson Education 2006
2. Engineering Electromagnetics – William H. Hayt Jr. and John A. Buck, TMH, 7th ed., 2006.
3. Electromagnetic Field Theory and Transmission Lines: G Sasi BhushanaRao, Wiley India 2013
4. Transmission Lines and Networks–Umesh Sinha, SatyaPrakashan (Tech. India Publications), New Delhi, 2001.

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OUTCOMES:

At the end of this course the student can able to:

i. Determine E and H using various laws and applications of electric & magnetic fields
ii. Apply the Maxwell equations to analyze the time varying behavior of EM waves
iii. Gain the knowledge in uniform plane wave concept and characteristics of uniform plane wave in various media
iv. Calculate Brewster angle, critical angle and total internal reflection
v. Derive the expressions for input impedance of transmission lines and Calculate reflection coefficient, VSWR etc. using smith chart

III Year - I Semester	R203104OE01	L	T	P	C
	OE-I	3	0	0	3

Computer Architecture and Organization

Course objectives:

i. To understand the architecture of modern computer with its various processing units.
ii. Also the Performance measurement of the computer system.
iii. To understand the memory management system of computer.
iv. To understand the various instructions, addressing modes.
v. To Understand the concept of I/O organization

UNIT -I:

Basic Structure Of Computers: Functional unit, Basic Operational concepts, Bus structures,
System Software, Performance, The history of computer development.

Machine Instruction and Programs:

Instruction and Instruction Sequencing: Register Transfer Notation, Assembly Language Notation, Basic Instruction Types,

UNIT -II:

Addressing Modes, Basic Input/output Operations, The role of Stacks and Queues in computer programming equation. Component of Instructions: Logic Instructions, shift and Rotate Instructions

Type of Instructions: Arithmetic and Logic Instructions, Branch Instructions, Addressing Modes, Input/output Operations

UNIT -III:

INPUT/OUTPUT ORGANIZATION: Accessing I/O Devices, Interrupts: Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Direct Memory Access,
Buses: Synchronous Bus, Asynchronous Bus, Interface Circuits, Standard I/O Interface: Peripheral Component Interconnect (PCI) Bus, Universal Serial Bus (USB)

UNIT -IV:

The MEMORY SYSTEMS: Basic memory circuits, Memory System Consideration, Read-Only Memory: ROM, PROM, EPROM, EEPROM, Flash Memory, And Cache Memories: Mapping Functions, INTERLEAVING

Secondary Storage: Magnetic Hard Disks, Optical Disks,

UNIT -V:

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

TEXTBOOKS:

1. Computer Organization, Carl Hamacher, ZvonksVranesic, SafeaZaky, 5thEdition, McGrawHill,2011.
2. Computer Architecture and Organization, John P. Hayes, 3rdEdition, McGrawHill,2002.

REFERENCE BOOKS:

1. Computer Organization and Architecture – William Stallings Sixth Edition, Pearson/PHI
2. Structured Computer Organization – Andrew S. Tanenbaum, 4th EditionPHI/Pearson, 2012.
3. Fundamentals or Computer Organization and Design, - SivaraamaDandamudiSpringer Int.Edition,2003.
4. "Computer Organization and Design: The Hardware/Software Interface" by DavidA. Patterson and John L.Hennessy, 1998.

Course Outcomes:

i. Students can understand the architecture of modern computer.
ii. They can analyze the Performance of a computer using performance equation.
iii. Understanding of different instruction types.
iv. Students can calculate the effective address of an operand by addressing modes.
v. Understand the concepts of I/O Organization and Memory systems.

III Year - I Semester

R203104OE01

OE-I

Mobile Computing

L	T	P	C
3	0	0	3

Course Objectives

i. To make the student understand the concept of mobile computing paradigm, its novel applications and limitations.
ii. To understand the typical mobile networking infrastructure through a popular GSM protocol
iii. To understand the issues and solutions of various layers of mobile networks, namely MAC layer, Network Layer & Transport Layer
iv. To understand the database issues in mobile environments & data delivery models.
v. To understand the ad hoc networks, platforms and protocols used in mobile environment.

UNIT- I

Introduction: Mobile Communications, Mobile Computing – Paradigm, Promises/Novel Applications and Impediments and Architecture; Mobile and Handheld Devices, Limitations of Mobile and Handheld Devices.

GSM – Services, System Architecture, Radio Interfaces, Protocols, Localization, Calling, Handover, Security, New Data Services, GPRS.

UNIT –II

(Wireless) Medium Access Control (MAC): Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA, Wireless LAN/ (IEEE 802.11)

UNIT –III

Mobile Network Layer: IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunnelling and Encapsulation, Route Optimization, DHCP.

UNIT –IV

Mobile Transport Layer: Conventional TCP/IP Protocols, Indirect TCP, Snooping TCP, Mobile TCP, Other Transport Layer Protocols for Mobile Networks.

Database Issues: Database Hoarding & Caching Techniques, Client-Server Computing & Adaptation, Transactional Models, Query processing, Data Recovery Process &QoS Issues.

UNIT- V

Data Dissemination and Synchronization : Communications Asymmetry, Classification of Data Delivery Mechanisms, Data Dissemination, Broadcast Models, Selective Tuning and Indexing Methods, Data Synchronization – Introduction, Software, and Protocols.

Mobile Ad hoc Networks (MANETs) : Introduction, Applications & Challenges of a MANET, Routing, Classification of Routing Algorithms, Algorithms such as DSR, AODV, DSDV, etc. , Mobile Agents, Service Discovery.

TEXT BOOKS:

1. Jochen Schiller, "Mobile Communications", Addison-Wesley, Second Edition, 2009.
2. Raj Kamal, "Mobile Computing", Oxford University Press, 2007, ISBN: 0195686772

REFERENCE BOOKS:

1. ASOKE K TALUKDER, HASAN AHMED, ROOPA R YAVAGAL, "Mobile Computing, Technology Applications and Service Creation" Second Edition, Mc Graw Hill.
2. UWE Hansmann, LotherMerk, Martin S. Nocklous, Thomas Stober, "Principles of Mobile Computing," Second Edition, Springer.

Course Outcomes:

i. Able to think and develop new mobile application.
ii. Able to take any new technical issue related to this new paradigm and come up with a solution(s).
iii. Able to develop new ad hoc network applications and/or algorithms/protocols.
iv. Able To understand the ad hoc networks
v. Able to understand & develop any existing or new protocol related to mobile environment

III Year - I Semester

R203104OE01

OE-I

L	T	P	C
3	0	0	3

PROGRAMMING WITH ARDUINO

COURSE OBJECTIVES:

i. Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software.
ii. It consists of a circuit board, which can be programmed (referred to as a microcontroller) and ready-made software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board.
iii. Arduino provides a standard form factor that breaks the functions of the micro-controller into a more accessible package.

UNIT- I: Overview of Arduino

Introduction to Arduino, Pin configuration and architecture. Device and platform features. Concept of digital and analog ports. Familiarizing with Arduino Interfacing Board , Introduction to Embedded C and Arduino platform Arduino data types, Variables and constants ,Operators, Control Statements, Arrays ,Functions[T1]

UNIT-II: Arduino I/O Functions

Pins Configured as INPUT ,Pull-up Resistors, Pins Configured as OUTPUT, pin Mode() Function, digital Write() Function , analog Read() function ,Arduino Interrupts, Incorporating Arduino time delay() function ,delay Microseconds() function ,millis() function, micros() function .[T2]

UNIT-III: Arduino Displays and Sensors

Working with Serial Monitor, Line graph via serial monitor, interfacing an 8 bit LCD to Arduino, Fixed one line static message display. Running message display. Using the LCD Library of Arduino. Arduino – Humidity Sensor Arduino – Temperature Sensor Arduino – Water Detector / Sensor Arduino – PIR Sensor Arduino – Ultrasonic Sensor Arduino – Connecting Switch (Magnetic relay switches) [T2]

UNIT-IV: Arduino Secondary Integrations

Types of Relay, Controlling Electrical appliances with electromagnetic relays, working of a matrix keypad, using the keypad library to interface with Arduino. Interfacing Servo motors to Arduino, Interfacing a RF Module Using serial input. Controlling LEDs with keys. Keys as toggle switch. Interfacing a piezo Buzzer, Using a buzzer as an alarm unit [T2]

UNIT-V : Arduino Communications and Arduino Projects

Parallel Communication, Serial Communication Modules, Types of Serial Communications, Arduino UART, GSM/GPRS Arduino Interfacing This will involve designing, developing, coding and implement Arduino project. Projects will include but not limited to: Intelligent home locking system. Intelligent water level management system. Home automation using RFID. Real time clock-based home automation. Intelligent Automatic Irrigation System [T2]

Text Books:

1. Simon Monk " Programming Arduino: Getting Started with Sketches" , McGraw-Hill Education TAB; 2nd edition
2. Brian Evans, "Beginning Arduino Programming", Technology in Action.

Reference Books:

1. Massimo BanziMichael Shiloh, "Make: Getting Started with Arduino", Shroff/Maker Media; Third edition.

COURSE OUTCOMES:

i. Learn the Arduino programming language and IDE, Program basic Arduino examples
ii. Prototype circuits and connect them to the Arduino
iii. Program the Arduino microcontroller to make the circuits work
iv. Explore the provided example code and online resources for extending knowledge about the capabilities of the Arduino microcontroller

III Year - I Semester	R203104PE01	L	T	P	C
	PE-1	**3**	**0**	**0**	**3**

Sensors and Instrumentation

COURSE OBJECTIVES:

i. To familiarize the characteristics and operation of measuring instruments.
ii. To introduce the concepts of active and passive transducers.
iii. To get an exposure on different signal generators and analyzers
iv. To understand the measurement of bridges
v. Students gain knowledge on different oscilloscopes and their functioning

UNIT I

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. DC Voltmeters-Multi-range, Range extension/Solid state and differential voltmeters, AC voltmeters-multi range, range extension, shunt. Thermocouple type RF ammeter, Ohmmeters series type, shunt type, Multi-meter for Voltage, Current and resistance measurements.

UNIT II

Signal Generator- fixed and variable, AF oscillators, Standard and AF sine and square wave signal generators, Function Generators, Square pulse, Random noise, sweep, Arbitrary waveform. Wave Analyzers, Harmonic Distortion Analyzers, Spectrum Analyzers, Digital Fourier Analyzers.

UNIT III

AC Bridges Measurement of inductance- Maxwell's bridge, Anderson Bridge. Measurement of capacitance -Schearing Bridge. Wheat stone bridge. Wien Bridge, Errors, and precautions in using bridges. Q-meter.

UNIT IV

Sensor Fundamentals and applications

Sensor Characteristics, System Characteristics, Instrument Selection, Data Acquisition and Readout, Installation, Acceleration, Shock and Vibration Sensors: Technology Fundamentals, Selecting and Specifying Accelerometers, Applicable Standards, Interfacing and Designs

UNIT V

Sound, Ultrasound and Infrasound sensors

Principles, Audio to electrical sensors and transducers: moving iron microphone, moving coil microphone, capacitor microphones. Microphone problems, frequency and wavelengths. Electrical to audio transducers: moving iron transducer, moving coil transducer, Capacitor transducers. Ultrasonic transducers, Infrasound sensors.

TEXT BOOKS:

1. Electronic instrumentation, second edition - H.S.Kalsi, Tata McGraw Hill, 2004.
2. Modern Electronic Instrumentation and Measurement Techniques – A.D. Helfrick and W.D. Cooper, PHI, 5th Edition, 2002.
3. Sensor Technology Handbook Hardcover – Import, 21 December 2004 by Jon S. Wilson (Author), Publisher : Newnes; Har/Cdr edition (21 December 2004)

REFERENCES:

1. Electronic Instrumentation & Measurements - David A. Bell, PHI, 2nd Edition, 2003.
2. Electronic Test Instruments, Analog and Digital Measurements - Robert A.Witte, Pearson Education, 2nd Ed., 2004.
3. Patranabis D, Sensors and Transducers, 2nd Edition, PHI, New Delhi, 2010

Course outcomes

The student will be able to

i. Select the instrument to be used based on the requirements.
ii. Understand and analyze different signal generators and analyzers.
iii. Analyze and understand the measurement of bridges along with errors and precautions in using bridges.
iv. Summarize sensor characteristics and applications
v. Demonstrate sound, ultrasound and infrared sensors

III Year - I Semester	R203104PE01	L	T	P	C
	PE-1	**3**	**0**	**0**	**3**

Tele communications and switching Networks

Course Objectives: The Course is designed

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

UNIT - I 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.

UNIT - II 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.

UNIT - III 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.

UNIT - IV Telephone Networks: Subscriber loop systems, switching hierarchy and routing, transmission plan, transmission systems, numbering plan, charging plan, Signalling techniques: In channel signalling, common channel signalling, 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.

UNIT - V Integrated Services Digital Network (ISDN): Introduction, motivation, new services, Network and protocol architecture, Transmission channels, User-Network interfaces, functional grouping, reference points, signalling, 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.

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.

REFERENCES:
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

Course outcomes:

i. Students will be able to analyze different switching methodologies.
ii. Students will be able to differentiate between signalling methods used in Telecommunication Networks
iii. Students will exhibit a good knowledge on data communication networks and ISDN and be able to differentiate LAN, MAN, WAN
iv. Students will demonstrate an ability to work on various Telecommunication Network concepts.
v. Students will demonstrate knowledge on modern telecommunication concepts like DSL & SONET.

III Year - I Semester R203104PE01

L	T	P	C
3	0	0	3

PE-1

DESIGN OF FAULT TOLERANT SYSTEMS

Course Objectives:

i. To provide or broad understanding of fault diagnosis and tolerant design Approach.
ii. To illustrate the framework of test pattern generation using semi and full automatic approach.

UNIT – I: Fault Tolerant Design:

Basic concepts: Reliability concepts, Failures & faults, Reliability and Failure rate, Relation between reliability and mean time between failure, maintainability and availability, reliability of series, parallel and parallel-series combinational circuits.

Fault Tolerant Design: Basic concepts-static, dynamic, hybrid, triple modular redundant System (TMR), 5MR reconfiguration techniques, Data redundancy, Time redundancy and software Redundancy concepts.

UNIT – II: Self Checking circuits & Fail safe Design:

Self Checking Circuits: Basic concepts of self checking circuits, Design of Totally self checking checker, Checkers using m out of n codes, Berger code, Low cost residue code.

Fail Safe Design: Strongly fault secure circuits, fail safe design of sequential circuits using partition theory and Berger code, totally self checking PLA design.

UNIT – III: Design for Testability:

Design for testability for combinational circuits: Basic concepts of Testability, Controllability and observability, The Reed Muller's expansion technique, use of Control and syndrome testable designs.

Design for testability by means of scan:

Making circuits Testable, Testability Insertion, Full scan DFT technique- Full scan insertion, flip-flop Structures, Full scan design and Test, Scan Architectures-full scan design, Shadow register DFT, Partial scan methods, multiple scan design, other scan designs.

UNIT - IV

Logic Built-in-self-test: BIST Basics-Memory-based BIST,BIST effectiveness, BIST types, Designing a BIST, Test Pattern Generation-Engaging TPGs, exhaustive counters, ring counters, twisted ring counter, Linear feedback shift register, Output Response Analysis Engaging ORA's, One's counter, transition counter, parity checking, Serial LFSRs, Parallel Signature analysis, BIST architectures-BIST related terminologies, A centralized and separate Board-level BIST architecture, Built-in evaluation and self test (BEST), Random Test socket (RTS), LSSD On-chip self test, Self –testing using MISR and SRSG, Concurrent BIST, BILBO, Enhancing coverage, RT level BIST design-CUT design, simulation and synthesis, RTS BIST insertion, Configuring the RTS BIST, incorporating configurations in BIST, Design of STUMPS, RTS and STUMPS results.

UNIT – V

Standard IEEE Test Access Methods: Boundary Scan Basics, Boundary scan architecture- Test access port, Boundary scan registers, TAP controller, the decoder unit, select and other units, Boundary scan Test Instructions-Mandatory instructions, Board level scan chain structure-One serial scan chain, multiple-scan chain with one control test port, multiple-scan chains with one TDI,TDO but multiple TMS, Multiple-scan chain, multiple access port, RT Level boundary scan-inserting boundary scan test hardware for CUT, Two module test case, virtual boundary scan tester, Boundary Scan Description language.

TEXTBOOKS:

1. Fault Tolerant & Fault Testable Hardware Design- Parag K.Lala, 1984,PHI
2. Digital System Test and Testable Design using HDL models and Architectures - Zainalabedin Navabi, Springer International Edition.

REFERENCES:

1. Digital Systems Testing and Testable Design-Miron Abramovici, Melvin A.Breuer and Arthur D. Friedman, Jaico Books
2. Essentials of Electronic Testing- Bushnell & Vishwani D.Agarwal, Springers.
3. Design for Test for Digital IC's and Embedded Core Systems- Alfred L. Crouch, 2008, Pearson Education.

Course Outcomes:

i. To acquire the knowledge of fundamental concepts in fault tolerant design.
ii. Design requirements of self check-in circuits
iii. Test pattern generation using LFSR
iv. Design for testability rules and techniques for combinational circuits
v. Introducing scan architectures.
vi. Design of built-in-self test.

III Year - I Semester R203104PC01A

L	T	P	C
0	0	0	1.5

Micro Processors and Micro Controllers Lab

Course Objectives

i. Introduction of assembly level programming
ii. Acquire skills to program microprocessors and micro controllers.
iii. To be able to understand the addressing modes of microprocessors.
iv. To be able to understand the micro controller capability.
v. To introduce interfacing of microprocessors and micro controllers.

LIST OF EXPERIMENTS

PART- A: (Minimum of 5 Experiments has to be performed)
8086 Assembly Language Programming using Assembler Directives

1. Sorting.
2. Multibyte addition/subtraction
3. Sum of squares/cubes of a given n-numbers
4. Addition of n-BCD numbers
5. Factorial of given n-numbers
6. Multiplication and Division operations
7. Stack operations
8. BCD to Seven segment display codes

PART- B: (Minimum of 3 Experiments has to be performed)
8086 Interfacing

1. Hardware/Software Interrupt Application
2. A/D Interface through Intel 8255
3. D/A Interface through Intel 8255
4. Keyboard and Display Interface through Intel 8279
5. Generation of waveforms using Intel 8253/8254

PART- C: (Minimum of 3 Experiments has to be performed)
8051 Assembly Language Programs

1. Finding number of 1's and number of 0's in a given 8-bit number
2. Addition of even numbers from a given array
3. Ascending / Descending order
4. Average of n-numbers

PART-D: (Minimum of 3 Experiments has to be performed)
8051 Interfacing

1. Switches and LEDs
2. 7-Segment display (multiplexed)
3. Stepper Motor Interface
4. Traffic Light Controller

Equipment Required:

1. Regulated Power supplies
2. Analog/Digital Storage Oscilloscopes
3. 8086 Microprocessor kits
4. 8051 microcontroller kits
5. ADC module
6. DAC module
7. Stepper motor module
8. Keyboard module

9. LED, 7-Segemt Units
10. Digital Multimeters
11. ROM/RAM Interface module
12. Bread Board etc.

Course outcomes The student will be able to

i. To be able to understand the microprocessor capability in general and explore the evolution of microprocessors.
ii. To be able to program microprocessors and micro controllers.
iii. To be able to understand the addressing modes of microprocessors.
iv. To be able to understand the micro controller capability.
v. To be able to develop interrupt handling through devices and to interface microprocessors and micro controllers electronic devices.

III Year - I Semester R203104PC02A

L	T	P	C
0	0	0	1.5

Digital Communications Lab

Course Objectives

i. To introduce basic theories of Digital communication system in practical
ii. To introduce implementation of different modulation and demodulation techniques.
iii. To introduce about shift keying techniques
iv. Introduce about companding technique
v. Enhance about encoding and decoding with different techniques.

LIST OF EXPERIMENTS

1. Time division multiplexing.
2. Pulse code modulation.
3. Differential pulse code modulation.
4. Delta modulation.
5. Frequency shift keying.
6. Phase shift keying.
7. Differential phase shift keying.
8. Companding
9. Source Encoder and Decoder
10. Linear Block Code-Encoder and Decoder
11. Binary Cyclic Code – Encoder and Decoder
12. Convolution Code – Encoder and Decoder

Equipment required for Laboratories:

1. RPS – 0 – 30 V
2. CRO – 0 – 20 M Hz.
3. Function Generators – 0 – 1 M Hz
4. RF Generators – 0 – 1000 M Hz./0 – 100 M Hz.
5. Multimeters
6. Lab Experimental kits for Digital Communication
7. Components

Course outcomes: The student will be able to

i. Able to understand basic theories of Digital communication system in practical
ii. Able to design and implement different modulation and demodulation techniques.
iii. Able to understand about multiplexing technique
iv. Able to analyze digital modulation techniques.
v. Able to identify and describe different techniques in modern digital communications, in particular in source coding and to perform channel coding

III Year - I Semester	R203104SC01	L	T	P	C
		1	0	2	2

English Communication skills (SC)

OBJECTIVES:
To enable the students to learn demonstratively the communication skills of listening, speaking, reading and writing.

OUTCOME:
A study of the communicative items in the laboratory will help the students become successful in the competitive world.
The course content along with the study material is divided into six units.

UNIT 1:

1. Debating - Practice work

UNIT 2:

1. Group Discussions -- Practice work

UNIT 3:

1. Presentation Skills - Practice work

UNIT 4:

1. Interview Skills - Practice work

UNIT 5:

1. Email, Curriculum Vitae - Practice work

UNIT 6:

1. Idiomatic Expressions
2. Common Errors in English - Practice work

Reference Books:

1. Strengthen your communication skills by Dr M Hari Prasad, Dr Salivendra Raju and Dr G Suvarna Lakshmi, Maruti Publications.
2. English for Professionals by Prof Eliah, B.S Publications, Hyderabad.
3. Unlock, Listening and speaking skills 2, Cambridge University Press
4. Spring Board to Success, Orient BlackSwan
5. A Practical Course in effective english speaking skills, PHI
6. Word power made handy, Dr shaliniverma, Schand Company
7. Let us hear them speak, JayashreeMohanraj, Sage texts
8. Professional Communication, ArunaKoneru, Mc Grawhill Education
9. Cornerstone, Developing soft skills, Pearson Education

III Year - I Semester	R2031MC01	L	T	P	C
	Mandatory course (AICTE suggested)	**2**	**0**	**0**	**0**

Indian Traditional Knowledge

Course Objectives

The course will introduce the students to

i. To get a knowledge in Indian Culture¬
ii. To Know Indian Languages and Literature and the fine arts in India¬
iii. To explore the Science and Scientists of Medieval and Modern India¬

UNIT - I Introduction to Culture: Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India

UNIT - II Indian Languages, Culture and Literature: Indian Languages and Literature-I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India Indian Languages and Literature-II: Northern Indian languages & literature

UNIT - III Religion and Philosophy: Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only)

UNIT – IV Fine Arts in India (Art, Technology& Engineering): Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

UNIT – V Education System in India: Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

Suggested Reading:

1. Kapil Kapoor, "Text and Interpretation: The India Tradition",ISBN: 81246033375, 2005
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450 494-X, 2004. S. Narain, "Examinations in ancient India", Arya Book Depot, 1993
5. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 1989
6. M. Hiriyanna, "Essentials of Indian Philosophy", MotilalBanarsidassPublishers, ISBN 13: 978- 8120810990, 2014

Course Outcomes

After successful completion of the course the students will be able to

i. Understand philosophy of Indian culture.
ii. Distinguish the Indian languages and literature.
iii. Learn the philosophy of ancient, medieval and modern India.
iv. Acquire the information about the fine arts in India.
v. Know the contribution of scientists of different eras.

III Year - I Semester	L	T	P	C
	0	0	0	1.5

Summer Internship 2 Months (Mandatory) after second year (to be evaluated during V semester

III Year - I Semester	L	T	P	C
	X	X	X	4

Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)

III Year - II Semester R203204PC01

L	T	P	C
3	0	0	3

Digital Signal Processing

Course Objectives

The student will be able to

i. Analyze the Discrete Time Signals and Systems
ii. Know the importance of FFT algorithm for computation of Discrete Fourier Transform
iii. Learn the IIR Filter design procedures and Understand the various implementations of digital filter structures
iv. Learn the FIR Filter design procedures and Understand the various implementations of digital filter structures
v. Know the need of Multirate Processing,Learn the concepts of DSP Processors

UNIT I 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.

UNIT II 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.

UNIT III. 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.

UNIT IV 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, Finite word length effects.

UNIT V MULTIRATE DIGITAL SIGNAL PROCESSING: Introduction, Decimation, Interpolation Sampling rate conversion, Implementation of sampling rate converters**,**
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, Auxiliary Register ALU, Index Register, Block Move Address Register, Parallel Logic Unit, Memory mapped registers, program controller, some flags in the status registers, on-chip memory, On-chip peripherals.

TEXT BOOKS:

1. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, DimitrisG.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

COURSE OUTCOMES

After going through this course the student will be able to

i. Apply the difference equations concept in the anayziation of Discrete time systems
ii. Use the FFT algorithm for solving the DFT of a given signal
iii. Design a Digital filter (IIR) from the given specifications Realize the IIR structures from the designed digital filter.
iv. Design a Digital filter (FIR) from the given specifications Realize the FIR structures from the designed digital filter
v. Use the Multirate Processing concepts in various applications (egg: Design of phase shifters, Interfacing of digital systems…) Apply the signal processing concepts on DSP Processor.

III Year - II Semester R203204PC02

L	T	P	C
3	0	0	3

Micro Waves, Waveguides and Antennas

COURSE OBJECTIVES:

i. To understand different Microwave components
ii. To understand about Microwave devices
iii. To apply the knowledge to measure different Microwave parameters
iv. To learn about different basic antennas
v. To learn about broad band antennas

UNIT I

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.

UNIT – II

Microwave Devices: Transistors, Tunnel Diodes and Microwave FETs: Structure; Operation; Characteristics and Power frequency limitations of microwave transistors; Tunnel diodes and Field-Effect 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.

UNIT – III

Microwave Measurement: Microwave bench; Precautions; Power measurement; Bolometric method; Attenuation; VSWR; Impedance, Frequency and Q of the Cavity.

UNIT – IV

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.

Antenna Arrays: Arrays of point sources, end fire and broadside arrays, pattern multiplication, synthesis of binomial and Dolph-Chebyshev arrays.

UNIT – V

Broadband Antennas: Log-periodic and Yagi antennas, frequency independent antennas, broadcast antennas.

Aperture and Reflector Antennas: Huygens' Principle, radiation from apertures in an infinite ground plane, slot and horn antennas, parabolic reflector antennas.

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. Balanis, C.A., "Antenna Theory and Design", 3rd Ed., John Wiley & 2005 Sons.

Reference text Books:

1. Kraus, J.D. and Fleisch, D.A., "Electromagnetics with Applications", McGraw-Hill.1999
2. Stutzman, W.L. and Thiele, H.A., "Antenna Theory and Design", 2nd 1998 Ed., John Wiley & Sons.

COURSE OUTCOMES:

At the end of this course the student can be able to:

i. Distinguish different active components used in low frequency and high frequencies.
ii. Identify different microwave devices operation and their applications
iii. Perform microwave measurements based on the learning
iv. Apply learned concepts for different basic antennas as per the need
v. Apply learned concepts to design broadband antennas, if required.

III Year - II Semester	R203204PC03	L	T	P	C
		3	0	0	3

VLSI Design

COURSE OBJECTIVES:

The main objectives of this course are:

i. Basic characteristics of MOS transistor and examines various possibilities for configuring inverter circuits and aspects of latch-up are considered.
ii. Design processes are aided by simple concepts such as stick and symbolic diagrams but the key element is a set of design rules, which are explained clearly.
iii. Basic circuit concepts are introduced for MOS processes we can set out approximate circuit parameters which greatly ease the design process.
iv. Understand the concepts of scaling MOS circuits
v. Understand FPGA design, synthesis and different case studies

UNIT-I

Introduction to MOS Technology: The IC Era, MOS transistor theory, Fabrication processes of nMOS, CMOSandBiCMOS technologies.

Basic Electrical Properties of MOS Circuits: I_{ds} versus V_{ds} relationships, MOS transistor threshold voltage, MOS transistor parameters, the pass transistor, the nMOS inverter, Pull-up to Pull-down ratios for various nMOS inverter configurations, alternative forms of pull-up, the CMOS inverter, the Bi-CMOS inverter, latch-up in CMOS circuits, Comparison between CMOS and BiCMOS technology.

UNIT-II

MOS and Bi-CMOS Circuit Design Processes: MOS layers, stick diagrams, design rules and layout, general observations on the design rules, 2μm Double Metal, Double Poly, CMOS/BiCMOS rules, 1.2μm Double Metal, Single Poly CMOS rules, Layout Diagrams of CMOS based inverter, NAND and NOR gates, Symbolic Diagrams-Translation to mask form.

UNIT-III

Basic Circuit Concepts: Sheet resistance, sheet resistance concept applied to MOS transistors and inverters, area capacitance of layers, standard unit of capacitance, some area capacitance calculations, the delay unit, inverter delays, driving large capacitive loads, propagation delays, wiring capacitances, choice of layers.

Scaling of MOS Circuits: Scaling models and scaling factors, scaling factors for device parameters, limitations of scaling, limits due to sub threshold currents, limits on logic levels and supply voltage due to noise and current density.

UNIT-IV

VLSI Design Issues: Advantages and challenges in VLSI Technology, VLSI Design methodologies, VLSI design process**,** design for testability-DUT, fault model, fault coverage, the single stuck-at fault model, technology options, power calculations, package selection, clock mechanism, introduction to ASIC design flow, mixed signal design and SoC design.

UNIT-V

FPGA Design: FPGAs: elements, types, advantages and limitations, basic FPGA architecture**,** FPGA design flow, the FPGA design cycle, FPGA routing terminology, basic concepts on verification and testing, simulation, synthesis, programming methods and programming issues of FPGA design.

TEXT BOOKS

1. Essentials of VLSI Circuits and Systems - Kamran Eshraghian, Douglas and A. Pucknell and SholehEshraghian, PHI Learning Private Limited, 2012.
2. VLSI Design–Black Book-Dr.K.V.K.K.Prasad, K.Shyamala, Kogent Learning Solutions Inc.,2012.

REFERENCES

1. CMOS Digital Integrated Circuits Analysis and Design- Sung-Mo Kang, Yusuf Leblebici, Tata McGraw-Hill Education, 2003.
2. VLSI Design – A.Shanthi, A.Kavita, and New age international Private Limited, 2006.

COURSE OUTCOMES:

At the end of this course the student can be able to:

i. Understand the properties of MOS active devices and simple circuits configured when using them and the reason for such encumbrances as ratio rules by which circuits can be interconnected in silicon.
ii. Know three sets of design rules with which nMOS and CMOS designs may be fabricated.
iii. Understand the scaling factors determining the characteristics and performance of MOS circuits in silicon technology.
iv. Know about scaling of MOS circuits
v. Know about FPGA design, synthesis and different case studies

III Year - II Semester

R203204OE01 **OE-II**

L	T	P	C
3	0	0	3

Information Theory and Coding

Course Objectives:

1. To understand the building blocks of digital communication system.
2. To prepare mathematical background for communication signal analysis.
3. To understand and analyze the signal flow in a digital communication system.
4. To analyze error performance of a digital communication system in presence of noise and other interferences.
5. To understand concept of spread spectrum communication system.
6. To understand the concept of Linear Block codes, Convolution Codes.

UNIT-1:

Introduction to Information Theory:

Measure of information, source coding ,error free communication over a noisy channel, channel capacity of a discrete memory less channel, practical communication system in light of Shannon's equation, Frequency-selective channel capacity, Multiple input – multiple output communication systems

UNIT-2

Error Control Coding:

Rational for coding and types codes, Discrete memory less channels ,Linear block codes, Cyclic codes, Maximum likely hood decoding of convolution codes, Distance properties of Convolution codes, Sequential decoding of Convolution codes, Trellis codes, Applications

UNIT-3

Detection and Estimation: Model of Digital Communication System, Gram-Schmitt Orthogonalization procedure, Geometric Interpretation of signals, Response of Bank Correlators to Noisy input, Detections of Known signal in noise, Probability error, Correlation receiver, Matched filter receiver, Detection of signals with unknown Phase and Noise, Estimation: Concepts and criteria, Maximum likelihood Estimation, Wiener Filter for wave form estimation.

Spared Spectrum Modulation:

Pseudo Noise sequences, A notion of Spared spectrum, Discrete-sequence spared Coherent binary phase shift keying, Signal-phase Dimensionality and processing Gain, Probability of error, Frequency hope-Spared Spectrum, Applications

UNIT-4

Groups, Fields and Linear Block Codes:

Galois field and its construction in GF(2^m) and its basic properties, vector spaces and matrices in GF(2), Linear block codes, systematic codes and its encoding circuit, syndrome and error detection, minimum distance, error detecting and correcting capabilities of block code, decoding circuit, probability of undetected error for linear block code in BSc, Hamming code and their applications.

UNIT-5

Cyclic Codes And BCH Codes: Basic properties of Cyclic codes, Generator and parity check matrix of cyclic codes, encoding and decoding circuits, syndrome computation and error detection, cyclic Hamming codes, encoding and decoding of BCH codes, error location and correction, Convolution Codes

Text Books:

1. Simon Haykin, "communication Systems", 4th Edition, John Wiley and Sons, 2001.
2. Fred Halsall, “Multimedia communications, Applications Networks Protocols and Standards", Pearson Education, Asia 2002.

References:

1. Lathi B.P., Modern Analog and Digital communication Systems, Oxford Univ. Press
2. Shu Lin and Costello, “Error Control coding: Fundamentals and Applications”, 2nd Edition, Pearson.
3. Sklar, “Digital Communication”, Pearson Education Asia.
4. Haykin Simon, Digital Communication, Wiley Publ.
5. Proakis, Digital Communication, McGraw Hill'
6. Schaum's Outline Series, “Analog and Digital Communication”, TMH.

Course Outcomes:

i. After successfully completing the course students will be able to
ii. Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.
iii. Perform the time and frequency domain analysis of the signals in a digital communication system.
iv. Select the blocks in a design of digital communication system.
v. Analyze Performance of spread spectrum communication system

III Year - II Semester	R203204OE01	L	T	P	C
	OE-II	**3**	**0**	**0**	**3**

Soft Computing Techniques

Course Objectives

The main objective of the course is to expose the students to soft computing, various types of soft computing techniques, and applications of soft computing. .Upon completion of this course, the student should be able to get an idea on:

i. Artificial Intelligence, Various types of production systems, characteristics of production systems.
ii. Neural Networks, architecture, functions and various algorithms involved.
iii. Fuzzy Logic, Various fuzzy systems and their functions.
iv. Genetic algorithms, its applications and advances.

Unit –I

Soft Computing: Introduction to soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing.

Artificial Intelligence: Introduction, Various types of production systems, characteristics of production systems, breadth first search, depth first search techniques, other Search Techniques like hill Climbing, Best first Search, A* algorithm, AO* Algorithms and various types of control strategies. Knowledge representation issues, Prepositional and predicate logic, monotonic and non monotonic reasoning, forward Reasoning, backward reasoning, Weak & Strong Slot & filler structures, NLP.

Unit –II

Neural Network: Structure and Function of a single neuron: Biological neuron, artificial neuron, definition of ANN, Taxonomy of neural net, Difference b/w ANN and human brain, characteristic and applications of ANN, single layer network.

Unit – III

Perceptron: Perceptron training algorithm, Linear separability , Widrow & Hebb's learning rule/Delta rule, ADALINE, MADALINE, AI v/s ANN. Introduction of MLP, different activation functions, Error back propagation algorithm, derivation of BBPA, momentum, limitation, characteristics and application of EBPA.

Counter propagation network: architecture , functioning & characteristics of counter Propagation network, Hop field/ Recurrent network, configuration, stability constraints, associative memory, and characteristics, limitations and applications. Hopfield v/s Boltzman machine. Adaptive Resonance Theory: Architecture, classifications, Implementation and training. Associative Memory.

Unit – IV

Fuzzy Logic: Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, Fuzzy systems: crisp logic, fuzzy logic, introduction & features of membership functions.

Fuzzy rule base system: Fuzzy propositions, formation, decomposition & aggregation of fuzzy Rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision making & Applications of fuzzy logic.

Unit – V

Genetic algorithm: Fundamental, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modelling: Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator ,Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional methods

TEXT BOOKS:

1. S.N. Sivanandam & S.N. Deepa, Principles of Soft Computing, Wiley Publications, 2nd Edition, 2011.
2. S, Rajasekaran & G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications, PHI Publication, 1st Edition, 2009.

REFERENCE BOOKS:

1. N.K.Bose, Ping Liang, Neural Network fundamental with Graph, Algorithms & Applications, TMH, 1st Edition, 1998.
2. Bart Kosko, Neural Network & Fuzzy System, PHI Publication, 1st Edition, 2009.

Web references: www.myreaders.info/html/soft_computing.html

Course Outcomes: At the end of the course the student should be able to

i. Learn about soft computing techniques and their applications
ii. Analyze various neural network architectures
iii. Understand perceptrons and counter propagation networks.
iv. Define the fuzzy systems
v. Analyze the genetic algorithms and their applications.

III Year - II Semester

R203204OE01

OE-II

L	T	P	C
3	0	0	3

ANTENNA THEORY: ANALYSIS AND DESIGN

Course Objectives: To give the Student:-

i. A foundation in the fundamentals of Antenna Design;
ii. Practice in the formulation of antennas and antenna arrays;
iii. An introduction to antenna synthesis and micro strip antennas;

UNIT1:

Concept of Radiation, Physical concept of radiation, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency. Friis transmission equation, radiation integrals and auxiliary potential functions.

UNIT 2:

Dipole and Aperture Antennas, Infinitesimal dipole, finite length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop. Aperture and Reflector Antennas Huygens 'Principle, radiation from rectangular and circular apertures design considerations.

UNIT3:

HF Antennas, Babinet's principle, Log, frequency independent antennas, broadcast antennas. Terrestrial and base station antennas for wireless applications.-Satellite terrestrial antennas, base station antennas, mobile terminal antennas, smart antennas, Adaptive and spatial filtering antennas.

Antenna Arrays, Array Antennas-Directivity of uniformly excited equally spaced linear arrays, Array pattern evaluation including mutual coupling. Phased arrays and array feeding techniques, Scan principles, Feed networks and array technology.

UNIT 4:

Antenna Synthesis, Antenna Synthesis: The Antenna Synthesis problem- Formulation of the Synthesis Problem, Synthesis Principles. Line source shaped beam synthesis methods - The Fourier Transform Method, The Woodward–Lawson Sampling Method.

UNIT 5:

Micro strip Antennas, Micro strip Antennas-Basic characteristics of micro strip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.CEM for Antennas- Introduction to CEM, Method of moments, Pocklington's Integral Equation, Source Modelling.

Text Books:

1. C. A. Balanis, "Antenna Theory and Design", 3rd Ed., John Wiley &Sons., 2005.
2. W. L. Stutzman, and G. A. Thiele, "Antenna Theory and Design", 2nd Ed., John Wiley &Sons., 1998.

References:

1. R. S. Elliot, "Antenna Theory and Design", Revised edition, Wiley-IEEE Press., 2003.
2. R. E. Collin, "Antennas and Radio Wave Propagation", McGraw-Hill., 1985
3. F. B. Gross, "Smart Antennas for Wireless Communications", McGraw-Hill., 2005.

Course Outcome: Students who successfully complete this course will have

i. Demonstrated an ability to understand the fundamental concepts of antenna design;
ii. Apply the basic equation to determine the radiation pattern of many antennas and antenna arrays;
iii. Use of various laws in antenna synthesis;
iv. Use the equations to solve micro strip antenna problems.

III Year - II Semester

R203204PE01

PE-II

L	T	P	C
3	0	0	3

Optical and Quantum Communications

Prerequisites: Basic of Optics, Electromagnetic Theory, Communication systems, and Computer networks

COURSE OBJECTIVES:

i. Introduction of structures and fabrication methods of Optical fibers
ii. Introduction of channel impairments: losses and dispersion
iii. Introduction of optical sourses detectors and amplifiers
iv. Introduction of quantum optics
v. Analyze the components of fiber optic networks: Couplers, multiplexers, switches and filters.

UNIT I:

Introduction to Optical Communications: Unguided optical communications – Li-fi - Evolution of fiber optic communications - Basic elements of an optical fiber communication link – Structure of optical fiber waveguide – Total internal reflection - Step-index and graded index fibers - Fiber materials – fiber fabrication – optical fiber cable

UNIT II:

Signal Degradation in Optical Fibers: Modal analysis - single mode and multi mode fibers- Signal attenuation in optical fibers - Dispersion effects in optical fibers - Dispersion Shifted, flattening and Compensating Fibers

UNIT III:

Optical Sources, Detectors and Amplifiers: Semiconductor Laser diode - LED - Source to Fiber Power launching and coupling - PIN and Avalanche photodiodes - Noise in detection process – Erbium Doped Fiber Amplifiers.

UNIT IV:

Quantum optics: Elementary introduction to quantum fields and photons. Light-matter interactions and the Jaynes-Cummings model. Generation and detection of non classical states of light: parametric down conversion and photon entanglement, photon action at a beam splitter, bubonic statistics. Berry and Pancharatnam phases.

UNIT V

Quantum mechanics and Quantum Bits: Two level systems as quantum bits. Superposition states, the Bloch sphere, mixed states, density matrices, Pauli matrices. Single qubit dynamics (gates): NOT, square root of NOT-gate, Hadamard, phase shift, networks of gates, the measurement gate.

TEXT BOOKS:

1. Gerd Keiser, Optical Fiber Communications, 5th Ed., Tata McGraw Hill, 2017
2. DjafarMynbaev and Lowell Scheiner, Fiber-Optic Communications Technology, Pearson education, 2001.
3. Nielsen M. A., **Quantum Computation and Quantum Information**, Cambridge University Press, 2002

REFERENCE BOOKS:

1. John Senior, Optical Fiber Communications – Principles and practice, 3rd Ed. Pearson, 2008
2. John Powers, An introduction to fiber optic systems, 2nd Ed., McGraw Hill, 1999
3. Rajiv Ramaswami, Kumar Sivarajan and Galen Sasaki, Optical Networks: A Practical Perspective, Morgan Kaufmann, 3rd ed., 2009

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

i. Illustrate the structure and fabrication methods of Optical fibers
ii. Analyze the channel impairments: losses and dispersion
iii. Analyze the Optical sources (LED and LASER) and detectors (PIN and Avalanche Photo diode).
iv. Apply design considerations to analog and digital fiber optic systems
v. Analyze the components of fiber optic networks: Couplers, multiplexers, switches and filters.

III Year - II Semester	R203204PE01	L	T	P	C
	PE-II	**3**	**0**	**0**	**3**

Global Positioning System

COURSE OBJECTIVES

1. To introduce fundamental blocks of global positioning system
2. To analysis on signal characteristics of GPS
3. Explore to the GPS Design analysis
4. Illustrate about differential GPS
5. Introduce about applications of GPS

UNIT - I 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 Geoaugmented navigation (GAGAN) architecture.

UNIT - II Signal Characteristics: GPS signal components, purpose, properties and power level, signal acquisition and tracking , Navigation information extraction, pseudorange estimation, frequency estimation, GPS satellite position calculation, Signal structure, anti spoofing (AS), selective availability, Difference between GPS and GALILEO satellite construction.

UNIT - III GPS Receivers & Data Errors: Receiver Architecture, receiver design options, Antenna design, GPS error sources, SA errors, propagation errors, ionospheric error, tropospheric error, multipath, ionospheric error, estimation using dual frequency GPS receiver, Methods of multipath mitigation, Ephemeris data errors, clock errors.

UNIT - IV 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

UNIT - V GPS Applications: GPS in surveying, Mapping and Geographical Information System, Precision approach Aircraft landing system, Military and Space application, 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

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

REFERENCES: 1. E.D.Kaplan, Christopher J. Hegarty, "Understanding GPS Principles and Applications", Artech House Boston 2005.

Course Outcomes:

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) Trained towards applications of GPS

III Year - II Semester

R203204PE01	L	T	P	C
PE-II	**3**	**0**	**0**	**3**

ADVANCED DIGITAL COMMUNICATION TECHNIQUES

Course Objectives:

i. To understand the concepts communication of noise channels.
ii. Effect of synchronization in communication.
iii. Concepts of band limited channels.

UNIT 1:

Review of Random variables, probability distribution and density functions, Moment generating function, Characteristic Function, Upper bounds on tail probability- Chebyshev inequality, Chernoff bound, Gaussian, Chi square, Rayleigh, Rician, Nakagami and Multi variate Gaussian distributions

UNIT 2:

PDFs and moments, Central limit Theorem, Characterization of Communication Signals and Systems, Signal space representation, Representation of digitally modulated Signals, Multi dimensional signalling.

UNIT 3:

Optimum receivers for AWGN channels, Waveform an vector AWGN channel models- Optimal detection, Correlation receive Matched filter receiver, Optimal detection and error probabilities of Band limited and Power limited signalling, Comparison of digital signalling methods

Carrier Recovery and Symbol Synchronization in Signal Demodulation, Signal parameter estimation, Carrier Phase Estimation, Maximum Likelihood phase estimation Phase locked loop Effect of additive noise on the phase estimate; Symbol Timing Estimation.

UNIT4:

Characterization for band limited channels, Signal design - Optimum pulse shaping, Nyquist criterion for zero ISI, Partial response signalling, Optimum receiver for channels with ISI and AWGN; Equalization Techniques, Linear Equalization Decision feedback equalization, Turbo equalization

UNIT 5:

Maximum Likelihood timing estimation- Non Decision Directed Timing Estimation, Joint Estimation of Carrier phase and Symbo Timing Adaptive Equalization - adaptive linear equalizer Zero forcing algorithm, LMS algorithm, adaptive decision feedback equalizer.

Text Books:

1. J.G. Proakis, M. Salehi, “Digital Communication”, MGH 5th edition, 2008.
2. Sheldon.M.Ross, “Introduction to Probability Models”, Elsevier, 9th edition, 2007.

References:

1. William Feller, “An introduction to Probability Theory and its applications”, Wiley 2000.
2. John B. Anderson, “Digital Transmission Engineering”, Wiley India Reprint,2012.
3. Edward. A. Lee and David. G. Messerschmitt, “Digital Communication”, Allied Publishers (Second edition).
4. J Marvin.K.Simon, Sami. M. Hinedi and William. C. Lindsey, “Digital Communication Techniques”, PHI.

Course Outcome:

i. The student will be able to analyze various aspects of digital communication Techniques

III Year - II Semester R203204PC01A

L	T	P	C
0	0	3	1.5

Digital Signal Processing Lab

Course objectives

i. Analysis of spectra of signals in **Digital Signal Processing**
ii. To verify the performance of a variety of modern and classical spectrum estimation techniques.
iii. To Analyze and simulate a digital filter
iv. To Analyze and Design new digital signal processing systems.
v. To Program a DSP processor to filter signals

LIST OF EXPERIMENTS:

1) Generation Of Discrete Time Signals For Discrete Signals
2) To Verify Linear Convolution.
3) To Verify The Circular Convolution.
4) To Find The Addition Of Sinusoidal Signals.
5) To Verify Discrete Fourier Transform (DFT) And Inverse Discrete Fourier Transform (IDFT).
6) Frequency Response of IIR Low Pass Butterworth Filter
7) Frequency Response of IIR High Pass Butterworth Filter
8) Frequency Response of IIR Low Pass Chebyshev Filter
9) Frequency Response of IIR High Pass Chebyshev Filter
10) Frequency Response of FIR Low Pass Filter Using Rectangle Window
11) Frequency Response of FIR Low Pass Filter Using Triangle Window
12) N-Point FFT Algorithm.
13) To Compute Power Density Spectrum of a Sequence.
14) To Find The FFT Of Given 1-D Signal And Plot.
15) To Study The Architecture Of DSP Chips – TMS 320C 5x/6x Instructions.

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

i. Able to Estimate the spectra of signals that are to be processed by a discrete time filter
ii. Able to verify the performance of a variety of modern and classical spectrum estimation techniques.
iii. Able to Design and simulate a digital filter
iv. Able to Design new digital signal processing systems.
v. Able to Design and realize FIR, IIR filters and to Program a DSP processor to filter signals

III Year - II Semester R203204PC02A

L	T	P	C
0	0	3	1.5

Micro Wave and Optical Communication Engineering Lab

Course objectives:

i. To analyses the microwave components characteristics
ii. To introduce the different types of Microwave devices and their principle
iii. To Analyze the concept of Microwave measurements
iv. To interpret concetps of Radiation patterns.
v. Analysis of the Antennas design using synthesis.

Minimum Twelve Experiments to be conducted:

Part – A (Any 7 Experiments (8& 9 compulsory)) :

1. Reflex Klystron Characteristics.
2. Gunn Diode Characteristics.
3. Attenuation Measurement.
4. Directional Coupler Characteristics.
5. Impedance and Frequency Measurement.
6. Scattering parameters of Circulator.
7. Scattering parameters of Magic Tee.
8. Radiation Pattern of Horn and Parabolic Antennas.
9. Synthesis of Microstip antennas (Rectangular Structure) Using HFSS.

Part – B (Any 5 Experiments) :

10. Characterization of LED.
11. Characterization of Laser Diode.
12. Intensity modulation of Laser output through an optical fiber.
13. Measurement of Data rate for Digital Optical link.
14. Measurement of NA.
15. Measurement of losses for Analog Optical link.

Equipment required for Laboratories:

1. Regulated Klystron Power Supply, Klystron mount
2. VSWR Meter
3. Micro Ammeter
4. Multi meter
5. CRO
6. GUNN Power Supply, Pin Modulator
7. Crystal Diode detector
8. Micro wave components (Attenuation)
9. Frequency Meter
10. Slotted line carriage
11. Probe detector
12. Wave guide shorts
13. SS Tuner
14. Directional Coupler
15. E, H, Magic Tees
16. Circulators, Isolator

17. Matched Loads
18. Pyramidal Horn and Parabolic Antennas
19. Turntable for Antenna Measurements
20. HFSS Software
21. Fiber Optic Analog Trainer based LED
22. Fiber Optic Analog Trainer based laser
23. Fiber Optic Digital Trainer 24. Fiber cables - (Plastic, Glass)

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

i. Explain and Perform the Reflex klystron characteristics using Microwave bench setup.
ii. Explain and perform the Gunn diode characteristics using Microwave bench setup.
iii. Measure the Frequency, attenuation, VSWR, Impedance using Klystron Bench Setup.
iv. Measure scattering parameters of Circulator, Scattering parameters of Magic Tee.
v. Explain Direction Coupler Characteristics using Microwave bench setup and to Measure waveguide parameters using Klystron Bench Setup.

III Year - II Semester R203204PC03A

L	T	P	C
0	0	3	1.5

VLSI Design Lab

Course objectives

i. Introduction of mentor graphics tool and technology mapping
ii. Design of basic cell blocks
iii. Introduction of layout tools
iv. Introduction of simulation of combinational circuits
v. Introduction of simulation of Sequential circuits

Note: The students are required to design the schematic diagrams using CMOS logic and to draw the layout diagrams to perform the following experiments using 130nm technology with the Industry standard EDA Tools.

List of Experiments:

i. Design and Implementation of an Universal Gates
ii. Design and Implementation of an Inverter
iii. Design and Implementation of Full Adder
iv. Design and Implementation of Full Subtract or
v. Design and Implementation of Decoder
vi. Design and Implementation of RS-Latch
vii. Design and Implementation of D-Latch
viii. Design and Implementation asynchronous counter
ix. Design and Implementation of static RAM cell
x. Design and Implementation of 8 bit DAC using R-2R latter network

Software Required:

i. Mentor Graphics Software / Equivalent Industry Standard Software.
ii. Personal computer system with necessary software to run the programs and to implement.

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

i. Able to design a schematic and simple layout for CMOS Inverter
ii. Able to design Entry & simulation of multiplexer circuit with test bench & functional verification.
iii. Able to design Entry & simulation of D flip-flop circuit with test bench & functional verification.
iv. Able to synthesize digital VLSI systems from register-transfer or higher level descriptions
v. Able to apply the Concept of design rules during the layout of a circuit and to understand current trends in semiconductor technology, and how it impacts scaling and Performance.

III Year - II Semester	R203204SC01	L	T	P	C
	SOC	1	0	2	2

Sensors based Instrumentation -(SC)

COURSE OBJECTIVES:

i. Introduction of different types of sensors
ii. Analysis of response of sensor circuits
iii. Introduction of op-amp based designs
iv. Analysis of filter design
v. Introduction about wireless sensors

UNIT-I

Sensors Fundamental: Sensor classification, Thermal sensors, Humidity sensors, Capacitive sensors, Electromagnetic sensors, Light sensing technology, Moisture sensing technology, Carbon dioxide (CO2) sensing technology, Sensors parameters, Selection of sensors

UNIT-II

Interfacing of Sensors and Signal Conditioning: Change of bios and level of signals, loading effects on Sensor's output, Potential divider, Low-Pass RC filter, High-Pass RC filter, practical issues of designing passive filters.

UNIT-III

Op-amp based Instrumentation: Op-Amp Fundamentals, Basic op-amp configurations, Ideal op-amp circuit analysis, Negative feedback, Feedback in op amp circuits, Loop gain, Op amp powering

Circuits with Resistive Feedback: I/V and V/I converters, Current amplifiers, Difference amplifiers, Triple and dual op amp Instrumentation amplifiers, Instrumentation applications, Transducer bridge amplifiers.

UNIT IV

Active Filters: Transfer function, First order active filters, Standard second order responses, KRC filters, Multiple feedback filters, Sensitivity, Filter approximations, Cascade design, Direct design, Switched capacitor, Switched capacitor filter.

UNIT V

Wireless sensors and sensors network: Introduction, Frequency of wireless communication, Development of wireless sensor network based project, Wireless sensor network based on only Zigbee.

Smart Transducers: Smart Sensors, Components of Smart Sensors, General Architecture of Smart Sensors, Evolution of Smart Sensors, Advantages, Application area of Smart Sensors

Reference Books:

1. Smart Sensors, Measurement and Instrumentation by Subhas Chandra Mukhopadhyay, Springer publication
2. Measurement and Instrumentation: Theory and ApplicationcBy Alan S Morris, Reza Langari, Academic Press, Elsevier, 2015

Reference Books:

1. Operational Amplifiers and Analog Integrated Circuits by Franco S. McGraw Hill International Edition, 1988
2. Data Acquisition and Signal Processing for Smart Sensors by Nikolay Kirianaki, Sergey Yurish, Nestor Shpak, Vadim Deynega, John Wiley & Sons Ltd

COURSE OUTCOMES:

By the end of the course student will be able to

i. Know different types of sensors
ii. Analyze the response of sensor circuits
iii. realize op-amp based design applications
iv. Design filters required for sensors
v. Analyze the applications of wireless sensors

III Year - II Semester	R2032MC01	L	T	P	C
	Mandatory course (AICTE suggested)	**2**	**0**	**0**	**0**

Research Methodology

COURSE OBJECTIVES:

i. Introduce about research and identification of problem
ii. Introduce different ways of data collection
iii. Introduce about optimization techniques
iv. Introduce about research ethics, scholarly publishing
v. Introduce about research publications and report writing

UNIT I –RESEARCH FORMULATION AND DESIGN:

Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis

UNIT II – DATA COLLECTION AND ANALYSIS:

Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with statically package (Sigma STAT,SPSS for student t-test, ANOVA, etc.), hypothesis testing.

UNIT III – SOFT COMPUTING:

Computer and its role in research, Use of statistical software SPSS, GRETL. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.

UNIT IV –RESEARCH ETHICS, IPR AND SCHOLARY PUBLISHING:

Ethics-ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability

UNIT V –INTERPRETATION AND REPORT WRITING:

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions.

REFERENCES:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
5. Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing

COURSE OUTCOMES:

By the completion of this course

i. Will know where to start research and identification of problem
ii. Able to know different ways of data collection
iii. Able to know different optimization techniques
iv. Able to know research ethics, scholarly publishing
v. Able to know about research publications and report writing

III Year - II Semester	**L**	**T**	**P**	**C**
	X	**X**	**X**	**4**

Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)

III Year - II Semester	**L**	**T**	**P**	**C**

Industrial/Research Internship (Mandatory) 2 Months during summer vacation

IV Year - I Semester	R204104PE01	L	T	P	C
		3	0	0	3

PE-III

Biomedical Instrumentation

Course Objective:

i. To study the biomedical signal characteristics and interfaces in human beings.
ii. To understand how different types of potentials are generated from the body
iii. To learn the fundamentals of functioning of the heart and how the heart signal is modeled
iv. To understand the principles of Neuro-Muscular Instrumentation.
v. To learn the working of different theraphic equipments.

UNIT – I Components of Medical Instrumentation System:

Bio amplifier Static and dynamic characteristics of medical instruments, Bio signals and characteristics, Problems encountered with measurements from human beings.

UNIT – II Organization of cell:

Nernst equation for membrane Resting Potential Generation and Propagation of Action Potential, Conduction through nerve to neuromuscular junction, Bio Electrodes: Bio potential Electrodes- External electrodes, Internal Electrodes. Bio chemical Electrodes

UNIT – III Mechanical function:

Electrical Conduction system of the heart, Cardiac cycle, Relation between electrical and mechanical activities of the heart, Cardiac Instrumentation: Blood pressure and Blood flow measurement. Specification of ECG machine, Einthoven triangle, Standard 12-lead configurations, Interpretation of ECG waveform with respect to electro mechanical activity of the heart,

UNIT – IV Neuro-Muscular Instrumentation:

Specification of EEG and EMG machines Electrode placement for EEG and EMG recording. Interpretation of EEG and EMG

UNIT – V Therapeutic equipment:

Pacemaker, Defibrillator, Shortwave diathermy, Haemodialysis machine, Respiratory Instrumentation: Mechanism of respiration, Spirometry, Pnemuotachograph Ventilators

TEXT BOOKS:

1. Hand-book of Biomedical Instrumentation – by R.S. Khandpur, McGraw-Hill, 2003. 2. Medical Instrumentation, Application and Design – by John G. Webster, John Wiley.

REFERENCE BOOKS:

1. Principles of Applied Biomedical Instrumentation – by L.A. Geoddes and L.E. Baker, John Wiley and Sons.
2. Biomedical Equipment Technology – Carr & Brown, Pearson.

Course Outcomes:

After completion of the course, the student will able to

i. To understand biomedical signal characteristics and interfaces in human beings.
ii. To recognize how different types of potentials are generated from the body
iii. ToAnalyze functioning of the heart and how the heart signal is modeled
iv. To understand the principles of Neuro-Muscular Instrumentation.
v. To realize the working of different theraphic equipments and how a new models can be developed.

IV Year - I Semester

R204104PE01

PE-III

L	T	P	C
3	0	0	3

LOW POWER VLSI DESIGN

Course Objective:

i. To study the fundamental concepts in low power CMOS VLSI design.
ii. To understand the design concepts of low power circuits
iii. To realize the applications in low power design
iv. To understand the design of low power low voltage ROM.
v. To understand the designs of low power low voltage RAM.

UNIT-I

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.

UNIT-II

Low-Voltage Low-Power Adders: Standard adder cells, CMOS adder's architectures, BiCMOS Adder, low-voltage low-power design techniques, current-mode adders.

UNIT-III

Low-Voltage Low-Power Adders: Overview of multiplication, types of multiplier architectures, Braun multiplier, Baugh-Wooley multiplier, Booth multiplier, Wallace tree multiplier.

UNIT-IV

Low-Voltage Low-Power Read-Only Memories: Types of ROM, basic physics of floating gate non-volatile devices, floating gate memories, basics of ROM, low power ROM technology, future trend and development of ROMs.

UNIT-V

Low-Voltage Low-Power Random-Access Memories: Basics of SRAM, memory cell, pre-charge and equalization circuit, decoder, sense amplifier, output latch, low power SRAM technologies, future trend and development of SRAM, types of DRAM, basics of DRAM, self-refresh circuit, future trend and development of DRAM.

TEXT BOOKS

1. Low-Voltage, Low-Power VLSI Subsystems – Kiat-Seng Yeo & Kaushik Roy - Tata McGraw-Hill Education Private Limited, 2009.
2. Low Power Design Methodologies - J. M. Rabaey and M. Pedram Boston – Springer Publications, 1996.

REFERENCES

1. CMOS Digital Integrated Circuits Analysis and Design- Sung-Mo Kang, Yusuf Leblebici, Tata McGraw-Hill Education, 2003.
2. Low-Voltage CMOS VLSI Circuits - J. B. Kuo and J.-H. Lou - New York: Wiley-Interscience Publications,1999.

Course Outcomes:

After completion of the course, the student will able to

i. Understand fundamantal concepts in low power CMOS VLSI design.
ii. Design Basic cells with low power.
iii. Realize the applications in low power design
iv. Understand the applications and developments in low power low voltage ROM.
v. Uunderstand the design of low power low voltage RAM.

IV Year - I Semester	R204104PE01	L	T	P	C
	PE-III	**3**	**0**	**0**	**3**
	RF MEMS				

Course Objectives: To give the Student:-

i. A foundation of RF MEMS;
ii. Applications of MEMS in RF circuit design.

UNIT 1: RF MEMS relays and switches:
Switch parameters, actuation mechanisms, Bistable relays and micro actuators, dynamics of switching operation.

UNIT 2: MEMS inductors:
Micro machined inductor, effect of inductor layout, Modelling and design issues of planar inductor.

UNIT 3: MEMS capacitors: Gap tuning and area tuning capacitors, dielectric tunable capacitors.
Micro machined RF filters:
Modelling of mechanical filters, electrostatic comb drive, and micromechanical filters using comb drives, Electrostatic coupled beam structures; MEMS phase shifters, types, Limitations

UNIT4: Micromachined Transmission lines:
Switched delay lines, micro machined transmission lines, coplanar lines, micro machined
Directional coupler and mixer.

UNIT5: Micro machined antennas: Micro strip antennas – design parameters, Micromachining to improve performance, reconfigurable antennas

Text Books:

1. Vijay K. Varadanetal, RF MEMS and their Applications, Wiley-India, 2011.

References:

1. "RF MEMS: Theory, Design, and Technology", Gabriel M. Rebeiz, Wiley, 2003.

Course Outcome:

i. At the end of the course students should be able to analyze different MEMS technologies.
ii. They are also expected to be familiar with the micro machined designs for the design of
iii. Reconfigurable antennas and different RF circuits.

IV Year - I Semester	R204104PE02	L	T	P	C
	PE-IV	3	0	0	3

Digital Image and Video Processing

Course Objectives:

i. To study the image fundamentals and mathematical transforms necessary for image Processing.
ii. To familiarize with image enhancement techniques in spatial and frequency domain, to study the need for image restoration and different restoration models/techniques.
iii. To learn the fundamentals of image segmentation and compression procedures, to study different segmentation and compression models.
iv. To understand the basics of image morphologies and different colour models.
v. To learn the basic steps of video processing.

UNIT I: Fundamentals of Image Processing:

Introduction, Image sampling, Quantization, Resolution, Image file formats, Elements of image processing system, Applications of Digital image processing

Image Transforms: Introduction, Need for transform, image transforms, Fourier transform, 2 D Discrete Fourier transform and its transforms, Importance of phase, Walsh transform, Hadamard transform, Haar transform, slant transform Discrete cosine transform, KL transform, singular value decomposition, Radon transform, comparison of different image transforms.

UNIT II:

Image Enhancement:

Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters. Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering.

Image Restoration:

Introduction to Image restoration, Image degradation, Types of image blur, Classification of image restoration techniques, Image restoration model, Linear and Nonlinear image restoration techniques, Blind de convolution.

UNIT III:

Image Segmentation: Introduction to image segmentation, Point, Line and Edge Detection, Region based segmentation., Classification of segmentation techniques, Region approach to image segmentation, clustering techniques, Image segmentation based on thresholding, Edge based segmentation, Edge detection and linking, Hough transform, Active contour

Image Compression: Introduction, Need for image compression, Redundancy in images, Classification of redundancy in images, image compression scheme, Classification of image compression schemes, Fundamentals of information theory, Run length coding, Shannon – Fano coding, Huffman coding, Arithmetic coding, Predictive coding, Transformed based compression, Image compression standard, Wavelet-based image compression, JPEG Standards.

UNIT-IV:

Morphological Image Processing: Preliminaries, Erosion and dilation, opening and closing, basic morphological algorithms for boundary extraction, thinning, gray-scale morphology, Segmentation using morphological watersheds.

Colour image processing: color fundamentals, color models, pseudo color image processing, and basics of full colour image processing, colour transformations, smoothing and sharpening. Image segmentation based on colour, noise in colour images, colour image compression.

UNIT V:

Basic Steps of Video Processing: Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, filtering operations.

2-D Motion Estimation: Optical flow, General Methodologies, different motion estimation models.

TEXT BOOKS:

1. Digital Image Processing – Gonzaleze and Woods, 4th Ed., Pearson.
2. Digital Video Processing – M. Tekalp, Prentice Hall International.
3. S.Jayaraman, S.Esakkirajan and T.VeeraKumar, "Digital Image processing, TataMcGraw Hill publishers, 2009

REFRENCE BOOKS:

1. Anil K.Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 9thEdition, Indian Reprint, 2002.
2. Multidimensional Signal, Image and Video Processing and Coding – John Woods, 2ndEd, Elsevier.
3. Digital Image Processing with MATLAB and Lab view – Vipula Singh, Elsevier.
4. Video Processing and Communication – Yao Wang, JoemOstermann and Ya–quin Zhang.1st Ed., PH Int.
5. https://nptel.ac.in/courses/117/105/117105135/

Course Outcomes:

After completion of the course, the student will able to

i. Perform the basic operations on images and can compute different image transforms.
ii. Perform image enhancement in spatial and frequency domain, be able to restore the given degraded image.
iii. Segment and compress the given image using different techniques.
iv. Perform different morphological operations on images and image colour inter conversions.
v. Differentiate analog and digital video, perform sampling and filtering of video signals using different models.

IV Year - I Semester	R204104PE02	L	T	P	C
	PE-IV	3	0	0	3

SPEECH AND AUDIO PROCESSING

Course Objectives:

i. To study fundamentals of human speech and music analysis,
ii. To model and process digital filters for speech encoding.
iii. To study the process of digitized human speech, the importance of adequate voiced and unvoiced speech sounds grouped into phonemes,
iv. To study the spectrograms for speech recognition, articulation and understanding. Also to learn - how the dominant features of speech may be analyzed to form significant abstractions for speaker identification and speaker-independent linguistic comprehension.
v. To study text to speech conversion system, different Synthesizer technologies, Emotion recognition from speech, watermarking of a speech signal

UNIT-I: FUNDAMENTALS OF SPEECH:

The human speech production mechanism, LTI model for speech production, Nature of speech signal, Linear time inverting model ,Phonetics, types of speech, voice and unvoiced decision making, Audio file Formats

UNIT-II: LINEAR PREDICTION OF SPEECH:

Lattice structure realization, forward linear prediction, autocorrelation method, Covariance method, Lattice methods, selection of the order of the predictor, line spectral frequencies

UNIT-III: SPEECH QUANTIZATION AND CODING:

Uniform and non uniform quantizers and coders, Companded quantizer, Uniform quantization and non uniform sources, waveform coding of speech, Pulse code modulation (PCM), Companded PCM, Adaptive PCM,DPCM,ADPCM, Comparison of different waveform coding techniques, Parametric speech coding techniques, Sinusoidal speech coding techniques, mixed excitation linear prediction coder, Multi mode speech coding ,Transfer domain coding of speech.

UNIT-IV: SPEECH PROCESSING APPLICATIONS:

Speech recognition systems, Architecture of large vocabulary continuous speech recognition system, Deterministic sequence recognition of SAR, Statical recognition of SAR, Statical pattern recognition and Parameter estimation, Word spotting ,keyboard spotting, Speech recognition and understanding, Speaker recognition, Distortion measures

UNIT-V: SPEECH SYNTHESIS

A text to speech system, Synthesizer technologies, Speech synthesis using other methods, speech transformations, Emotion recognition from speech, watermarking of authentication of a speech signal

Textbooks:

1. Dr. Shaila,D.Apte, "Speech and audio processing "Wiley Publications
2. Rabiner, L.R. and Schafer, R.W., "Digital Processing of Speech Signals", Pearson Education,2006.
3. Quatieri, T.F., "Discrete-Time Speech Signal Processing: Principles and Practice", Pearson Education, 2002.

Reference Books:

1. Spanias, A., Painter, T. and Venkatraman, A., "Audio Signal Processing and Coding", John Wiley & Sons,2007.
2. Gold, B. and Morgan, N., "Speech and Audio Signal Processing", John Wiley & Sons,2002.

Course Outcomes:

After the course, the student able to

i. Design and implement algorithms for processing audio and speech signals using MATLAB.
ii. Take into account the properties of acoustic signals and human hearing in the design of audio signal processing systems.
iii. Operate the speech production apparatus and different models
iv. Estimate the effect of the signal representations on sound quality, also can Perform common audio signal processing operations (equalization, dynamic control, perceptual audio coding.
v. Perform text to speech conversion and speech synthesis, speech watermarking

IV Year - I Semester	R204104PE02	L	T	P	C
	PE-IV	3	0	0	3

MULTICARRIER COMMUNICATION SYSTEMS

Course Objectives:

i. To provide an overview of OFDM and wireless channel characteristics;
ii. To understand the basic concepts of synchronization and channel impairment in OFDM;

UNIT 1:

Multi carrier and OFDM system fundamentals, OFDM system model, Single carrier communication, Comparison with other multi carrier modulation scheme, Channel capacity

UNIT 2:

FFT implementation, Power spectrum, Impairments of wireless channels to OFDM signals, Synchronization in OFDM , Timing and Frequency Offset in OFDM, Synchronization & system architecture

UNIT 3:

Timing and Frequency Offset estimation, Pilot and Non pilot based methods, Joint Time & Frequency Offset estimation.

Channel Estimation in OFDM systems, Differential and Coherent detection, and Pilot symbol aided estimation, Block type and Comb type pilot arrangement

UNIT4:

Decision directed channel estimation, MMSE estimation using time and frequency domain, correlation, MIMO channel estimation- basic concepts, Concepts of Time and Frequency domain equalization

UNIT 5:

Clipping in Multi carrier systems, Power amplifier non linearity, Error probability analysis, Performance in AWGN channel, PAPR properties of OFDM signals, PAPR reduction techniques with signal distortion, Techniques for distortion less PAPR reduction, Selective mapping and Optimization techniques.

Text Books:

1. Y. Li. G. Stuber, “OFDM for Wireless Communication”, Springer, 2006.
2. R. Prasad, “OFDM for Wireless Communication”, Artech House, 2006.

References:

References:

1. Ahmad R.S. Bahai, B.R. Saltzberg, M. Ergen, “ Multi carrier Digital Communications-Theory and Applications of OFDM”, Second Edition, Springer

Course Outcome: Students who successfully complete this course can

i. Understand the basics of OFDM and wireless channel characteristics.
ii. They can also learn the concepts of synchronization and channel impairment in OFDM.

IV Year - I Semester	R204104PE03	L	T	P	C
	PE-V	3	0	0	3

EMBEDDED SYSTEMS

Course Objectives:

i. To study the fundamentals of Embedded systems design
ii. To familiarize hardware components in embedded systems.
iii. To familiarizes in software environments used in embedded systems.
iv. To understand the basics of Real time operating system.
v. To realize the hardware software Co-Design environment.

UNIT-I

Introduction: Definitions of system and embedded system, classification of embedded systems, processor embedded in to a system, embedded hardware units and devices in a system, embedded software in a system, major application areas of embedded systems, Embedded firmware, Characteristics of an embedded system, design process in embedded system.

UNIT-II

Embedded Hardware: Analog and digital electronic components, I/O types and examples, serial communication devices, parallel device ports, wireless devices, timer and counting devices, watchdog timer, real time clock, networked embedded systems, qualitative concepts of communication protocols.

UNIT-III

Embedded Software: Embedded software development languages, ISR concept, interrupt sources, interrupt servicing mechanism, multiple interrupts, DMA, device driver programming, program elements: macros & functions, data types, data structures, modifiers, statements, loops & pointers, object-oriented programming, embedded programming in C++ & java.

UNIT-IV

Real Time Operating System: Operating system basics, types of operating systems, Services, process management, timer and event functions, memory management, tasks, process and threads, multiprocessing and multitasking, task scheduling, threads, task communication& synchronisation, device drivers, device, file and IO subsystem management, basic design using an RTOS.

UNIT-V

Embedded System Development, Implementation and Testing: The integrated development environment, emulators and debugging, boundary scan, embedded software development process and tools, issues in hardware-software design and co-design, translation tools-pre-processors, interpreters, compilers and linkers, debugging tools, testing on host machine, simulators, laboratory tools.

TEXT BOOKS

1. Embedded Systems-By Shibu.K.V-Tata McGraw Hill Education Private Limited, 2013.
2. Embedded Systems-Architecture, Programming and Design-Raj Kamal- Tata McGraw-Hill Publishing Company Limited-Second Edition,2008.

REFERENCES

1. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley Publications, 2013.
2. Embedded Systems Architecture- By Tammy Noergaard, Elsevier Publications, 2013.

Course Outcomes:

After the course, the student able to

i. Learn the embedded systems design
ii. Toselect hardware components in that are required for applications in embedded systems.
iii. Tocreate software environment suitable for embedded system applications.
iv. To realize the importance of Real time operating system.
v. To orient hardware software Co-Design oriented applications.

IV Year - I Semester	R204104PE03	L	T	P	C
	PE-V	3	0	0	3

Digital Data Communications

Course Objectives

The student will be introduced to:

i. Understand the Digital modulation schemes
ii. Understand the different types of interferences, modems influencing Data communications.
iii. Understand the concept of error correction,datalink layer fundamentals
iv. Understand the concepts of networks and multiplexing.
v. Understand the architectures Multiple Access techniques.

UNIT -I:

Digital Modulation Schemes:

BPSK, QPSK, 8PSK, 16PSK, 8QAM, 16QAM, DPSK – Methods, Band Width Efficiency, Carrier Recovery, Clock Recovery.

UNIT -II:

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 model.

UNIT -III:

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.

UNIT -IV:

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.

UNIT -V:

Multiple Access Techniques:

Frequency- Division Multiple Access (FDMA), Time - Division Multiple Access (TDMA), Code - Division Multiple Access (CDMA), OFDM and OFDMA. Random Access, Aloha- Carrier Sense Multiple Access (CSMA) - Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA), Controlled Access- Reservation- Polling- Token Passing, Channelization.

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.

Reference books:

1. Introduction to Digital and Data Communications Hardcover – Import, 31 January 1992 by M.A. Miller (Author), Publisher : Delmar Cengage Learning; 1st edition (31 January 1992)

Course Outcomes:

At the end of this course the student can able to:

i. Explain the fundamentals of Digital modulation schemes.
ii. Analyse the concepts of different different types of interferences ,modems influencing Data communications.
iii. Identify the Error correction, datalink layer design suitable for Data communications.
iv. Distinguish the networks and multiplexing techniques used Data communications
v. .Distinguish thee architectures Multiple Access techniques

IV Year - I Semester	R204104PE03	L	T	P	C
	PE-V	3	0	0	3

MIMO COMMUNICATION SYSTEMS

Course Objectives:

i. To be familiar with the fundamentals of MIMO communication system
ii. To be familiar with various Diversity and Multiplexing techniques of MIMO
iii. To gain understanding regarding capacity considerations.
iv. To introduce the various types of channel coding techniques
v. To be exposed to Space Time Codes

UNIT 1: Information Theoretic aspects of MIMO:

Review of SISO communications, MIMO channel models, Classical i.i.d. and Extended channels, Frequency selective and correlated channel models.

UNIT 2: MIMO Diversity and Spatial Multiplexing:

Space Time Diversity Aspects, Sources and types of diversity, Analysis under Rayleigh fading, Diversity and Channel knowledge.

UNIT 3:

Capacity of MIMO channels, Ergodic and outage capacity, Capacity bounds, Influence of channel properties on capacity. SVD and Eigen modes of MIMO channel.

Alamouti space time code, MIMO Spatial multiplexing and Transmit beam forming approach. Space Time receivers, ML, ZF, MMSE and Sphere decoding, BLAST receivers, Diversity multiplexing trade-off.

UNIT 4: Space Time Block Codes:

STBC based on real and complex orthogonal designs, Code Design criteria for quasi-static channels (Rank, determinant and Euclidean distance), orthogonal designs, Generalized Orthogonal designs, Quasi-orthogonal designs, Performance analysis.

UNIT 5: Space Time Trellis Codes:

Representation of STTC, Shift register, Generator matrix, State-transition diagram, Trellis diagram, Code construction, Delay diversity as a special case of STTC, Performance analysis

Text Books:

1. David Tse and Pramod Viswanath, “Fundamentals of Wireless Communication”, Cambridge University Press, 2005

References:

1. EzioBiglieri, Robert Calderbank et al “MIMO Wireless Communications”, Cambridge University Press, 2007
2. B.Vucetic and J. Yuan, “Space-Time Coding”, John Wiley, 2003
3. Hamid Jafarkhani, “Space-Time Coding: Theory and Practice”, Cambridge University Press, 2005
4. A. Paulraj, R. Nabar and D. Gore, “Introduction to Space-Time Wireless Communications”, Cambridge University Press, 2003
5. E.G. Larsson and P. Stoica, “Space-Time Block Coding for Wireless Communications”, Cambridge University Press, 2008

Course Outcome: Students will be able to

i. Design MIMO systems with transmit beam forming, with channel knowledge. Improved signal reception can be made possible in faded channel conditions.

IV Year - I Semester	R204104OE01	L	T	P	C
	OE-III	**3**	**0**	**0**	**3**

Cellular Mobile Communications

Course Objectives

The student will be introduced to:

i. Understand the basic cellular concepts like frequency reuse, cell splitting, cell sectoring etc., and various cellular systems.
ii. Understand the different types of interferences influencing cellular and mobile communications.
iii. Understand the concept of propagation model and the different types antennas used at cell site and mobile
iv. Understand the frequency management, channel assignment, various propagation effects in cellular environment and the concepts of handoff and types of handoffs.
v. Understand the architectures of GSM and 3G cellular systems.

UNIT I

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.

UNIT II

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, non-co channel interference-different types.

UNIT III

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 point-to-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.

UNIT IV

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.

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 V

DIGITAL CELLULAR NETWORKS: GSM architecture, GSM channels, multiple access schemes; TDMA, CDMA, OFDMA; architecture of 3G cellular systems.

TEXTBOOKS:

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.

REFERENCES:

1. Wireless Communications – Theodore. S. Rapport, Pearson education, 2ndEdn., 2002.
2. Mobile Cellular Communication – G Sasibhushana Rao Pearson

Course Outcomes:

At the end of this course the student can 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.

IV Year - I Semester	R204104OE01	L	T	P	C
	OE-III	**3**	**0**	**0**	**3**

Wireless Communications and Networks

Course Objectives

The student will be introduced to:

i. Understand the basic cellular cconcept system design
ii. Understand the concept of path loss in mobile radio propagation
iii. Understand the concepts of fading and multipath
iv. Understand the concepts of equalizers and diversity effects in wireless communications
v. Understand the architectures of Wireless networks and standards

UNIT -I:

The Cellular Concept-System Design Fundamentals:

Introduction, Frequency Reuse, Interference and system capacity – Co channel Interference and system capacity, Channel planning for Wireless Systems, Adjacent Channel interference , Power Control for Reducing interference, Improving Coverage & Capacity in Cellular Systems- Cell Splitting, Sectoring, Channel Assignment Strategies, Handoff Strategies- Prioritizing Handoffs, Practical Handoff Considerations, Trunking and Grade of Service

UNIT –II:

Mobile Radio Propagation: Large-Scale Path Loss:

Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, Basic Propagation Mechanisms, **Reflection**: Reflection from Dielectrics, Brewster Angle, Reflection from prefect conductors, Ground Reflection (Two-Ray) Model, **Diffraction**: Fresnel Zone Geometry, Knife-edge Diffraction Model, Multiple knife-edge Diffraction, Scattering, Outdoor Propagation Models- Longley-Ryce Model, Okumura Model, Hata Model, PCS Extension to Hata Model, Walfisch and Bertoni Model, Wideband PCS Microcell Model, Indoor Propagation Models-Partition losses (Same Floor), Partition losses between Floors, Log-distance path loss model, Ericsson Multiple Breakpoint Model, Attenuation Factor Model, Signal penetration into buildings, Ray Tracing and Site Specific Modeling.

UNIT –III:

Mobile Radio Propagation: Small –Scale Fading and Multipath

Small Scale Multipath propagation-Factors influencing small scale fading, Doppler shift, Impulse Response Model of a multipath channel- Relationship between Bandwidth and Received power, Small-Scale Multipath Measurements-Direct RF Pulse System, Spread Spectrum Sliding Correlator Channel Sounding, Frequency Domain Channels Sounding, Parameters of Mobile Multipath Channels-Time Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time, Types of Small-Scale Fading-Fading effects Due to Multipath Time Delay Spread, Flat fading, Frequency selective fading, Fading effects Due to Doppler Spread-Fast fading, slow fading, Statistical Models for

multipath Fading Channels-Clarke's model for flat fading, spectral shape due to Doppler spread in Clarke's model, Simulation of Clarke and Gans Fading Model, Level crossing and fading statistics, Two-ray Rayleigh Fading Model.

UNIT -IV:

Equalization and Diversity

Introduction, Fundamentals of Equalization, Training a Generic Adaptive Equalizer, Equalizers in a communication Receiver, Linear Equalizers, Non-linear Equalization-Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer, Algorithms for adaptive equalization-Zero Forcing Algorithm, Least Mean Square Algorithm, Recursive least squares algorithm. Diversity -Derivation of selection Diversity improvement, Derivation of Maximal Ratio Combining improvement, Practical Space Diversity Consideration-Selection Diversity, Feedback or Scanning Diversity, Maximal Ratio Combining, Equal Gain Combining, Polarization Diversity, Frequency Diversity, Time Diversity, RAKE Receiver.

UNIT -V:

Wireless Networks

Introduction to wireless Networks, Advantages and disadvantages of Wireless Local Area Networks, WLAN Topologies, WLAN Standard IEEE 802.11, IEEE 802.11 Medium Access Control, Comparison of IEEE 802.11 a,b,g and n standards, IEEE 802.16 and its enhancements, Wireless PANs, Hiper Lan, WLL.

TEXT BOOKS:

1. Wireless Communications, Principles, Practice – Theodore, S. Rappaport, 2nd Ed., 2002, PHI.
2. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press.

REFERENCE BOOKS:

1. Principles of Wireless Networks – KavehPahLaven and P. Krishna Murthy, 2002, PE
2. Wireless Digital Communications – KamiloFeher, 1999, PHI.

Course Outcomes:

At the end of this course the student can able to:

i. Explain the fundamentals basic cellular cconcept system design.
ii. Analyse the concepts of different path loss mechanisms in mobile radio propagation.
iii. Identify the various types fading and multipath deviations in wireless communications
iv. Realize the importance of equalizers in designing Wireless communication system.
v. Summarize the different architectures of Wireless networks and standards.

IV Year - I Semester	R204104OE01	L	T	P	C
	OE-III	3	0	0	3

INTRODUCTION TO SPACE TECHNOLOGY

UNIT – I: Fundamentals of Rocket Propulsion and Trajectories:

Space Mission- Types-Space environment-launch vehicle selection.; Introduction to rocket propulsion-fundamentals of solid propellant rockets- Fundamentals of liquid propellant rockets-Rocket equation, Two dimensional trajectories of rockets and missiles-Multi-stage rockets-Vehicle sizing-Two multi-stage rockets-Trade-off ratios-Single stage to orbit- Sounding rocket-Aerospace plane Gravity turn trajectories-Impact Point calculation-Injection conditions-Flight dispersions

UNIT- II Atmospheric Re-entry:

Introduction-Steep ballistic re-entry-Ballistic orbital re-entry-Skip re-entry-"Double-Dip" re-entry - Aero-braking - Lifting body re-entry

UNIT-III

Fundamentals of Orbital Mechanics, Orbital Manoeuvres:

Two-body motion-circular, elliptic, hyperbolic, and parabolic orbits-Basic orbital elements-Ground trace**.** In-Plane orbit changes-Hohmann transfer-Bi-elliptical transfer-Plane changes- Combined manoeuvres Propulsion for manoeuvres

UNIT IV : Satellite Attitude Dynamics:

Torque free axisymmetric rigid body-Attitude control for spinning spacecraft - Attitude control for non-spinning spacecraft - The Yo-Yo mechanism –Gravity – Gradient satellite-Dual spin spacecraft-Attitude determination

UNIT-V: Space mission Operations:

Supporting ground system architecture and team interfaces - Mission phases and core operations- Team responsibilities – Mission diversity – Standard operations practices

TEXT BOOK:

1. 'Spaceflight Dynamics', W.E. Wiesel, 3rd edition, McGraw-Hill, 2010

REFERENCES

1. 'Rocket Propulsion and Space flight dynamics', Cornelisse JW, Schoyer HFR, and Wakker KF, Pitman, 1984
2. 'Fundamentals of Space Systems', Vincet L. Pisacane, Oxford University Press, 2005.
3. 'Understanding Space: An Introduction to Astronautics', J. Sellers, 2nd edition, McGraw- Hill, 2004

IV Year - I Semester

R204104OE02

OE-IV

L	T	P	C
3	0	0	3

Radar and Satellite Communications

Course Objectives

i. The goal of the course is to introduce students to the fundamentals of radar and satellite communication.
ii. 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.
iii. This course contributes to the educational objectives - Fundamental knowledge, specialization, design skills, and self – learning.

Unit I: 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.

Unit II: 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, Monopulse: amplitude comparison and phase comparison methods, Radar antennas. Radar displays.

Unit III: Introduction to Satellite Communication

Orbital aspects of Satellite Communication: Introduction to geo-synchronous and geo-stationary satellites, Kepler's laws, locating the satellite with respect to the earth, Sub-satellite point, Look angles, Mechanics of launching a synchronous satellite, Orbital effects, Indian scenario in communication satellites

Unit IV: 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

Unit V: 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.

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 Text 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 Outcomes

On completion of this course, the students will be able to

i. Learn the communication satellite mechanics and about radar technology.
ii. Analyze and evaluate various parameters to design the power budget for satellite links.
iii. Compare Earth station technology and Satellite navigation & the global positioning system

IV Year - I Semester

R204104OE02

OE-IV

L	T	P	C
3	0	0	3

RF Circuit Design

Course Objectives

The student will be introduced to:

i. Understand the basic components used in RF Electronics
ii. Understand the concepts in Transmission line.
iii. Understand the concepts Matching and Biasing Networks used RF circuits
iv. Familiarize with Design of RF Amplifiers.
v. Familiarize with Design of Oscillators.

UNIT -I:

Introduction to RF Electronics:

The Electromagnetic Spectrum, units and Physical Constants, Microwave bands – RF behaviour of Passive components: Tuned resonant circuits, Vectors, Inductors and Capacitors - Voltage and Current in capacitor circuits – Tuned RF / IF Transformers.

UNIT -II:

Transmission Line Analysis: Examples of transmission lines- Transmission line equations and Biasing- Micro Strip Transmission Lines- Special Termination Conditions- sourced and Loaded Transmission Lines. **Single And Multiport Networks:** The Smith Chart, Interconnectivity networks, Network properties and Applications, Scattering Parameters.

UNIT -III:

Matching and Biasing Networks:

Impedance matching using discrete components – Micro strip line matching networks, Amplifier classes of Operation and Biasing networks. **RF Passive & Active Components:** Filter Basics – Lumped filter design – Distributed Filter Design – Diplexer Filters- Crystal and Saw filters- Active Filters - Tunable filters – Power Combiners / Dividers – Directional Couplers – Hybrid Couplers – Isolators. RF Diodes – BJTs- FETs- HEMTs and Models.

UNIT -IV:

RF Transistor Amplifier Design: Characteristics of Amplifiers - Amplifier Circuit Configurations, Amplifier Matching Basics, Distortion and noise products, Stability Considerations, Small Signal amplifier design, Power amplifier design, MMIC amplifiers, Broadband High Power multistage amplifiers, Low noise amplifiers, VGA Amplifiers.

UNIT -V:

Oscillators: Oscillator basics, Low phase noise oscillator design, High frequency Oscillator configuration, LC Oscillators, VCOs, Crystal Oscillators, PLL Synthesizer, and Direct Digital Synthesizer. **RF Mixers:** Basic characteristics of a mixer - Active mixers-Image Reject and Harmonic mixers, Frequency domain considerations

TEXT BOOKS:

1. RF Circuit design: Theory and applications by Reinhold Ludwing, PavelBretchko. Pearson Education Asia Publication, New Delhi 2001.
2. Radio Frequency and Microwave Communication Circuits – Analysis and Design – Devendra K. Misra, Wiley Student Edition, John Wiley & Sons

REFERENCE BOOKS:

1. Radio frequency and Microwave Electronics - Mathew M.Radmangh, 2001, PE Asia Publ.
2. RF Circuit Design – Christopher Bowick, Cheryl Aljuni and John Biyler, Elsevier Science, 2008.
3. Secrets of RF Design - Joseph Carr., 3rd Edition, Tab Electronics.
4. Complete Wireless Design - Cotter W. Sawyer, 2nd Edition, Mc-Graw Hill.
5. Practical RF Circuit Design for Modem Wireless Systems Vol.2 -Less Besser and Rowan Gilmore.

Course Outcomes:

At the end of this course the student can able to:

i. Explain the basic components used in RF Electronics
ii. Illustrate the concepts in Transmission line.
iii. Understand the concepts Matching and Biasing Networks used RF circuits
iv. Design of RF Amplifiers.
v. Design of Oscillators.

IV Year - I Semester

R204104OE02

OE-IV

L	T	P	C
3	0	0	3

AIR TRANSPORTATION SYSTEMS

UNIT- I: Aviation Industry & Its Regulatory Authorities:

Introduction, history of aviation- evolution, development, growth, challenges. Aerospace industry, air transportation industry- economic impact- types and causes. Airline Industry- structure and economic characteristics. The breadth of regulation- ICAO, IATA, national authorities (DGCA, FAA). Safety regulations- risk assessment- human factors and safety, security regulations, environmental regulations.

UNIT-II: Airspace:

Categories of airspace- separation minima, airspace sectors- capacity demand and delay. Evolution of air traffic control system- procedural ATC system, procedural ATC with radar assistance, first generation 'automated' ATC system, current generation radar and computer-based ATC systems. Aerodrome air traffic control equipment and operation - ICAO future air-navigation systems (FANS). Air-navigation service providers as businesses. Communication, navigation and surveillance systems (CNSS). Radio communications- VHF, HF, ACARS, SSR, ADS. Navigation- NDB, VOR, DME, area-navigation systems(R-Nav), ILS, MLS, GPS, INS.

UNIT- III: Aircraft:

Costs- project cash-flow, aircraft price. Compatibility with the operational infrastructure. Direct and indirect operating costs. Balancing efficiency and effectiveness- payload-range, fuel efficiency, technical contribution to performance, operating speed and altitude, aircraft field length performance. Typical operating costs. Effectiveness- wake-vortices, cabin dimensions, flight deck.

UNIT- IV: Airports:

Setting up an airport- airport demand, airport sitting, runway characteristics- length, Declared distances, aerodrome areas, obstacle safeguarding. Runway capacity- evaluating runway capacity- sustainable runway capacity. Runway pavement length, Manoeuvring area- airfield lighting, aprons, Passenger terminals-terminal sizing and configuration. Airport demand, capacity and delay.

UNIT - V: Airlines:

Setting up an airline- modern airline objectives. Route selection and development, Airline fleet planning, annual utilization and aircraft size, seating arrangements. Indirect Operating costs. Aircraft- buy or lease. Revenue generation, computerized reservation Systems, yield management. Integrating service quality into the revenue-generation process. Marketing the seats. Airline scheduling. Evaluating success- financial viability, regulatory compliance, efficient use of resources, effective service.

TEXT BOOK:

1. Hirst, M., *the Air Transport System*, Woodhead Publishing Ltd, Cambridge, England, 2008.

REFERENCES:

1. Wensven, J.G., *Air Transportation: A Management Perspective*, Eighth Edition, shgate, 2015.
2. Belobaba, P., Odoni, A. and Barnhart, C., *Global Airline Industry*, Second Edition, Wiley, 2015.
3. M. Bazargan, M., *Airline Operations and Scheduling*, Second Edition, Ashgate, 2010.
4. Nolan, M.S., *Fundamentals of Air Traffic Control*, 5th edn., Thomson Learning, 2011.
5. Wells, A. and Young, S., *Airport Planning and Management*, 6th edn., McGraw-Hill, 2011.

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IV Year - I Semester R204104HS01

L	T	P	C
3	0	0	3

Universal Human Values 2: Understanding Harmony

Course Objective: The objective of the course is to:

i. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
ii. Understanding (or developing clar it y) of the harmony in the human being, family, society and nature/existence
iii. Strengthening of self-reflection.
iv. Development of commitment and courage to act.
v. Understanding of Harmony on Professional Ethics

UNIT -I: Need, Basic Guidelines, Content and Process for Value

1. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration,Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority , Understanding Happiness and Prosperity correctly, Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

UNIT -II: Understanding Harmony in the Human Being - Harmony in Myself!

7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - happiness and physical facility, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health.

UNIT -III: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

Understanding values in human- human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding he meaning of Trust ; Difference between intention and ccompetence,Understanding the meaning of Respect, Difference between respect and differentiation,Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

UNIT -IV: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

Understanding the harmony in the Nature Inter connectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space Holistic perception of harmony at all levels of existence.

UNIT V: Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics: a. Ability t o utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate

Technologies and management patterns for above production systems. Case studies of typical holistic ttechnologies, management models and production systems, Strategy for transit ion from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations

Text Book:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference Books

1. JeevanVidya: EkParichaya, ANagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beaut iful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa

Course Outcomes:

At the end of this course the student can able to:

By the end of the course, students are expected to

i. Bbecome more aware of themselves, and their surroundings (family, society, nature);
ii. They would become more responsible in life,
iii. Handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
iv. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
v. apply what they have learnt to their own self in different day-to-day

IV Year - I Semester R204104SC01

L	T	P	C
1	0	2	2

Advances in Communications and signal processing (SC)

Course Objectives

The student will be introduced to:

i. Understand the basic concepts in Digital Signal Processing
ii. Understand the concepts in Digital signal generation.
iii. Understand the concepts of Multirate Digital Signal Processing
iv. Familiarize with Linear Prediction and Optimum Linear Filters:
v. Familiarize with power spectrum estimation and Digital Signal Processors.

UNIT -I:

Introduction and Review: Basic concepts of Digital Signal Processing, Basic digital signal processing examples in block diagram, Overview of typical Digital Signal Processing in real-world applications.

UNIT -II:

Sampling and Reconstruction of Signals: Sampling band-pass signals, Analog-to-digital and digital-to analog conversions.

UNIT -III:

Multirate Digital Signal Processing: Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Filter design and implementation for sampling rate conversion, Multistage implementation of sampling rate conversion, Sampling rate conversion of band-pass signals, Sampling rate conversion by an arbitrary factor, Applications of multirate signal processing.

UNIT -IV:

Linear Prediction and Optimum Linear Filters: Representation of a random process, Forward and backward linear prediction, Solution of normal equations, Properties of the linear error-prediction filters, AR lattice and ARMA lattice-ladder filters, Wiener filters for filtering and prediction.

UNIT -V:

Power Spectrum Estimation: Estimation of spectra from finite-duration observations of signals, nonparametric methods for power spectrum estimation, parametric methods for Power Spectrum Estimation, Minimum variance spectral estimation, Eigen analysis algorithm for spectral estimation.

Hardware and Software for Digital Signal Processors: Digital signal processor architecture, Digital signal processor hardware units, Fixed-point and floating-point formats.

Text Books:

1. John G. Proakis and Dimitris G. Manolakis, "Digital Signal Processing", 3rd Edition, Pearson, 2003.
2. Li Tan, "Digital Signal Processing – Fundamentals and applications", Elsevier, 2008.

Reference Books:

1. Paulo S. R. Diniz, Eduardo A. B. da Silva And Sergio L. Netto, "Digital Signal Processing: System Analysis and Design", Cambridge University Press, 2002.
2. Sanjit K. Mitra, "Digital Signal Processing", A Computer Based Approach, Tata McGraw Hill, 2001.
3. Alan V.Oppenheim and Ronald W.Schafer, "Digital Signal Processing", PHI Learning, 2003.

Course Outcomes:

At the end of this course the student can able to:

i. Explain the basic blocks in Digital Signal Processing
ii. Illustrate the concepts in Digital signal generation.
iii. Understand the concepts of Multirate Digital Signal Processing
iv. Design of filter based on application.
v. Estimate the power and also illustrate the architectures of Digital signal processors.

		L	T	P	C
IV Year - I Semester		**X**	**X**	**X**	**4**

Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)

		L	T	P	C
IV Year - II Semester	R204204PR01				
	Major Project	**0**	**0**	**0**	**12**

Project work, seminar and internship in industry

LIST OF HONOR COURSES OFFERED BY ECE DEPARTMENT – R20 Regulations

POOL-I-	
P1-1	EMI AND EMC
P1-2	IOT AND APPLICATIONS
P1-3	QUANTUM COMMUNICATIONS
P1-4	ADVANCED OPTICAL COMMUNICATION SYSTEMS
POOL-II	
P2-1	ADAPTIVE SIGNAL PROCESSING
P2-2	MULIRATE SYSTEMS AND FILTER BANKS
P2-3	TRASFORM TECHNIQUES
P2-4	PATTERN RECOGNITION AND MACHINE LEARNING
POOL-III	
P3-1	DIGITAL IC APPLICATIONS.(DICA)
P3-2	TELEMETRY AND TELECONTROL
P3-3	DIGITAL SYSTEM DESIGN
P3-4	VLSI TECHNOLOGY & DESIGN
POOL-IV	
P4-1	HARDWARE- SOFTWARE CO-DESIGN
P4-2	EMBEDDED SYSTEM DESIGN
P4-3	DETECTION AND ESTIMATION THEORY
P4-4	SOFTWARE DEFINED RADIO

P1-1	EMI AND EMC

Pre requisites: EMTL and AWP Courses.

Course Objectives:

i. Student shall be able to understand the root causes for Electromagnetic Noise (EMI), its sources.
ii. Shall be able to understand the effects of EMI and the required precautions to be taken/to be discussed with his peer group.
iii. Shall be able to understand the different measurement techniques of EMI (for conducted and normal) and their influences in detail.
iv. Shall be able to understand different compatibility techniques (EMC) to reduce/suppress EMI.
v. Shall be able to understand different standards being followed across the world in the fields of EMI/EMC.

UNIT-I: **Natural and Nuclear sources of EMI / EMC**:

Introduction, Electromagnetic environment, History, Concepts, Practical experiences and concerns, frequency spectrum conservations an overview of EMI / EMC, Natural and Nuclear sources of EMI.

UNIT-II: EMI from apparatus, circuits and open area test sites:

Electromagnetic emissions, noise from relays and switches, non-linearity's in circuits, passive inter modulation, cross talk in transmission lines, transients in power supply lines, electromagnetic interference (EMI). Open area test sites and measurements.

UNIT-III: Radiated and conducted interference measurements:

Anechoic chamber, TEM cell, GH TEM Cell, characterization of conduction currents / voltages, conducted EM noise on power lines, conducted EMI from equipment, Immunity to conducted EMI detectors and measurements.

ESD, Grounding, shielding, bonding and EMI filters:

Principles and types of grounding, shielding and bonding, characterization of filters, power lines filter design. ESD, Electrical fast transients / bursts, electrical surges.

UNIT-IV: Cables, connectors, components: Introduction, EMI suppression cables, EMC connectors, EMC gaskets, Isolation transformers, opto-isolators, Transient and Surge Suppression Devices.

UNIT-V: EMC standards- National / International: Introduction, Standards for EMI and EMC, MIL-Standards, IEEE/ANSI standards, CISPR/IEC standards, FCC regulations, Euro norms, British Standards,

EMI/EMC standards in JAPAN, Conclusions.

Text Books:

1. Engineering Electromagnetic Compatibility by Dr. V.P. Kodali, IEEE Publication, Printed in India by S. Chand & Co. Ltd., New Delhi, 2000.
2. Electromagnetic Interference and Compatibility IMPACT series, IIT – Delhi, Modules 1 – 9.

References:

1. Introduction to Electromagnetic Compatibility, NY, John Wiley, 1992, by C.R. Pal.
2. Introduction to Electromagnetic Compatibility, Second Edition Clayton, Kai Chang(eds.)2006.ISBN 13:9780471758150

Course Outcomes

At the end of this Course

i. Students shall be able to distinguish effects of EMI and counter measures by EMC-techniques.
ii. Students shall apply the knowledge gained in selecting proper gadget/device/appliance/system, as per EMC- norms specified by regulating authorities.
iii. Students shall choose career in the fields of EMI/EMC as an Engineer/Researcher/Entrepreneur in India/abroad.
iv. Students will be able to choose the appropriate cables, connectors, components for applications.
v. Students acquire knowledge onEMC standards- National / International

P1-2	IOT and Applications

Course Objectives:

i. Student shall be able to understand the basics of IOT applications
ii. Shall be able to understand the concepts of Machine to machine and architectural overview of IOT
iii. Shall be able to understand the different architectural models in IOT
iv. Shall be able to analyze applications of IOT in industry
v. Shall be able to understand different standards used for providing Security in IOT applications

Unit 1

IoT & Web Technology The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

Unit 2

M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Unit 3

IoT Architecture -State of the Art – Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Unit 4

IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, e Health.

Unit 5

Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smart Approach. Data Aggregation for the IoT in Smart Cities, Security

Text books:

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT,2014.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1stEdition, Apress Publications,2013.

References:

1. CunoPfister, "Getting Started with the Internet of Things", O Reilly Media,2011.
2. "Security and Privacy Trends in the Industrial Internet of Things"Springer International Publishing*Cristina Alcaraz*Year:2019

Course Outcomes:

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

i. Understand the importance of IOT Applications
ii. Understand the concept of IOT andM2M
iii. Study IOT architecture and applications in various fields
iv. Acquire the knowledge of different IOT based applications in industries
v. Study the security and privacy issues in IoT.

P1-3	QUANTUM COMMUNICATIONS

Course Objective:

i. To introduce the fundamentals of quantum communication
ii. Understand Quantum circuits and cryptography
iii. Study quantum algorithms
iv. Discuss Quantum Error correction

UNIT-I

Introduction to Quantum Computation: Quantum bits, Bloch sphere representation of a qubit, multiple qubits.

Background Mathematics and Physics: Hilbert space, Probabilities and measurements, entanglement, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis.

UNIT-II

Quantum Circuits: single qubit gates, multiple qubit gates, design of quantum circuits.

UNIT-III

Quantum Information and Cryptography: Comparison between classical and quantum information theory, Bell states, Quantum teleportation, Quantum Cryptography, no cloning theorem.

UNIT-IV

Quantum Algorithms: Classical computation on quantum computers, Relationship between quantum and classical complexity classes, Deutsch's algorithm, Deutsch's-Jozsa algorithm, Short factorization, Grover search.

UNIT-V

Noise and error correction: Graph states and codes, Quantum error correction, fault-tolerant computation.

TEXT BOOKS

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press, 2002
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific, 2004
3. Pittenger A. O., An Introduction to Quantum Computing Algorithms, 2000.

REFERENCE BOOKS

1. Quantum computing explained, David McMahon, Wiley-interscience, John Wiley & Sons, Inc. Publication 2008.
2. Introduction to Quantum Mechanics, 2nd Edition, David J. Griffiths, Prentice Hall New Jersey 1995

Course Outcomes: Students will able to,

i. Understand the fundamentals of quantum communication
ii. Explain the quantum circuits
iii. Interpret quantum cryptography
iv. Analyze the quantum algorithms
v. Analyze Quantum error correction

P1-4	ADVANCED OPTICAL COMMUNICATION SYSTEMS

Course Objectives:

i. A basis in the essentials of optical fiber, amplifier, transmitters and receivers;
ii. A practical guide to design a Light wave system architecture using power budget and rise time budget;
iii. An overview to Soliton Systems;

UNIT1: Light wave system components:

Optical fibers, step-index fiber, graded-index fibers, wave propagation, fiber modes, single mode and multi-mode fibers, dispersion in fibers, group velocity dispersion, material dispersion, waveguide dispersion, higher-order dispersion, polarization mode Dispersion.

UNIT2: Optical transmitters:

LED, LED spectrum, modulation response, LED structure, semiconductor LASER, optical gain, LASER structure, characteristics, transmitter design

UNIT3: Optical receivers:

Common photo detectors, p-n photodiodes, p-i-n photodiodes, Avalanche photodiode, receiver design, receiver noise, Receivers sensitivity, bit error rate, minimum received power

Light wave system architecture:

Design, loss limited and dispersion limited, power budget and rise time budget, long haul systems performance limiting factors, terrestrial light wave system, under sea light wave systems.

UNIT4: Optical amplifiers:

Gain spectrum, amplifier noise, amplifier specifications, semiconductor optical amplifiers, amplifier design characteristics, pulse amplifier, system application, Raman amplifiers, EDFA, gain spectrum, amplifier noise, multichannel amplification, distributed gain amplifier, dispersion management, pre-compensation schemes, post compensation technique, dispersion compensation fibers.

UNIT5: Soliton Systems:

Fiber solitons, nonlinear Schrodinger equation, bright soliton, dark solitons, soliton based communications, information transmission with solitons, soliton interaction, loss managed soliton, dispersion managed solitons, impact of amplifier noise, high speed soliton system.

Text Books:

1. Govind P. Agrawal, “Fiber Optic Communication System”, John Wiley and Sons, 2003

References:

1. J Diggonet, “Rare Earth Doped Fiber Lasers and Amplifiers”
2. Hasegawa, “Solitons in Optical Communications”
3. Govind P. Agrawal, “Nonlinear Optics”, Academic press 2nd Ed.

Course Outcome:

Students finishing this course will have the ability to

i. recognise the uses of optical fiber,
ii. transmitters and receivers;
iii. Use the power budget and rise time budget to design a light wave system;
iv. understand the use of different optical amplifiers for different purpose;
v. Use the solitons in an apt manner.

P2-1	ADAPTIVE SIGNAL PROCESSING

Course Objectives:

i. Student shall be able to understand the concepts involved in designing adaptive systems
ii. Shall be able to understand the concepts adaptive filter theory
iii. Shall be able to understand the algorithms in Adaptive signal processing
iv. Shall be able to analyze applications , algorithms
v. Shall be able to adopt filtering techniques in adaptive signal processing

UNIT –I:

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.

UNIT –II:

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 & Ideas of Gradient Search methods - Gradient Searching Algorithm & its Solution - Stability & Rate of convergence - Learning Curve.

UNIT –III:

Steepest Descent Algorithms:

Gradient Search by Newton's Method, Method of Steepest Descent, Comparison of Learning Curves.

UNIT –IV:

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.

UNIT –V:

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.

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.

Course outcomes: After completion of the course students shall able to

i. Uunderstand the Theory of adaptive systems
ii. Uunderstand the concepts adaptive filter theory
iii. Analyze algorithms in Adaptive signal processing
iv. Design Adaptive signal processing Applications
v. Adopt filtering techniques in adaptive signal processing

P2-2	MULIRATE SYSTEMS AND FILTER BANKS

Course Objectives:

i. Student shall be able to understand the fundamentals in Multirate systems
ii. Shall be able to understand the concepts QMF filters
iii. Shall be able to understand the concepts of reconstructing filters
iv. Shall be able to analyze designs of filter banks
v. Shall be introduced to wavelet theory

Unit-1

Fundamentals of Multirate Systems:

Basic multi-rate operations, interconnection of building blocks, poly-phase representation, multistage implementation, applications of multi-rate systems, special filters and filter banks

Unit-2

Maximally decimated filter banks:

Errors created in the QMF bank, alias-free QMF system, power symmetric QMF banks, M-channel filter banks, poly-phase representation, perfect reconstruction systems, alias-free filter banks, tree structured filter banks, trans-multiplexers

Unit-3

Para-unitary Perfect Reconstruction Filter Banks:

Lossless transfer matrices, filter bank properties induced by para unitariness, two channel Para-unitary lattices, M-channel FIR Para-unitary QMF banks, transform coding

Linear Phase Perfect Reconstruction QMF Banks:

Necessary conditions, lattice structures for linear phase FIR PR QMF banks, formal synthesis of linear phase FIR PR QMF lattice (Text 1).

Unit-4

Cosine Modulated Filter Banks:

Pseudo-QMF bank and its design, efficient poly-phase structures, properties of cosine matrices, cosine modulated perfect reconstruction systems

Unit-5

Wavelet Transform:

Short-time Fourier transforms Wavelet transform, discrete-time Ortho-normal wavelets, and continuous time Ortho-normal wavelets

Textbooks

1. P. P. Vaidyanathan, *Multirate Systems and Filter Banks*. Prentice-Hall. Englewood Cliffs, NJ: 1993.
2. G. Strang and T. Q. Nguyen, *Wavelets and Filter Banks.* Wellesley-Cambridge Press, Wellesley, MA, Revised Edition, 1998.

Reference Textbooks

1. Stephane Mallat, *A Wavlet Tour of Signal Processing*. San Diego: Academic Press, 1999.
2. M. Vetterli and J. Kovacevic, *Wavelets and Subband Coding*, Prentice Hall, Englewood Cliffs, NJ, 1995.

Course outcomes: After completion of the course students shall able to

1. Uunderstand the concepts in Multirate systems
2. Know the applications of QMF filters
3. Design reconstructing filters
4. Analyze and filter banks
5. Understand the importance of wavelet theory

P2-3	TRASFORM TECHNIQUES

Course Objectives:

i. Student shall be able to understand the Fourier analysis of signals
ii. Shall be able to understand the concepts transformations
iii. Shall be able to understand the concepts of continuous wavelet transforms
iv. Shall be able to understand multirate analysis and DWT concepts
v. Shall be able to understand wavelet packet concepts

UNIT -I:

Fourier analysis:

Fourier series, Examples, Fourier Transform, Properties of Fourier Transform, Examples of Fourier transform, sampling theorem, Partial sum and Gibbs phenomenon, Fourier analysis of Discrete time Signals, Discrete Fourier Transform.

Time – Frequency Analysis: Window function, Short Time Fourier Transform, Discrete Short Time Fourier Transform, Continuous wavelet transform, Discrete wavelet transform, wavelet series, Interpretations of the Time-Frequency plot.

UNIT -II:

Transforms:

Walsh, Hadamard, Haar and Slant Transforms, DCT, DST, KLT, Singular value Decomposition – definition, properties and applications

UNIT -III:

Continuous Wavelet Transform (CWT):

Short comings of STFT, Need for wavelets, Wavelet Basis- Concept of Scale and its relation with frequency, Continuous time wavelet Transform Equation- Series Expansion using Wavelets- CWT- Tiling of time scale plane for CWT. Important Wavelets: Haar, Mexican Hat, Meyer, Shannon, Daubechies.

UNIT -IV:

Multi Rate Analysis and DWT:

Need for Scaling function – Multi Resolution Analysis, Two-Channel Filter Banks, Perfect Reconstruction Condition, Relationship between Filter Banks and Wavelet Basis, DWT, Structure of DWT Filter Banks, Daubechies Wavelet Function, Applications of DWT.

UNIT -V:

Wavelet Packets and Lifting: Wavelet Packet Transform, Wavelet packet algorithms, Thresholding-Hard thresholding, Soft thresholding, Multidimensional Wavelets, Bi-orthogonal basis- B-Splines, Lifting Scheme of Wavelet Generation, Multi Wavelets

TEXT BOOKS:

1. A Wavelet Tour of Signal Processing theory and applications -RaghuveerM.Rao and Ajit S. Bopardikar, Pearson Edu, Asia, New Delhi, 2003.
2. K.P.Soman and K.I Ramachandran, " Insight into Wavelets – from theory to practice" PHI, Second edition,2008

Course outcomes: After completion of the course students shall able to

i. Apply Fourier analysis to signals
ii. Apply different transformation on signal
iii. Apply and analyze continuous wavelet transform techniques
iv. Apply and analyze multirate and DWT concepts
v. Apply Multidimensional wavelets to signals

P2-4	PATTERN RECOGNITION AND MACHINE LEARNING

Course Objectives:

Student shall be able to

i. Student shall be able to understand the theories involved in pattern recognition
ii. Shall be able to understand the concepts linear models in pattern recognition
iii. Shall be able to understand the concepts of neural networks
iv. Shall be able to understand discriminate decision functions
v. Shall be able to understand machine learning algorithms

Unit 1

Introduction to Pattern Recognition: Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error analysis

Unit 2

Linear models: Linear Models for Regression, linear regression, logistic regression Linear Models for Classification

Unit 3

Neural Network: perceptron, multi-layer perceptron, back propagation algorithm, error surfaces, practical techniques for improving back propagation, additional networks and training methods, Adaboost, Deep Learning

Unit 4

Linear discriminant functions - decision surfaces, two-category, multi-category, minimum- squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine

Unit 5

Algorithm independent machine learning – lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers
Unsupervised learning and clustering – k-means clustering, fuzzy k-means clustering, hierarchical clustering

Text books:

1. Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification", 2nd Edition John Wiley & Sons,2001.
2. Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, "The Elements of Statistical Learning", 2nd Edition, Springer,2009.

References:

1. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer,2006

Course Outcomes:

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

i. Estimate parameters used in decision functions
ii. Study the parametric and linear models for classification
iii. Design neural network and different training methods
iv. Design SVM for classification
v. Develop machine independent and unsupervised learning techniques.

P3-1	DIGITAL IC APPLICATIONS.(DICA)

Course Objectives

The main objectives of this course are:

- **i.** Introduction of digital logic families and interfacing concepts for digital design is considered.
- **ii.** VHDL fundamentals were discussed to modelling the digital system design blocks.
- **iii.** VHDL compilers, simulators and synthesis tools are described, which are used to verify digital systems in a technology-independent fashion.
- **iv.** Design and implementation of combinational and sequential digital logic circuits is explained.
- **v.** Design and implementation of Synchronous and Asynchronous Sequential Circuits

UNIT-I

Digital Logic Families and Interfacing: Introduction to logic families, CMOS logic, CMOS steady state and dynamic electrical behaviour, CMOS logic families. Bipolar logic, transistor-transistor logic, TTL families, CMOS/TTL interfacing, low voltage CMOS logic and interfacing, Emitter coupled logic.

UNIT-II

Introduction to VHDL: Design flow, program structure, levels of abstraction, Elements of VHDL: Data types, data objects, operators and identifiers. Packages, Libraries and Bindings, Subprograms. VHDL Programming using structural and data flow modelling.

UNIT-III

Behavioural Modelling: Process statement, variable assignment statement, signal assignment statement, wait statement , if statement, case statement ,null statement, loop statement, exit statement, next statement ,assertion statement, more on signal assignment statement ,Inertial Delay Model, Transport Delay Model ,Creating Signal Waveforms, Signal Drivers , Other Sequential Statements , Multiple Processes. Logic Synthesis, inside a logic Synthesizer.

Combinational Logic Design: Binary Adder-Subtract or, Ripple Adder, Look Ahead Carry Generator, ALU, Decoders, encoders, multiplexers and demultiplexers, parity circuits, comparators, Barrel Shifter, Simple Floating-Point Encoder, Dual Priority Encoder, Design considerations of the above combinational logic circuits with relevant Digital ICs, modelling of above ICs using VHDL.

UNIT-IV

Sequential Logic Design: SSI Latches and flip flops, Ring Counter, Johnson Counter, Design of Modulus N Synchronous Counters, Shift Registers, Universal Shift Registers, Design considerations of the above sequential logic circuits with relevant Digital ICs, modelling of above ICs using VHDL**.**

UNIT-V

Synchronous and Asynchronous Sequential Circuits: Basic design steps: State diagram, state table, state assignment, choice of flip flops and derivation of next state and output expressions, timing diagram. State assignment problem: One hot encoding. Mealy and Moore type FSM for serial adder, VHDL code for the serial adder. Analysis of Asynchronous circuits, State Reduction, State Assignment. A complete design example: The vending machine controller.

Text Books:

1. Digital Design Principles & Practices – John F. Wakerly, PHI/ Pearson Education Asia, 3rd Ed., 2005.
2. VHDL Primer – J. Bhasker, Pearson Education/ PHI, 3rd Edition.

References:

1. Fundamentals of Digital Logic with VHDL Design- Stephen Brown, ZvonkoVranesic, McGrawHill, 3rd Edition.

Course Outcomes:

At the end of this course the student can able to:

i. Understand the structure of commercially available digital integrated circuit families.
ii. Learn the IEEE Standard 1076 Hardware Description Language (VHDL).
iii. Model complex digital systems at several levels of abstractions, behavioural, structural, simulation, synthesis and rapid system prototyping.
iv. Analyze and design basic digital circuits with combinatorial and sequential logic circuits using VHDL.
v. Design and implementation of Synchronous and Asynchronous Sequential Circuits

P3-2	TELEMETRY AND TELECONTROL

COURSE OBJECTIVES:

i. To make students understand the application of telemetry techniques to Instrumentation

UNIT – I

Telemetry Principles: Introduction, Functional blocks of Telemetry system, Methods of
Telemetry – Non Electrical, Electrical, Pneumatic, Frequency.
Symbols and Codes: Bits and Symbols, Time function pulses, Line and Channel Coding, Modulation Codes. Inter symbol Interference.

UNIT – II

Frequency& Time Division Multiplexed Systems: FDM, IRIG Standard, FM and PM Circuits, Receiving end, PLL.
TDM - PAM, PAM /PM and TDM – PCM Systems. PCM reception. Differential PCM Introduction, QAM, Protocols.

UNIT – III

Satellite Telemetry: General considerations, TT & C Service, Digital Transmission systems,
TT & C Subsystems, Telemetry, and Communications.
Modern Telemetry: Zigbee, Ethernet.

UNIT – IV

Optical Telemetry: Optical fibers Cable – Sources and detectors – Transmitter and Receiving Circuits, Coherent Optical Fiber Communication System.

UNIT – V

Telecontrol Methods: Analog and Digital techniques in Telecontrol, Telecontrol apparatus –
Remote adjustment, Guidance, and regulation – Telecontrol using information theory – Example of a Telecontrol System.

TEXT BOOKS:

1. Telemetry Principles – D. Patranabis, TMH
2. Telecontrol Methods and Applications of Telemetry and Remote Control – by Swoboda G., Reinhold Publishing Corp., London, 1991

REFERENCE BOOKS:

1. Handbook of Telemetry and Remote Control – by Gruenberg L., McGraw Hill, New York, 1987.
2. Telemetry Engineering – by Young R.E., Little Books Ltd., London, 1988.
3. Data Communication and Teleprocessing System – by Housley T., PH Intl., Englewood Cliffs, New Jersey, 1987.

COURSE OUTCOMES:

ii. Upon completion of this course students will appreciate t he application of different telemetry systems and control to any process.

P3-3	DIGITAL SYSTEM DESIGN

COURSE OBJECTIVES:

The main objectives of this course are:

i. Understand the Minimization Procedures and CAMP Algorithm
ii. To Design PLA with different minimization procedures.
iii. Understand Basic circuit concepts in design of large Scale Digital systems.
iv. Understand the concepts Fault diagnosis in combinational circuits
v. Understand the concepts Fault diagnosis in sequential circuits

UNIT-I: Minimization Procedures and CAMP Algorithm:

Review on minimization of switching functions using tabular methods, k-map, QM algorithm, CAMP-I algorithm, Phase-I: Determination of Adjacencies, DA, CSC, SSMs and EPCs, CAMP-I algorithm, Phase-II: Passport checking, Determination of SPC, CAMP-II algorithm: Determination of solution cube, Cube based operations, determination of selected cubes are wholly within the given switching function or not, Introduction to cube based algorithms.

UNIT-II: PLA Design, Minimization and Folding Algorithms:

Introduction to PLDs, basic configurations and advantages of PLDs, PLA-Introduction, Block diagram of PLA, size of PLA, PLA design aspects, PLA minimization algorithm(IISc algorithm), PLA folding algorithm(COMPACT algorithm)-Illustration of algorithms with suitable examples.

UNIT -III: Design of Large Scale Digital Systems:

Algorithmic state machine charts-Introduction, Derivation of SM Charts, and Realization of SM Chart, control implementation, control unit design, data processor design, ROM design, and PAL design aspects, digital system design approaches using CPLDs, FPGAs and ASICs.

UNIT-IV: Fault Diagnosis in Combinational Circuits:

Faults classes and models, fault diagnosis and testing, fault detection test, test generation, testing process, obtaining a minimal complete test set, circuit under test methods- Path sensitization method, Boolean difference method, properties of Boolean differences, Kohavi algorithm, faults in PLAs, DFT schemes, built in self-test.

UNIT-V: Fault Diagnosis in Sequential Circuits:

Fault detection and location in sequential circuits, circuit test approach, initial state identification, Haming experiments, synchronizing experiments, machine identification, distinguishing experiment, adaptive distinguishing experiments.

TEXT BOOKS:

1. Logic Design Theory-N. N. Biswas, PHI
2. Switching and Finite Automata Theory-Z. Kohavi , 2nd Edition, 2001, TMH
3. Digital system Design using PLDd-Lala

REFERENCE BOOKS:

1. Fundamentals of Logic Design – Charles H. Roth, 5th Ed., Cengage Learning.
2. Digital Systems Testing and Testable Design – MironAbramovici, Melvin A. Breuer and Arthur D. Friedman- John Wiley & Sons Inc.

COURSE OUTCOMES:

At the end of this course the student can be able to:

i. Understand the Minimization Procedures and CAMP Algorithm
ii. Design PLA with different minimization procedures .
iii. Understand Design approaches in large Scale Digital systems.
iv. Test patterns can be generated for Fault diagnosis in combinational circuits
v. Test patterns can be generated for Fault diagnosis in sequential circuits

P3-4	VLSI TECHNOLOGY & DESIGN

COURSE OBJECTIVES:

The main objectives of this course are:

i. Understand the steps involved in VLSI technology and design
ii. Introduction of the Design of CMOS VLSI design concepts.
iii. Understand Basic circuit concepts in design CMOS systems.
iv. Understand the steps involved in the subsystem design of layout
v. Understand the concepts floor planning, architecture design and chip design

UNIT-I:

VLSI Technology: Fundamentals and applications, IC production process, semiconductor processes, design rules and process parameters, layout techniques and process parameters.

VLSI Design: Electronic design automation concept, ASIC and FPGA design flows, SOC designs, design technologies: combinational design techniques, sequential design techniques, state machine logic design techniques and design issues.

UNIT-II:

CMOS VLSI Design: MOS Technology and fabrication process of pMOS, nMOS, CMOS and BiCMOS technologies**,** comparison of different processes.

Building Blocks of a VLSI circuit: Computer architecture, memory architectures, communication interfaces, mixed signal interfaces.

VLSI Design Issues: Design process, design for testability, technology options, power calculations, package selection, clock mechanisms, mixed signal design.

UNIT-III:

Basic electrical properties of MOS and BiCMOS circuits, MOS and BiCMOS circuit design processes, Basic circuit concepts, scaling of MOS circuits-qualitatitive and quantitative analysis with proper illustrations and necessary derivations of expressions.

UNIT-IV:

Subsystem Design and Layout: Some architectural issues switch logic, gate logic, examples of structured design (combinational logic), some clocked sequential circuits, other system considerations.

Subsystem Design Processes: Some general considerations and an illustration of design processes, design of an ALU subsystem.

UNIT-V:

Floor Planning: Introduction**,** Floor planning methods, off-chip connections.

Architecture Design: Introduction, Register-Transfer design, high-level synthesis, architectures for low power, architecture testing.

Chip Design: Introduction and design methodologies.

TEXT BOOKS:

1. Essentials of VLSI Circuits and Systems, K. Eshraghian, Douglas A. Pucknell, SholehEshraghian, 2005, PHI Publications.
2. Modern VLSI Design-Wayne Wolf, 3rd Ed., 1997, Pearson Education.
3. VLSI Design-Dr.K.V.K.K.Prasad, KattulaShyamala, Kogent Learning Solutions Inc., 2012.

REFERENCE BOOKS:

1. VLSI Design Technologies for Analog and Digital Circuits, Randall L.Geiger, Phillip E.Allen, Noel R.Strader, TMH Publications, 2010.
2. Introduction to VLSI Systems: A Logic, Circuit and System Perspective- Ming-BO Lin, CRC Press, 2011.
3. Principals of CMOS VLSI Design-N.H.E Weste, K. Eshraghian, 2nd Edition, Addison Wesley.

COURSE OUTCOMES:

At the end of this course the student can be able to:

i. Understand the steps involved in VLSI technology and design
ii. Design CMOS based VLSI circuits.
iii. Analyze circuit concepts in CMOS systems.
iv. Design of layout for a circuit
v. Understand and apply different techniques in floor planning, architecture design and chip design

P4-1	HARDWARE- SOFTWARE CO-DESIGN

COURSE OBJECTIVES:

The main objectives of this course are:

i. Motivate towards importance of hardware and soft ware co design approaches
ii. Introduction of methodologies used in co-design
iii. Elaborate integrations involved in hardware and soft ware co-design.
iv. To Introduce objected oriented hardware design
v. System C programming introduction

UNIT I – CO-DESIGN CONCEPTS

Nature of hardware & software, quest for energy efficiency, driving factors for hardware-software co design, design space, system specification and modelling-Embedded Systems-Functional decomposition, Hardware Software tradeoffs-Comparison of Co-Design Approaches, Models of Computation, Requirements for Embedded System Specification.

UNIT II– METHODOLOGY FOR CO-DESIGN

Partitioning source description into different implementation domains, Dataflow modelling and transformation, Dataflow implementation in Hardware and Software, Analysis of Control flow and Dataflow, hardware-software co-synthesis, Distributed System Co-Synthesis.

UNIT III– HARDWARE-SOFTWARE INTEGRATION

Prototyping and Emulation Techniques, Target Architectures-Micro Programmed Architectures, General-Purpose Embedded Cores, System-on-Chip, Hardware-Software Interfaces, Principles of Hardware/Software Communication, Microprocessor Interfaces, Hardware Interfaces.

UNIT IV– OBJECTED ORIENTED HARDWARE DESIGN

Motivation for object oriented techniques, object oriented design strategies, modelling hardware components as classes, designing specialized components, data decomposition, and Processor example.

UNIT V – SYSTEM C PROGRAMMING

Design Methodology, Modules and Hierarchy, Processes, Ports and signals, Data types, Simulation using System C. CASE STUDY: Processor/Coprocessor design using System C.

TEXT BOOKS:

1. Patrick Schaumont "A Practical Introduction to Hardware/Software Co-design", Patrick Schaumont, Springer, 2012.
2. Ralf Niemann, "Hardware/Software Co-Design for Data Flow Dominated Embedded Systems", Kluwer, 1998.
3. AlxelJantsch, "Modeling Embedded Systems and SOC's. Concurrency and Time in Models of Computation", MK, 2004.

REFERENCES

1. Vahid and Frank, "Embedded System Design: A Unified Hardware/Software Introduction", Wiley, 2002.
2. Wolf and Wayne, "Computers as Components: Principles of Embedded Computing System Design", MK, 2001.
3. Grotker T, Liao S, Martin G and Swan S, "System design with SystemC", Kluwer Academic Publishers, 2002.

COURSE OUTCOMES:

At the end of this course the student can be able to:

i. Understand the importance of hardware and soft ware co design approaches
ii. Understand methodologies used in co-design
iii. Understand integrations involved in hardware and soft ware co-design.
iv. Understand the steps involved in the OBJECTED ORIENTED HARDWARE DESIGN
v. Understanding System C programming

P4-2	EMBEDDED SYSTEM DESIGN

COURSE OBJECTIVES:

The main objectives of this course are:

i. Motivate towards importance of embedded system design concepts
ii. Introduction of interfaces and components used in Embedded hardware
iii. Introduction of interfaces and components used in Embedded software
iv. To Introduce Embedded System Design, Development, Implementation and Testing concepts
v. Exposure of case studies in embedded designs

UNIT-I: Introduction

An Embedded System-Definition, Examples, Current Technologies, Integration in system Design, Embedded system design flow, hardware design concepts, software development, processor in an embedded system and other hardware units, introduction to processor based embedded system design concepts.

UNIT-II: Embedded Hardware

Embedded hardware building blocks, Embedded Processors – ISA architecture models, Internal processor design, processor performance, Board Memory – ROM, RAM, Auxiliary Memory, Memory Management of External Memory, Board Memory and performance.

Embedded board Input / output – Serial versus Parallel I/O, interfacing the I/O components, I/O components and performance, Board buses – Bus arbitration and timing, Integrating the Bus with other board components, Bus performance.

UNIT-III: Embedded Software

Device drivers, Device Drivers for interrupt-Handling, Memory device drivers, On-board bus device drivers, Board I/O drivers, Explanation about above drivers with suitable examples.

Embedded operating systems – Multitasking and process Management, Memory Management, I/O and file system management, OS standards example – POSIX, OS performance guidelines, Board support packages, Middleware and Application Software – Middle ware, Middleware examples, Application layer software examples.

UNIT-IV: Embedded System Design, Development, Implementation and Testing

Embedded system design and development lifecycle model, creating an embedded system architecture, introduction to embedded software development process and tools- Host and Target machines, linking and locating software, Getting embedded software into the target system, issues in Hardware-Software design and co-design.

Implementing the design-The main software utility tool, CAD and the hardware, Translation tools, Debugging tools, testing on host machine, simulators, Laboratory tools, System Boot-Up.

UNIT-V: Embedded System Design-Case Studies

Case studies- Processor design approach of an embedded system –Power PC Processor based and Micro Blaze Processor based embedded system design on Xilinx platform-NiosII Processor based embedded system design on Altera platform-Respective Processor architectures should be taken into consideration while designing an Embedded System.

TEXT BOOKS:

1. Tammy Noergaard "Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers", Elsevier(Singapore) Pvt.Ltd.Publications, 2005.
2. Frank Vahid, Tony D. Givargis, "Embedded system Design: A Unified Hardware/Software Introduction", John Wily & Sons Inc.2002.

REFERENCE BOOKS:

1. Peter Marwedel, "Embedded System Design", Science Publishers, 2007.
2. Arnold S Burger, "Embedded System Design", CMP.
3.Rajkamal, "Embedded Systems: Architecture, Programming and Design", TMH Publications, Second Edition, 2008.

COURSE OUTCOMES:

At the end of this course the student can be able to:

i. Understand importance of embedded systems
ii. Choose interfaces and components required in the design of Embedded hardware
iii. Handle software interfaces and components used in Embedded software
iv. Understand steps involved in Embedded System Design, Development, Implementation and Testing concepts
v. Understand the processors involved in case studies in embedded designs

P4-3	DETECTION AND ESTIMATION THEORY

Course Objectives:

i. Student shall be able to understand the concepts of a random process
ii. Shall be able to understand the concepts of decision rules and probable errors
iii. Shall be able to understand the error filtering techniques
iv. Shall be able to estimate different statistical parameters
v. Shall be able to estimate parameters of random process

UNIT –I:

Random Processes:

Discrete Linear Models, Markov Sequences and Processes, Point Processes, and Gaussian Processes.

UNIT –II:

Detection Theory:

Basic Detection Problem, Maximum A posterior Decision Rule, Minimum Probability of Error Classifier, Bayes Decision Rule, Multiple-Class Problem (Bayes)- minimum probability error with and without equal a priori probabilities, Neyman-Pearson Classifier, General Calculation of Probability of Error, General Gaussian Problem, Composite Hypotheses.

UNIT –III:

Linear Minimum Mean-Square Error Filtering:

Linear Minimum Mean Squared Error Estimators, Nonlinear Minimum Mean Squared Error Estimators. Innovations, Digital Wiener Filters with Stored Data, Real-time Digital Wiener Filters, Kalman Filters.

UNIT –IV:

Statistics:

Measurements, Nonparametric Estimators of Probability Distribution and Density Functions, Point Estimators of Parameters, Measures of the Quality of Estimators, Introduction to Interval Estimates, Distribution of Estimators, Tests of Hypotheses, Simple Linear Regression, Multiple Linear Regression.

UNIT –V:

Estimating the Parameters of Random Processes from Data:

Tests for Stationarity and Ergodicity, Model-free Estimation, Model-based Estimation of Autocorrelation Functions, Power Special Density Functions.

TEXT BOOKS:

1. Random Signals: Detection, Estimation and Data Analysis - K. Sam Shanmugan& A.M. Breipohl, Wiley India Pvt. Ltd, 2011.
2. Random Processes: Filtering, Estimation and Detection - Lonnie C. Ludeman, Wiley India Pvt. Ltd., 2010.

REFERENCE BOOKS:

1. Fundamentals of Statistical Signal Processing: Volume I Estimation Theory– Steven.M.Kay, Prentice Hall, USA, 1998.
2. Fundamentals of Statistical Signal Processing: Volume I Detection Theory– Steven.M.Kay, Prentice Hall, USA, 1998.

Course outcomes:

After completion of the course students shall able to

i. Analyze concepts of a random process
ii. Apply decision rules and calculate probable errors
iii. Apply filtering techniques and calculate errors
iv. Estimate different statistical parameters in systems
v. Estimate parameters of random process

P4-4	SOFTWARE DEFINED RADIO

Course Objectives:

i. Student shall be able to understand the concepts involved in software radio
ii. Shall be able to understand the concepts of filters used in multirate signal processing
iii. Shall be able to understand the synthesization of signals
iv. Shall be able to understand the designs of smart antennas
v. Shall be able to understand the design of software radio

UNIT – I: INTRODUCTION TO SOFTWARE RADIO CONCEPTS:

The need for Software radios and its definition, Characteristics and benefits of Software radio, Design principles of a software radio. Radio Frequency Implementation Issues: Purpose of RF front – end, Dynamic range, 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 & DAC distortion, Pre-distortion, Flexible RF systems using micro-electromechanical systems.

UNIT – II: MULTIRATE SIGNAL PROCESSING IN SDR:

Sample rate conversion principles, Polyphase filters, Digital filter banks, Timing recovery in digital receivers using multirate digital filters.

UNIT -III: 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.

UNIT – IV: SMART ANTENNAS:

Introduction, Vector channel modelling, Benefits of smart antennas, Structures for beam forming systems, Smart antenna algorithms, Diversity and Space time adaptive signal processing, Algorithms for transmit STAP, Hardware implementation of smart antennas, Array calibration, Digital Hardware Choices-Key hardware elements, DSP processors, FPGAs, Power management issues

UNIT – V: OBJECT ORIENTED REPRESENTATION OF RADIOS AND NETWORK:

Networks, Object –oriented programming, Object brokers, Mobile application environments, Joint Tactical radio system.

Case Studies in Software Radio Design:

SPEAKeasy, JTRS, Wireless Information transfer system, SDR-3000 digital transceiver subsystem, Spectrum Ware, Brief introduction to Cognitive Networking.

TEXT BOOKS:

1. Jeffrey Hugh Reed, "Software Radio: A Modern Approach to Radio Engineering," Prentice Hall Professional, 2002.
2. Paul Burns, "Software Defined Radio for 3G," Artech House, 2002.

REFERENCE BOOKS:

1. Tony J Rouphael, "RF and DSP for SDR," Elsevier Newnes Press, 2008.
2. P. Kenington, "RF and Baseband Techniques for Software Defined Radio," Artech House, 2005.

Course outcomes: After completion of the course students shall able to

i. Uunderstand the applications of software radio
ii. Design filters used in multirate signal processing
iii. Generate synthesized signals
iv. Analyze the requirements for design of smart antennas
v. Understand the design of software radio and motivated towards cognitive radio application

LIST OF MINOR COURSES OFFERED BY ECE DEPARTMENT
R20 Regulations

POOL-I	
P1-1	Signals and systems
P1-2	Analog communications
P1-3	Principles of communication Engineering
P1-4	Digital Data Communications
POOL-II	
P2-1	Electromagnetic Waves and Radiating Systems
P2-2	Antenna theory
P2-3	Microwave and Radar engineering
P2-4	Cellular and Mobile Communication
POOL-III	
P3-1	Digital Signal Processing
P3-2	Advanced Digital Signal Processing
P3-3	Digital Image and Video Processing
P3-4	Switching Theory and Logic Design
POOL-IV	
P4-1	Electronic Devices and Circuits
P4-2	Electronic Circuit Analysis
P4-3	Linear IC Applications
P4-4	Linear Circuits & Analog IC design

P1-1	Signals and systems

Course Objectives:

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- I:

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.

UNIT –II:

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.

UNIT-III:

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.

UNIT –IV:

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.

UNIT –V:
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.

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

Course Outcomes: At the end of the course students will be able to

i. Characterize the signals and systems and principles of vector spaces, Concept of orthgonality.
ii. Analyze the continuous-time signals and continuous-time systems using Fourier transform and Laplace transform.
iii. Apply sampling theorem to convert continuous-time signals to discrete-time signal and reconstruct back.
iv. Understand the relationships among the various representations of LTI systems
v. Understand the Concepts of convolution, correlation, Energy and Power density spectrum and their relationships. And Apply z-transform to analyze discrete-time signals and systems.

P1-2	Analog communications

Course Objectives:

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 I

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.

UNIT II

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.

UNIT III

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

UNIT IV

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

UNIT V

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.

TEXT BOOKS:

1. Communication Systems - Simon Haykin, John Wiley, 2nd Ed.,.
2. Modern digital and analog communication systems , 4th edition B.P.Lathi, Ding, Gupta oxford publishers

REFERENCES:

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.

Course Outcomes:

At the end of the course the student will be able to:

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

P1-3	Principles of communication Engineering

Principles of Communication Engineering

OBJECTIVES: The main objectives of this course are given below:

i. To introduce the terminology of signals and systems.
ii. To introduce Fourier tools to analyze signals and systems
iii. Familiarize with the fundamentals of analog communication systems.
iv. Familiarize with various techniques for analog modulation and demodulation of signals.
v. Familiarize with basic techniques for generating and demodulating various pulse modulated signals

UNIT- I: 10Hours

Review of Signals: 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 of Signals and Systems.

Analogy between vectors and signals, orthogonal signal space, Signal approximation using orthogonal functions, Mean square error, closed or complete set of orthogonal functions.

UNIT-II: 10 Hours

Fourier Analysis of Signals : 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.

UNIT-III: 10Hours

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**.(Qualitative treatment only)**

UNIT-IV: - 10Hours

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. **(Qualitative treatment only)**

UNIT-V: 10Hours

Introduction to Pulse Modulation: Time Division Multiplexing, Types of Pulse modulation, PAM (Single polarity, double polarity) PWM: Generation & demodulation of PWM, PPM, Generation and demodulation of PPM, introduction to PCM. **(Qualitative treatment only)**

TEXT BOOKS:

1. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawab, PHI, 2nd Edn.
2. Principles of Communication Systems – H Taub & D. Schilling, Gautam Sahe, TMH, 2007 3rd Edition.
3. Electronics & Communication System – George Kennedy and Bernard Davis, TMH 2004.

REFERENCES:

1. Signals & Systems - Simon Haykin and Van Veen, Wiley, 2nd Edition.
2. Principles of Communication Systems - Simon Haykin, John Wiley, 2nd Ed.,.
3. Signals, Systems & Communications - B.P. Lathi, BS Publications, 2003.

OUTCOMES: At the end of this course the student will able to:

i. Characterize the signals and systems and the principles of vector spaces, Concept of orthgonality.
ii. Analyze the continuous-time signals and continuous-time systems using Fourier series, Fourier transform.
iii. Differentiate various Analog modulation and demodulation schemes and their spectral characteristics.
iv. Differentiate various Angle modulation and demodulation schemes and their spectral characteristics.
v. Understand the concept different Pulse modulation techniques.

P1-4	Digital Data Communications

UNIT -I:

Digital Modulation Schemes:

BPSK, QPSK, 8PSK, 16PSK, 8QAM, 16QAM, DPSK – Methods, Band Width Efficiency, Carrier Recovery, Clock Recovery.

UNIT -II:

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 model.

UNIT -III:

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.

UNIT -IV:

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.

UNIT -V:

Multiple Access Techniques:

Frequency- Division Multiple Access (FDMA), Time - Division Multiple Access (TDMA), Code - Division Multiple Access (CDMA), OFDM and OFDMA. Random Access, Aloha- Carrier Sense Multiple Access (CSMA)- Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA), Controlled Access- Reservation- Polling- Token Passing, Channelization.

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.

P2-1	Electromagnetic Waves and Radiating Systems

Unit-1

Vectors analysis: Vector algebra, vector calculus - divergence, gradient, curl, Laplacian; Coordinate systems - Cartesian, cylindrical and spherical;

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;

Unit-3

Magnetostatics : Biot-Savart law, Ampere's law, magnetic vector potential, Lorentz force, magnetization, boundary conditions, magnetic energy and inductance;

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;

Unit-5

Advanced Topics: Antenna fundamentals, dipole antenna, Microstrip transmission lines, Waves along guiding 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.

P2-2	Antenna theory

Unit – I

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.

Unit – II

Antenna Arrays: Arrays of point sources, endfire and broadside arrays, pattern multiplication, synthesis of binomial and Dolph-Chebyshev arrays.

Unit – III

Broadband Antennas: Log-periodic and Yagi antennas, frequency independent antennas, broadcast antennas.

Unit – IV

Aperture and Reflector Antennas: Huygens' principle, radiation from apertures in an infinite ground plane, slot and horn antennas, parabolic reflector antennas.

Unit – V

Printed Antennas: Radiation from rectangular and circular patches, feeding techniques.

Suggested 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
3. Stutzman, W.L. and Thiele, H.A., "Antenna Theory and Design", 2nd 1998 Ed., John Wiley & Sons.
4. Elliot, R.S., "Antenna Theory and Design", Revised edition, Wiley-IEEE Press.2003

P2-3	Microwave and Radar engineering

UNIT I : 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.

UNIT – II : 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.

UNIT – III : Microwave Devices:

Transistors, Tunnel Diodes and Microwave FETs: Structure; Operation; Characteristics and Power frequency limitations of microwave transistors; Tunnel diodes and Field-Effect 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.

UNIT – IV :

Microwave Measurement: Microwave bench; Precautions; Power measurement; Bolometric method; Attenuation; VSWR; Impedance, Frequency and Q of the Cavity.

UNIT – V: 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.

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.

P2-4	Cellular and Mobile Communication

Course Objectives

The student will be introduced to:

i. Understand the basic cellular concepts like frequency reuse, cell splitting, cell sectoring etc., and various cellular systems.
ii. Understand the different types of interferences influencing cellular and mobile communications.
iii. Understand the concept of propagation model and the different types antennas used at cell site and mobile
iv. Understand the frequency management, channel assignment, various propagation effects in cellular environment and the concepts of handoff and types of handoffs.
v. Understand the architectures of GSM and 3G cellular systems.

UNIT I

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.

UNIT II

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, non-co channel interference-different types.

UNIT III

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 point-to-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.

UNIT IV

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.

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 V

DIGITAL CELLULAR NETWORKS: GSM architecture, GSM channels, multiple access schemes; TDMA, CDMA, OFDMA; architecture of 3G cellular systems.

TEXTBOOKS:

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.

REFERENCES:

1. Wireless Communications – Theodore. S. Rapport, Pearson education, 2ndEdn., 2002.
2. Mobile Cellular Communication – G Sasibhushana Rao Pearson

Course Outcomes:

At the end of this course the student can 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.

P3-1	Digital Signal Processing

Course Objectives

The student will be able to

i. Analyze the Discrete Time Signals and Systems
ii. Know the importance of FFT algorithm for computation of Discrete Fourier Transform
iii. Learn the IIR Filter design procedures and Understand the various implementations of digital filter structures
iv. Learn the FIR Filter design procedures and Understand the various implementations of digital filter structures
v. Know the need of Multirate Processing, Learn the concepts of DSP Processors

UNIT I 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.

UNIT II 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.

UNIT III. 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.

UNIT IV 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, Finite word length effects.

UNIT V MULTIRATE DIGITAL SIGNAL PROCESSING: Introduction, Decimation, Interpolation Sampling rate conversion, Implementation of sampling rate converters**,**
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, Auxiliary Register ALU, Index Register, Block Move Address Register, Parallel Logic Unit, Memory mapped registers, program controller, some flags in the status registers, on-chip memory, On-chip peripherals.

TEXT BOOKS:

1. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, DimitrisG.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

COURSE OUTCOMES

After going through this course the student will be able to

i. Apply the difference equations concept in the anayziation of Discrete time systems
ii. Use the FFT algorithm for solving the DFT of a given signal
iii. Design a Digital filter (IIR) from the given specifications Realize the IIR structures from the designed digital filter.
iv. Design a Digital filter (FIR) from the given specifications Realize the FIR structures from the designed digital filter
v. Use the Multirate Processing concepts in various applications (egg: Design of phase shifters, Interfacing of digital systems…) Apply the signal processing concepts on DSP Processor.

P3-2	Advanced Digital Signal Processing

Course Outcomes:

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

i. To understand theory of different filters and algorithms
ii. To understand theory of multirate DSP, solve numerical problems
iii. To understand theory of prediction and solution of normal equations
iv. To know applications of DSP at block level.

Unit 1

Overview of DSP, Characterization in time and frequency, FFT Algorithms, Digital filter design and structures: Basic FIR/IIR filter design &structures, design techniques of linear phase FIR filters,IIR filters by impulse invariance, bilinear transformation , FIR/IIR Cascaded lattice structures, and Parallel all pass realization of IIR.

Unit 2

Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in sub band coding.

Unit 3

Linear prediction & optimum linear filters, stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

Unit 4

Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm. Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation ,Parametric Methods for Power Spectrum Estimation, Minimum- Variance Spectral Estimation, Eigenan alysis Algorithms for Spectrum Estimation.

Unit 5

Application of DSP & Multi rate DSP, Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications

Text books:

1. J.G.Proakis and D.G.Manolakis"Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall,2007.
2. N. J. Fliege, "Multirate DigitalSignalProcessing: Multirate Systems -Filter Banks – Wavelets", 1st Edition, John Wiley and Sons Ltd,1999.

References:

1. Bruce W. Suter, "Multirateand Wavelet Signal Processing",1stEdition, Academic Press,1997.
2. M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc.,2002.
3. S.Haykin, "Adaptive Filter Theory", 4th Edition, Prentice Hall,2001.
4. D.G.Manolakis, V.K. Ingle and S.M.Kogon,"Statistical and Adaptive Signal Processing", McGraw Hill,2000.

P3-3	Digital Image and Video Processing

Course Objectives:

i. To study the image fundamentals and mathematical transforms necessary for image Processing.
ii. To familiarize with image enhancement techniques in spatial and frequency domain, to study the need for image restoration and different restoration models/techniques.
iii. To learn the fundamentals of image segmentation and compression procedures, to study different segmentation and compression models.
iv. To understand the basics of image morphologies and different colour models.
v. To learn the basic steps of video processing.

UNIT I: Fundamentals of Image Processing:

Introduction, Image sampling, Quantization, Resolution, Image file formats, Elements of image processing system, Applications of Digital image processing

Image Transforms: Introduction, Need for transform, image transforms, Fourier transform, 2 D Discrete Fourier transform and its transforms, Importance of phase, Walsh transform, Hadamard transform, Haar transform, slant transform Discrete cosine transform, KL transform, singular value decomposition, Radon transform, comparison of different image transforms.

UNIT II:

Image Enhancement:

Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters. Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering.

Image Restoration:

Introduction to Image restoration, Image degradation, Types of image blur, Classification of image restoration techniques, Image restoration model, Linear and Nonlinear image restoration techniques, Blind de convolution.

UNIT III:

Image Segmentation: Introduction to image segmentation, Point, Line and Edge Detection, Region based segmentation., Classification of segmentation techniques, Region approach to image segmentation, clustering techniques, Image segmentation based on thresholding, Edge based segmentation, Edge detection and linking, Hough transform, Active contour

Image Compression: Introduction, Need for image compression, Redundancy in images, Classification of redundancy in images, image compression scheme, Classification of image compression schemes, Fundamentals of information theory, Run length coding, Shannon – Fano coding, Huffman coding, Arithmetic coding, Predictive coding, Transformed based compression, Image compression standard, Wavelet-based image compression, JPEG Standards.

UNIT-IV:

Morphological Image Processing: Preliminaries, Erosion and dilation, opening and closing, basic morphological algorithms for boundary extraction, thinning, gray-scale morphology, Segmentation using morphological watersheds.

Colour image processing: color fundamentals, color models, pseudo color image processing, and basics of full colour image processing, colour transformations, smoothing and sharpening. Image segmentation based on colour, noise in colour images, colour image compression.

UNIT V:

Basic Steps of Video Processing: Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, filtering operations.

2-D Motion Estimation: Optical flow, General Methodologies, different motion estimation models.

TEXT BOOKS:

1. Digital Image Processing – Gonzaleze and Woods, 4th Ed., Pearson.
2. Digital Video Processing – M. Tekalp, Prentice Hall International.
3. S.Jayaraman, S.Esakkirajan and T.VeeraKumar, "Digital Image processing, TataMcGraw Hill publishers, 2009

REFRENCE BOOKS:

1. Anil K.Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 9thEdition, Indian Reprint, 2002.
2. Multidimensional Signal, Image and Video Processing and Coding – John Woods, 2ndEd, Elsevier.
3. Digital Image Processing with MATLAB and Lab view – Vipula Singh, Elsevier.
4. Video Processing and Communication – Yao Wang, JoemOstermann and Ya–quin Zhang.1st Ed., PH Int.
5. https://nptel.ac.in/courses/117/105/117105135/

Course Outcomes:

After completion of the course, the student will able to

i. Perform the basic operations on images and can compute different image transforms.
ii. Perform image enhancement in spatial and frequency domain, be able to restore the given degraded image.
iii. Segment and compress the given image using different techniques.
iv. Perform different morphological operations on images and image colour inter conversions.
v. Differentiate analog and digital video, perform sampling and filtering of video signals using different models.

P3-4	Switching Theory and Logic Design

Course Objectives:

i. To solve a typical number base conversions and analyze new error coding techniques
ii. To optimize logic gates for digital circuits using various techniques
iii. To understand concepts of Adders and Sub tractors and analyze different types of decoders, encoders, code converters, multiplexers and comparators.
iv. To understand the basic concept flip flops and analyze basic counters and shift registers
v. To understand the basic concepts of PLDs

UNIT-I

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, I^2L, MOS, CMOS and BiCMOS logic families.

UNIT-II

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.

UNIT-III

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.

UNIT-IV

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.

UNIT-V

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.

TEXT BOOKS

1. Digital Design - Morris. M. Mano, Michael D. Ciletti - Fourth Edition - Prentice-Hall India, 2008.
2. Modern Digital Electronics – R.P.Jain - Fourth Edition – Tata McGraw Hill Education Private Limited, 2010.

REFERENCES

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.

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

P4-1	Electronic Devices and Circuits

Objectives:

The main objectives of this course are:

i. The basic concepts of semiconductor physics are to be reviewed.
ii. Study the physical phenomena such as conduction, transport mechanism and electrical characteristics of different diodes.
iii. The application of diodes as rectifiers with their operation and characteristics with and without filters are discussed.
iv. The principal of working and operation of Bipolar Junction Transistor and Field Effect Transistor and their characteristics are explained.
v. The need of transistor biasing and its significance is explained. The quiescent point or operating point is explained.
vi. Small signal equivalent circuit analysis of BJT and FET transistor amplifiers in different configuration is explained.

UNIT-I:Semi Conductor Physics:

Insulators, Semi conductors, and Metals classification using energy band diagrams, mobility and conductivity, electrons and holes in intrinsic semi conductors, extrinsic semi conductors, drift and diffusion, charge densities in semiconductors, Hall effect, continuity equation, law of junction, Fermi Dirac function, Fermi level in intrinsic and extrinsic Semiconductors

UNIT- II: 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, Diode resistance, Diode capacitance, energy band diagram of PN junction Diode.

Special Semiconductor Diodes: Zener Diode, Breakdown mechanisms, Zener diode applications, LED, Photo diode, Tunnel Diode, SCR, UJT. Construction, operation and characteristics of all the diodes are required to be considered.

UNIT- III:

Rectifiers:

Basic Rectifier setup**,** half wave rectifier, full wave rectifier, bridge rectifier, derivations of characteristics of rectifiers, rectifier circuits-operation, input and output waveforms.

Filters:

Introduction to Filters, Inductor filter, Capacitor filter, comparison of various filter circuits in terms of ripple factors.

UNIT- IV:

Transistor Characteristics:

BJT: Junction transistor, transistor current components, transistor equation, transistor configurations, transistor as an amplifier, characteristics of transistor in Common Base,

Common Emitter and Common Collector configurations, Ebers-Moll model of a transistor, punch through/ reach through, Photo transistor, typical transistor junction voltage values.

Small Signal Low Frequency Transistor Amplifier Models: Two port network, Transistor hybrid model, determination of h-parameters, conversion of h-parameters, generalized analysis of transistor amplifier model using h-parameters, Analysis of CB, CE and CC amplifiers using exact and approximate analysis, Comparison of transistor amplifiers.

UNIT- V:

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}, Ic, and β, Stability factors, (S, S', S''), Bias compensation, Thermal runaway, Thermal stability.

FET: FET types, construction, operation, characteristics, parameters, MOSFET-types, construction, operation, characteristics, comparison between JFET and MOSFET. Generalized analysis of small signal model, Analysis of CG, CS and CD amplifiers, comparison of FET amplifiers and FET Biasing- methods and stabilization.

Text Books:

1. Electronic Devices and Circuits- J. Millman, C. Halkias, Tata Mc-Graw Hill, Second Edition.
2. Integrated Electronics- Jacob Millman, C. Halkies, C.D.Parikh, Tata Mc-Graw Hill, 2009.

References:

1. Electronic Devices and Circuits-Salivahanan, Kumar, Vallavaraj, Tata Mc-Graw Hill, Second Edition
2. Electronic Devices and Circuits – Bell, Oxford

Outcomes:

At the end of this course the student can able to:

i. Understand the basic concepts of semiconductor physics.
ii. Understand the formation of p-n junction and how it can be used as a p-n junction as diode in different modes of operation.
iii. Know the construction, working principle of rectifiers with and without filters with relevant expressions and necessary comparisons.
iv. Understand the construction, principle of operation of transistors, BJT and their V-I characteristics in different configurations.
v. Know the need of transistor biasing, various biasing techniques for BJT and FET and stabilization concepts with necessary expressions.
vi. Perform the analysis of small signal low frequency transistor amplifier circuits using BJT and FET in different configurations.

P4-2	Electronic Circuit Analysis

Objectives:

The main objectives of this course are:

i. Small signal high frequency BJT transistor amplifier Hybrid-π equivalent circuit and the expressions for conductances and capacitances are derived.
ii. Cascading of single stage amplifiers is discussed. Expressions for overall voltage gain are derived.
iii. The concept of feedback is introduced. Effect of negative feedback on amplifier characteristics is explained and necessary equations are derived and Basic principle of oscillator circuits is explained and different oscillator circuits are given with their analysis.
iv. Power amplifiers Class A, Class B, Class C, Class AB and other types of amplifiers are analyzed.
v. Different types of tuned amplifier circuits are analyzed.

UNIT-I

Small Signal High Frequency Transistor Amplifier models:

BJT: Transistor at high frequencies, Hybrid- π common emitter transistor model, Hybrid π conductances, Hybrid π capacitances, validity of hybrid π model, determination of high-frequency parameters in terms of low-frequency parameters , CE short circuit current gain, current gain with resistive load, cut-off frequencies, frequency response and gain bandwidth product.

FET: Analysis of common Source and common drain Amplifier circuits at high frequencies.

UNIT-II

Multistage Amplifiers : Classification of amplifiers, methods of coupling**, c**ascaded transistor amplifier and its analysis, analysis of two stage RC coupled amplifier, high input resistance transistor amplifier circuits and their analysis-Darlington pair amplifier, Cascode amplifier, Boot-strap emitter follower, Analysis of multi stage amplifiers using FET, Differential amplifier using BJT.

UNIT-III:

Feedback Amplifiers : Feedback principle and concept, types of feedback, classification of amplifiers, feedback topologies, Characteristics of negative feedback amplifiers, Generalized analysis of feedback amplifiers, Performance comparison of feedback amplifiers, Method of analysis of feedback amplifiers.

Oscillators: Oscillator principle, condition for oscillations, types of oscillators, RC-phase shift and Wein bridge oscillators with BJT and FET and their analysis, Generalized analysis of LC Oscillators, Hartley and Colpitt's oscillators with BJT and FET and their analysis, Frequency and amplitude stability of oscillators.

UNIT-IV

Power Amplifiers: Classification of amplifiers, Class A power Amplifiers and their analysis, Harmonic Distortions, Class B Push-pull amplifiers and their analysis, Complementary symmetry push pull amplifier, Class AB power amplifier, Class-C power amplifier, Thermal stability and Heat sinks, Distortion in amplifiers.

UNIT-V

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.

Text Books:

1. Integrated Electronics- J. Millman and C.C. Halkias, Tata Mc Graw-Hill, 1972.
2. Electronic Devices and Circuits- Salivahanan, N.Suressh Kumar, A. Vallavaraj, TATA McGraw Hill, Second Edition

References:

1. Electronic Circuit Analysis and Design – Donald A. Neaman, Mc Graw Hill.
2. Electronic Devices and Circuits Theory – Robert L. Boylestad and Louis Nashelsky, Pearson/Prentice Hall, Tenth Edition.
3. Electronic Circuit Analysis-B.V.Rao,K.R.Rajeswari, P.C.R.Pantulu,K.B.R.Murthy, Pearson Publications.
4. Microelectronic Circuits-Sedra A.S. and K.C. Smith, Oxford University Press, Sixth Edition.

Outcomes:

At the end of this course the student can able to:

i. Design and analysis of small signal high frequency transistor amplifier using BJT and FET.
ii. Design and analysis of multi stage amplifiers using BJT and FET and Differential amplifier using BJT
iii. Derive the expressions for frequency of oscillation and condition for oscillation of RC and LC oscillators and their amplitude and frequency stability concept.
iv. Know the classification of the power amplifiers and their analysis with performance comparison.
v. Know the classification of the tuned amplifiers and their analysis with performance comparison.

P4-3	Linear IC Applications

OBJECTIVES

i. To understand the basic operation &performance parameters of differential amplifiers.
ii. To understand & learn the measuring techniques of performance parameters of OP-AMP
iii. To learn the linear and non-linear applications of operational amplifiers and the analysis & design of different types of active filters using opamps
iv. To learn the internal structure, operation and applications of different analog ICs
v. To Acquire skills required for designing and testing integrated circuits

UNIT I: 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.

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, 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.

UNIT III: 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. Non-Linear 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.

UNIT IV: 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).

UNIT V: 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).

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.

REFERENCES:

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

OUTCOMES

i. Design circuits using operational amplifiers for various applications.
ii. Analyze and design amplifiers and active filters using Op-amp.
iii. Diagnose and trouble-shoot linear electronic circuits.
iv. Understand the gain-bandwidth concept and frequency response of the amplifier configurations.
v. Understand thoroughly the operational amplifiers with linear integrated circuits.

P4-4	Linear Circuits & Analog IC design

Course Objectives:

i. Student will able to understand different wave shaping circuits
ii. Students will able to understand operation and characteristics of op-amp
iii. Able to design filters, oscillators and non linear applications using op-amp
iv. Able to understand the operations of different analog IC & their applications
v. Understand the concepts of CMOS basic circuits.

UNIT-I

LINEAR AND NONLINEAR WAVE SHAPING: High pass, low pass RC circuits, their response for sinusoidal, step, pulse, square and ramp inputs. RC network as differentiator and integrator, Diode clippers, Transistor as a switch, Transistor clippers, clipping at two independent levels, Transfer characteristics of clippers, Emitter coupled clipper,

UNIT-II

Operational Amplifier (Op-Amp) Characteristics: Differential Amplifier using BJT,Op-Amp block diagram,DC and AC characteristics of Op-Amp, ideal and practical Op-Amp specifications, IC741 Op-Amp & its features, Inverting and Non-inverting Op-Amps.

Linear Applications using Op-Amp:

DC and AC amplifiers, summing, scaling & averaging amplifiers, instrumentation amplifier, V to I, I to V converters, integrator, differentiator.

UNIT-III

Active Filters and Oscillators using Op-Amp:

Active filters, first and second order low-pass and high-pass Butterworth filters, band-pass and band-reject and all-pass filters, phase shift and wien bridge oscillators, square-wave, triangular-wave and sawtooth-wave generators, VCO.

Non-Linear Applications using Op-Amp:

Basic comparator, zero-crossing detector, Schmitt trigger, comparator characteristics, V to F and F to V converters, sample-and-hold circuit.

UNIT-IV

Specialized IC Applications:

VCO using IC 566, astable and mono stable multivibrators using IC 555 timer & IC 741 and their applications, PLL using IC 565 and its applications, D/ A and A/ D converters, weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, parallel comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC. DAC and ADC Specifications.

UNIT-V

Analog CMOS Basic Circuits: MOS switches, MOS active resistors, MOS diode, current sources and sinks, passive and active current mirrors- basic, Cascode and active current mirrors, current and voltage references, temperature independent reference.

TEXT BOOKS

1. Pulse, Digital and Switching Waveforms - J. Millman and H. Taub and MS Prakash Rao, McGraw-Hill, 2007.
2. Op-Amps and Linear Integrated Circuits - Ramakanth A. Gayakwad, PHI Private Limited, 2002.
3. Design of Analog CMOS Integrated Circuits - BehzadRazavi, TMH Edition, 2006.

REFERENCES

1. Linear Integrated Circuits - D. Roy Choudhury, ShailB.Jain, New Age International Publishers, 2nd Edition, 2006.
2. CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010

Course Outcomes: At the end of the course the student will be able to:

i. To realize the linear and non linear wave shaping circuits
ii. To able to understand operation & characteristics of op-amp
iii. To realize the design of active filters, oscillators and non linear applications using op-amp
iv. Realize the operations and applications of different analog IC
v. To know about the basic cmos circuits