LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING (AUTONOMOUS), MYLAVARAM

B.Tech. (Electronics and Communication Engineering) R20 Regulations (w.e.f. 2020-21)

I - SEMESTER

- **Course Code:** 20FE01
  Course Title: Professional Communication-I
  Contact hours/week: 2 (L) 0 (T) 0 (P)
  Credits: 2
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20FE03
  Course Title: Differential Equations
  Contact hours/week: 2 (L) 1 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20FE07
  Course Title: Applied Physics
  Contact hours/week: 2 (L) 1 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20EE01
  Course Title: Basic Electrical Engineering
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20EC01
  Course Title: Electronic Devices and Circuits
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100

Laboratory Courses:

- **Course Code:** 20FE51
  Course Title: Professional Communication Skills Lab
  Contact hours/week: 0 (L) 0 (T) 2 (P)
  Credits: 1
  Scheme of Valuation: CIE - 15, SEE - 35, Total - 50

- **Course Code:** 20FE54
  Course Title: Applied Physics Lab
  Contact hours/week: 0 (L) 0 (T) 3 (P)
  Credits: 1.5
  Scheme of Valuation: CIE - 15, SEE - 35, Total - 50
- **Course Code:** 20EE51
  Course Title: Basic Electrical Engineering Lab
  Contact hours/week: 0 (L) 0 (T) 3 (P)
  Credits: 1.5
  Scheme of Valuation: CIE - 15, SEE - 35, Total - 50
- **Course Code:** 20EC51
  Course Title: Electronic Devices and Circuits Lab
  Contact hours/week: 0 (L) 0 (T) 3 (P)
  Credits: 1.5
  Scheme of Valuation: CIE - 15, SEE - 35, Total - 50

Total Credits for I Semester: 19.5 (CIE: 210, SEE: 490, Total: 700)

II - SEMESTER

- **Course Code:** 20FE02
  Course Title: Professional Communication-II
  Contact hours/week: 2 (L) 0 (T) 0 (P)
  Credits: 2
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20FE04
  Course Title: Linear Algebra and Transformation Techniques
  Contact hours/week: 2 (L) 1 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20FE06
  Course Title: Engineering Chemistry
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20CS01
  Course Title: Programming for Problem Solving Using C
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100

- **Course Code:** 20EC02
  Course Title: Digital Logic Circuits
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20MC01
  Course Title: Constitution of India
  Contact hours/week: 2 (L) 0 (T) 0 (P)
  Credits: 0
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100

Laboratory Courses:

- **Course Code:** 20FE53
  Course Title: Engineering Chemistry Lab
  Contact hours/week: 0 (L) 0 (T) 3 (P)
  Credits: 1.5
  Scheme of Valuation: CIE - 15, SEE - 35, Total - 50
- **Course Code:** 20CS51
  Course Title: Programming for Problem Solving Using C Lab
  Contact hours/week: 0 (L) 0 (T) 3 (P)
  Credits: 1.5
  Scheme of Valuation: CIE - 15, SEE - 35, Total - 50
- **Course Code:** 20EC52
  Course Title: Digital Logic Circuits Lab
  Contact hours/week: 0 (L) 0 (T) 2 (P)
  Credits: 1
  Scheme of Valuation: CIE - 15, SEE - 35, Total - 50
- **Course Code:** 20ME51
  Course Title: Engineering Workshop
  Contact hours/week: 0 (L) 0 (T) 3 (P)
  Credits: 1.5
  Scheme of Valuation: CIE - 15, SEE - 35, Total - 50

Total Credits for II Semester: 19.5 (CIE: 240, SEE: 560, Total: 800)

III - SEMESTER

- **Course Code:** 20FE10
  Course Title: Numerical Methods and Integral Calculus
  Contact hours/week: 2 (L) 1 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100

- **Course Code:** 20CS03
  Course Title: Data Structures
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20EC03
  Course Title: Analog Circuit Design
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20EC04
  Course Title: Signals and Systems
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20EC05
  Course Title: Random Variables and Stochastic Processes
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100

Laboratory Courses:

- **Course Code:** 20CS53
  Course Title: Data Structures Lab
  Contact hours/week: 0 (L) 0 (T) 3 (P)
  Credits: 1.5
  Scheme of Valuation: CIE - 15, SEE - 35, Total - 50
- **Course Code:** 20EC53
  Course Title: Analog Circuit Design Lab
  Contact hours/week: 0 (L) 0 (T) 2 (P)
  Credits: 1
  Scheme of Valuation: CIE - 15, SEE - 35, Total - 50
- **Course Code:** 20EC54
  Course Title: Signals and Systems Lab
  Contact hours/week: 0 (L) 0 (T) 2 (P)
  Credits: 1
  Scheme of Valuation: CIE - 15, SEE - 35, Total - 50

Total Credits for III Semester: 19.5 (CIE: 240, SEE: 560, Total: 800)

IV - SEMESTER

- **Course Code:** 20FE09
  Course Title: Complex Variables and Partial Differential Equations
  Contact hours/week: 2 (L) 1 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20EC06
  Course Title: Communication Theory
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20EC07
  Course Title: Microprocessors and Microcontrollers
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20EC08
  Course Title: Control Systems
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20EC09
  Course Title: Electromagnetic Fields
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100

Laboratory Courses:

- **Course Code:** 20EC52
  Course Title: Communication Theory Lab
  Contact hours/week: 0 (L) 0 (T) 3 (P)
  Credits: 1.5
  Scheme of Valuation: CIE - 15, SEE - 35, Total - 50
- **Course Code:** 20EC53
  Course Title: Microprocessors Lab
  Contact hours/week: 0 (L) 0 (T) 3 (P)
  Credits: 1.5
  Scheme of Valuation: CIE - 15, SEE - 35, Total - 50
- **Course Code:** 20EC54
  Course Title: Control Systems Lab
  Contact hours/week: 0 (L) 0 (T) 3 (P)

Credits: 1.5
Scheme of Valuation: CIE - 15, SEE - 35, Total - 50

Total Credits for IV Semester: 19.5 (CIE: 240, SEE: 560, Total: 800)

V - SEMESTER

- **Course Code:** 20EC10
  Course Title: Digital Communication
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20EC11
  Course Title: VLSI Design
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20EC12
  Course Title: Computer Networks
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20EC13
  Course Title: Digital Signal Processing
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20EC14
  Course Title: Embedded Systems
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100

Laboratory Courses:

- **Course Code:** 20EC55
  Course Title: Digital Communication Lab
  Contact hours/week: 0 (L) 0 (T) 3 (P)
  Credits: 1.5
  Scheme of Valuation: CIE - 15, SEE - 35, Total - 50
- **Course Code:** 20EC56
  Course Title: VLSI Design Lab
  Contact hours/week: 0 (L) 0 (T) 3 (P)

Credits: 1.5
Scheme of Valuation: CIE - 15, SEE - 35, Total - 50

Total Credits for V Semester: 21 (CIE: 270, SEE: 630, Total: 900)

VI - SEMESTER

- **Course Code:** 20EC15
  Course Title: Microwave Engineering
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20EC16
  Course Title: Optical Communication
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20EC17
  Course Title: Wireless Communication
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20EC18
  Course Title: Software Engineering
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100

Laboratory Courses:

- **Course Code:** 20EC57
  Course Title: Microwave Engineering Lab
  Contact hours/week: 0 (L) 0 (T) 3 (P)
  Credits: 1.5
  Scheme of Valuation: CIE - 15, SEE - 35, Total - 50
- **Course Code:** 20EC58
  Course Title: Optical Communication Lab
  Contact hours/week: 0 (L) 0 (T) 3 (P)
  Credits: 1.5
  Scheme of Valuation: CIE - 15, SEE - 35, Total - 50

Total Credits for VI Semester: 21 (CIE: 210, SEE: 490, Total: 700)

VII - SEMESTER

- **Course Code:** 20EC19
  Course Title: Internet of Things (IoT)
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20EC20
  Course Title: Cyber Security
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20EC21
  Course Title: Project Management
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100
- **Course Code:** 20EC22
  Course Title: Seminar
  Contact hours/week: 0 (L) 0 (T) 3 (P)
  Credits: 2
  Scheme of Valuation: CIE - 100, SEE - 0, Total - 100

Total Credits for VII Semester: 14 (CIE: 120, SEE: 0, Total: 120)

VIII - SEMESTER

- **Course Code:** 20EC23
  Course Title: Major Project
  Contact hours/week: 0 (L) 0 (T) 0 (P)
  Credits: 8
  Scheme of Valuation: CIE - 100, SEE - 100, Total - 200
- **Course Code:** 20EC24
  Course Title: Professional Ethics and Human Values
  Contact hours/week: 3 (L) 0 (T) 0 (P)
  Credits: 3
  Scheme of Valuation: CIE - 30, SEE - 70, Total - 100

Total Credits for VIII Semester: 11 (CIE: 130, SEE: 100, Total: 230)

Cumulative Information

- **Total Credits for the Program:** 164

- **Total CIE Marks:** 1800
- **Total SEE Marks:** 3900
- **Total Marks:** 5700

Program Outcome Mapping (POs)

1. **PO1:** Engineering Knowledge
2. **PO2:** Problem Analysis
3. **PO3:** Design and Development of Solutions
4. **PO4:** Conduct Investigations of Complex Problems
5. **PO5:** Modern Tool Usage
6. **PO6:** The Engineer and Society
7. **PO7:** Environment and Sustainability
8. **PO8:** Ethics
9. **PO9:** Individual and Team Work
10. **PO10:** Communication
11. **PO11:** Project Management and Finance
12. **PO12:** Lifelong Learning

Course Outcomes (COs)

Each course will have specified course outcomes aligned with the program outcomes, ensuring that graduates possess the necessary skills and knowledge in their field.

B.Tech. (ISem.) **20FE01 - PROFESSIONAL COMMUNICATION – I**

L	T	P	Cr.
2	0	0	2

Pre-requisites: Nil

Course Educational Objectives: To improve English language proficiency of the students in various aspects like vocabulary, grammar, communication skills, listening skills, reading & writing skills.

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

CO1 : Write sentences and paragraphs using proper grammatical structures and word forms (**Remember – L1**)
CO2 : Comprehend the given text by employing suitable strategies for skimming and scanning and draw inferences (**Understand – L2**)
CO3 : Write summaries of reading texts using correct tense forms & appropriate structures (**Remember – L1**)
CO4 : Write Formal Letters, Memos & E-Mails (**Apply – L3**)
CO5 : Edit the sentences/short texts by identifying basic errors of grammar/vocabulary/syntax (**Understand – L2**)

Unit - I
Exploration - 'A Proposal to Girdle the Earth – Nellie Bly'; Reading: Skimming for main idea; Scanning for specific information; Grammar & Vocabulary: Content Words; Function Words; Word Forms: verbs, nouns, adjectives and adverbs; Nouns: Countable and Uncountable, Singular and Plural forms; Wh - Questions; Word Order in Sentences; Writing: Paragraph Analysis; Paragraph Writing; Punctuation and Capital Letters

Unit – II
On Campus- 'The District School as it Was by One Who Went to it – Warren Burton'; Reading: Identifying Sequence of Ideas; Grammar & Vocabulary: Cohesive Devices: Linkers/Signposts/Transition signals, Synonyms, Meanings of Words/Phrases in the context; Writing: Memo Drafting.

Unit – III
Working Together-'The Future of Work'
Reading: Making basic inferences; Strategies to use text clues for comprehension; Summarizing; Grammar & Vocabulary: Verbs: Tenses; Reporting Verbs for Academic Purpose; Writing**:** Rephrasing what is read; Avoiding redundancies and repetitions; Abstract Writing/ Summarizing.

Unit – IV
'A.P.J.Abdul Kalam'; Grammar & Vocabulary: Direct & Indirect Speech; Articles and their Omission; Writing: E-Mail Drafting.

Unit – V
'C.V.Raman'; Grammar & Vocabulary: Subject-Verb Agreement; Prepositions; Writing: Formal Letter Writing.

Text Books:

1. Prabhavati. Y & et al, "English All Round – Communication Skills for Undergraduate Learners", Orient BlackSwan, Hyderabad, 2019.
2. "Panorama – A Course on Reading", A collection of prose selections, Oxford University Press, New Delhi, 2016.

Reference Books:

1. Swan, M., "Practical English Usage", Oxford University Press, 2016.
2. Kumar,S and Latha, P, "Communication Skills", Oxford University Press, 2018.
3. Rizvi Ashraf M., "Effective Technical Communication", Tata Mc Graw Hill, New Delhi, 2008.
4. Baradwaj Kumkum, "Professional Communication", I.K. International Publishing House Pvt. Ltd., New Delhi, 2008.
5. Wood, F.T., "Remedial English Grammar", Macmillan, 2007.

B.Tech. (I Sem.) **20FE03 - DIFFERENTIAL EQUATIONS**

L	T	P	Cr.
2	1	0	3

Pre-requisites: Nil

Course Educational Objective: The objective of this course is to introduce the first order and higher order differential equations, functions of several variables. The students also learn solving of first order partial differential equations.

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

- **CO1**: Apply first order and first-degree differential equations to find orthogonal trajectories. **(Apply – L3)**
- **CO2**: Distinguish between the structure and methodology of solving higher order differential equations with constant coefficients. **(Understand – L2)**
- **CO3**: Apply various Numerical methods to solve initial value problem.**(Apply – L3)**
- **CO4**: Generate the infinite series for continuous functions and investigate the functional dependence.**(Understand – L2)**
- **CO5**: Solve partial differential equations using Lagrange's method.**(Apply – L3)**

UNIT –I

Differential Equations of First Order and First Degree

Differential equations of first order and first degree – Exact and Non Exact differential Equations, Applications of differential equations – Orthogonal Trajectories.

UNIT –II

Linear Differential Equations of Higher Order

Homogeneous and Non-Homogeneous Linear differential equations of second and higher order with constant coefficients with R.H.S. functions e^{ax}, sin $(ax+b)$, cos $(ax+b)$, x^m, $e^{ax}V(x)$, $xV(x)$, Method of variation of parameters.

UNIT – III

Numerical solution of Ordinary Differential Equations

Numerical solution of Ordinary Differential equations, Solution by Taylor's series - Picard's Method of successive approximations.

Euler's Method - Runge- Kutta Methods.

UNIT –IV

Functions of several variables

Generalized Mean Value Theorem (without proof), Maclaurin's series, Functions of several variables, Jacobians (Cartesian and polar coordinates), Functional dependence. Maxima and Minima of function with two variables.

UNIT – V

Partial Differential Equations

Formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions. Solution of first order and first degree linear partial differential equation – Lagrange's method.

Text Books:

1. B.S. Grewal, "*Higher Engineering Mathematics*", 42nd Edition, Khanna Publishers, New Delhi, 2012.
2. B. V. Ramana, "*Higher Engineering Mathematics*", 1st Edition, TMH Publications, New Delhi, 2010.

Reference Books:

1. M. D. Greenberg, "*Advanced Engineering Mathematics*", 2nd Edition, TMH Publications, New Delhi,2011.
2. Erwin Kreyszig, *"Advanced Engineering Mathematics"*, 8th Edition, John Wiley & sons, New Delhi,2011.
3. W.E. Boyce and R. C. Diprima, " *Elementary Differential Equations"* , 7th Edition, John Wiley & sons, New Delhi,2011.
4. S. S. Sastry, *"Introductory Methods of Numerical Analysis"* 5th Edition, PHI Learning Private Limited, New Delhi, 2012.

B.Tech. (I Sem.)	20FE07 - APPLIED PHYSICS	L	T	P	Cr.
		2	1	0	3

Pre-requisites: Nil

Course Educational Objectives: It enables the students to understand the fundamental concepts ofoptics, quantum mechanics, free electron theory of metals, semiconductors, dielectrics and their applications.

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

CO1: Define the nature of interference and diffraction.**(Remember – L1)**
CO2: Apply the lasers and optical fibres in different fields.**(Apply – L3)**
CO3: Estimate the electrical conductivity of metals.**(Understand – L2)**
CO4: Analyze the properties of semiconducting materials.**(Understand – L2)**
CO5: Classify the different types of magnetic and dielectric materials.**(Understand – L2)**

UNIT – I

Wave Optics

Interference**:** Principle of super position, Conditions for Interference, Interference in thin parallel film by reflection, Newton's rings (reflection), working principle of Interferometer.

Diffraction**:** Introduction, Fraunhofer diffraction at single slit- Diffraction due to circular aperture, Diffraction Grating- Resolving power of Grating.

UNIT – II

Lasers and optical fibers

Lasers**:** Introduction - Principle of laser (absorption, spontaneous and stimulated emission of radiation), Einstein Coefficients – Nd-YAG laser, Helium Neon laser- applications.

Optical Fibers: Optical Fiber principle, Structure of optical fiber, numerical aperture and acceptance angle, types of optical fibers - applications.

UNIT – III

Principles of Quantum Mechanics &Free electron theory

Principles of quantum mechanics:de Broglie Hypothesis, Davisson - Germer experiment, Schrodinger time independent and dependent wave equations, physical significance of the wave function – particle in a box.

Free electron theory

Classical free electron theory- Postulates, Advantages and Draw backs, Fermi-Dirac distribution function-Temperature dependence of Fermi- Dirac distribution function, Classification of Solids on the basis of Band theory.

UNIT – IV

Semiconductor physics

Conductivity of Intrinsic and Extrinsic semiconductors, Drift and Diffusion Current, Einstein relation, Hall Effect, Differences between direct and indirect Band Gap semiconductors, Solar Cell, Applications of Solar Cells.

UNIT – V

Magnetic & Dielectricmaterials

Magnetic parameters, Classification of magnetic materials-Diamagnetic, paramagnetic and ferromagnetic materials, Hysteresis loop, soft and hard magnetic materials, Applications of Ferro magnetic materials

Dielectrics: polarization - Electronic and ionic polarization, orientation polarization (Qualitative), Local field, ClaussiusMosotti equation, Applications of dielectric materials.

TEXT BOOKS

1. V. Rajendran, "*Engineering Physics*", TMH, New Delhi, 6th Edition, 2014.
2. M.N. Avadhanulu, P.G. Kshirsagar, "Engineering *Physics*", S. Chand & Co., 2ndEdition, 2014.

REFERENCE BOOKS

1. M.N. Avadhanulu, TVS Arun Murthy, "Applied *Physics*", S. Chand & Co., 2ndEdition, 2007.
2. P.K. PalaniSamy, "*Applied Physics*", Sci. Publ. Chennai, 4th Edition, 2016.
3. P. Sreenivasa Rao, K Muralidhar, "*Applied Physics*", Him. Publi. Mumbai, 1st Edition, 2016.
4. HitendraK Mallik , AK Singh " *Engineering Physics*", TMH, New Delhi, 1st Edition, 2009.

B.Tech. (I Sem.) **20EE01 - BASIC ELECTRICAL ENGINEERING**

L	T	P	Cr.
3	0	0	3

Prerequisite: Physics

COURSE OBJECTIVE: This course deals with nature of basic electrical components, analysis of steady state and transient response of linear electrical networks. It also deals with the principle of operation of AC and DC machines.

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

CO1: Illustrate the behavior of active and passive components, series and parallel circuits, self and mutual inductance of magnetic circuits, network functions and two port networks using circuit and mathematical approaches.**(Understand – L2)**

CO2: Interpret the working principles of AC and DC machines along with grounding and earthling using electrical engineering fundamentals and mathematical approaches.**(Understand – L2)**

CO3: Apply mesh analysis, nodal analysis and network theorems to solve the Thevinen's voltage, Norton's current and maximum power transfer of the linear circuits. **(Apply – L3)**

CO4: Analyze the concepts of bandwidth, quality factor of series and parallel resonant circuits using circuit and mathematical approaches.**(Analyze – L4)**

UNIT – I:Electrical Circuit Fundamentals

Basic definitions, Types of elements-active and passive, Ohm's Law, Kirchhoff's Laws-Network reduction techniques- series, parallel, star to delta, delta to star transformations, source transformations, mesh analysis, nodal analysis, duality and dual networks.

UNIT – II: MAGNETIC CIRCUITS & AC FUNDAMENTALS

Magnetic Circuits: Self and mutual inductance, dot convention, coefficient of coupling, analysis of series and parallel magnetic circuits, coupled circuits.

AC Fundamentals: Peak, R.M.S, average and instantaneous values, Form factor and Peak factor for periodic waveforms – Phase and Phase difference –Concepts of Reactance, Impedance, Susceptance and Admittance, Real , Reactive and apparent Powers, Power Factor.

UNIT – III: NETWORK THEOREMS & RESONANCE CIRCUITS

Network Theorems (DC Networks): Superposition, Thevenin's, Norton's, Maximum power transfer, reciprocity and Milliman's theorems.

Resonant circuits: Series and parallel resonant circuits, concept of band width, quality factor.

UNIT – IV: NETWORK FUNCTIONS & TWO PORT NETWORKS

Network Functions: Driving point and transfer functions, poles and zeros of network functions, Restrictions of pole and zero locations for driving point and transfer functions.

Two-Port Networks: Z, Y, ABCD & h-parameters, Inter-relationship between parameters, Two port network connections in series, parallel and cascaded.

UNIT – V:ELECTRICAL MACHINES

Electrical Machines: Types of Electrical Machines and their applications; Working principle of DC machines, single phase transformer, 3-phase induction motor; EMF equation.

Electrical Safety: Definition, precautions, concepts of grounding and earthing.

TEXT BOOKS

1. Ravish R Singh, *"Network Analysis and synthesis"*, Tata McGraw Hill Pvt Ltd, New Delhi.2013
2. B.L Theraja, A.K. Theraja, "Electrical Technology in S.I. UNITS. Volume *II*. AC & DC MACHINES" Published by S. Chand & Company Ltd 2016

REFERENCE BOOKS

1. M.S Naidu and S. Kamakshaiah, "Introduction to Electrical Engineering", TMH Publication, 3rd edition 2017.
2. A Sudhakar, Shyammohan S Palli, "Circuits and Networks, Analysis and Synthesis", McGraw Hill Education Pvt. Ltd,7th Edition, New Delhi 2017.

B.Tech. (I Sem.) **20EC01 - ELECTRONIC DEVICES AND CIRCUITS**

L	T	P	Cr.
3	0	0	3

Pre-requisites: Fundamentals of Physics.

Course Educational Objective: This course introduces the Device construction, characteristics and applications of semiconductor devices like PN junction diode, Bipolar Junction Transistor (BJT), Field Effect Transistor (FET), Metal oxide Semiconductor Field Effect Transistor (MOSFET) and various special devices.

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

CO1: Identify the types of Diodes, Transistors, FETs, Biasing techniques and their comparisons to select the best approaches for designing the electronic circuits using Devices and components.**(Apply – L3)**

CO2: Interpret the mathematical models of Currents and Voltages of Diodes, Bipolar Junction Transistors and Field Effect Transistors and biasing of BJT and FET using fundamental circuits.**(Understand – L2)**

CO3: Apply the knowledge of diodes, transistors and filters for designing the rectifiers, Filters, Regulators and Amplifier circuits using Devices and components.**(Apply – L3)**

CO4: Analyze the characteristics of Diodes, Bipolar Junction Transistors, Field Effect Transistors and their equivalent models using VI Characteristics and mathematical models.**(Analyze – L4)**

UNIT – I

PN Junction Diode: Qualitative theory of the p-n Junction; The Current components in a p-n Diode; The Volt- Ampere Characteristic; Diode Capacitance- Transition Capacitance and Diffusion Capacitance. Operation and characteristics of Zener Diode, Tunnel Diode, UJT and SCR.

UNIT – II

Diode Applications: Half wave Rectifier, Full wave Rectifiers, ripple removal using Capacitive. Inductive, and L section Filters. Voltage Regulator using Zener diode, Clippers, and Clampers.

UNIT – III

Bipolar Junction Transistor: BJT-construction and types, different regions of operations; Transistor Current components-Emitter Efficiency, Transport Factor, Large Signal Current Gain; Input and Output characteristics of Transistor configurations; Relation between α , β and γ; Ebers-Moll Model.

UNIT – IV

Field Effect Transistors: Construction and Operation, classification of FET, Comparison between FET and BJT; Drain and Transfer Characteristics of JFET and MOSFET and MOS Capacitor.

UNIT –V

BJT Biasing: Need for biasing; Operating Point, DC load line, AC load line and Stability factors S,S' and S''; Biasing circuits- Fixed bias, Collector to Base Bias and Self Bias; Thermal Runaway and Thermal Stability, Bias Compensation techniques.

FET Biasing: Voltage divider bias, Small signal equivalent of FET.

TEXT BOOKS

1. Jacob Millman, Christos C Halkias, Electronic Devices and Circuits, Third edition, Tata McGraw Hill, Publishers, New Delhi.2012

REFERENCE

1. Boylestad R.L. and Louis Nashelsky, Electronic Devices and Circuits, Fourth edition, Pearson/Prentice Hall Publishers,2014.
2. Ben Streetman and Sanjay Banerjee, Solid State Electronic Devices, Fourth edition, Prentice Hall Publishers,2014.
3. Thomas L. Floyd, Electronic Devices, Third edition, Pearson Education Publishers,2014.

B.Tech. (I Sem.)	20FE51 - PROFESSIONAL COMMUNICATION SKILLSLAB	L	T	P	Cr.
		0	0	2	1

Pre-requisites : Nil

Course Educational Objective: To improve the proficiency of students in English with an emphasis on better communication in formal and informal situations; Develop speaking skills required for expressing their knowledge and abilities and to face interviews with confidence.

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

CO1: Introduce oneself and others using appropriate language and details (**Understand – L2**)

CO2: Comprehend short talks and speak clearly on a specific topic using error free English(**Understand – L2**)

CO3: Report effectively after participating in informal discussions ethically (**Remember –L1**)

CO4: Interpret data aptly, ethically & make oral presentations (**Apply – L3**)

Syllabus: Professional Communication Skills Lab (PCS) shall have two parts:

- **Computer Assisted Language Learning (CALL) Lab** for 60 students with 60 systems, LAN facility and English language software for self- study by learners.
- **Interactive Communication Skills (ICS) Lab** with movable chairs and audio-visual aids with a P.A System, a T. V., a digital stereo – audio & video system and camcorder etc.

Exercise – I

CALL Lab: Understand - Sentence structure

ICS Lab: Practice - Listening: Identifying the topic, the context and specific information
Speaking: Introducing oneself and others

Exercise – II

CALL Lab: Understand - Framing questions

ICS Lab: Practice - Listening: Answering a series of questions about main idea and supporting ideas after listening to audio text
Speaking: Discussing in pairs/small groups on specific topics; Delivering short structured talks using suitable cohesive devices (JAM)

Exercise – III

CALL Lab: Understand - Comprehension practice – Strategies for Effective Communication

ICS Lab: Practice - Listening: Listening for global comprehension and summarizing
Speaking: Discussing specific topics in pairs/small groups, reporting what is discussed

Exercise – IV

CALL Lab: Understand- Features of Good Conversation – Strategies for Effective Communication.

ICS Lab: Practice -Listening: Making predictions while listening to conversations/transactional dialogues with/without video
Speaking: Role – plays – formal & informal – asking for and giving information / directions / instructions / suggestions

Exercise – V

CALL Lab: Understand - Features of Good Presentation, Methodology of Group Discussion
ICS Lab: Practice - Introduction to Group Discussions
Listening: Answering questions, identifying key terms and understanding concepts
Speaking: Formal Oral & Poster presentations on topics from academic contexts without the use of PPT

Lab Manual:

1. Prabhavati. Y & et al, "English All Round – Communication Skills for Undergraduate Learners", Orient BlackSwan, Hyderabad, 2019.

Suggested Software:

1. Digital Mentor: Globarena, Hyderabad, 2005
2. Sky Pronunciation Suite: Young India Films, Chennai, 2009
3. Mastering English in Vocabulary, Grammar, Spelling, Composition, Dorling Kindersley,USA,2001
4. Dorling Kindersley Series of Grammar, Punctuation, Composition, USA, 2001
5. Oxford Talking Dictionary, The Learning Company, USA, 2002
6. Learning to Speak English - 4 CDs. The Learning Company,USA,2002
7. Cambridge Advanced Learners English Dictionary (CD). Cambridge University Press, New Delhi,2008.

L	T	P	Cr.
0	0	3	1.5

B.Tech. (I Sem.) **20FE54 - APPLIED PHYSICS LAB**

Pre-requisites: Nil

Course Educational Objective: This course enables the students to acquire theoretical ideas, analytical techniques, and graphical analysis, by completing a host of experiments with the procedures and observational skills for appropriate use of simple and complex apparatus.

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

Co1: Analyze the wave characteristics of light.**(Understand – L2)**
Co2: Estimate the magnetic field using Stewart's and Gee's apparatus.**(Understand – L2)**
Co3: Verify the characteristics of semiconductor diodes.**(Apply – L3)**
Co4: Determine the acceptance angle and numerical aperture of optical fiber.**(Apply – L3)**
Co5: Improve report writing skills and individual teamwork with ethical values.**(Understand–L2)**

List of Experiments

(Any of the 10 experiments are required to be conducted)

General experiments**:**

1. Determine the energy band gap of a semiconductor Diode.
2. Study the characteristics of Zener Diode.
3. Study the magnetic field along the axis of a current carrying circular coil using Stewart's& Gee's apparatusand to verify Biot - Savart's law.
4. Study the characteristics of Solar cell
5. Determination of dielectric constant by charging and discharging method.
6. Study the characteristics of Photo diode.
7. Determination of resistivity of semiconductor by four probe method.

Optics lab experiments:

8. Determine the wavelength of a laser radiation.
9. Determine the width of a single slit by forming diffraction pattern.
10. Determine the Radius of Curvature of a Plano - Convex lens by forming Newton's Rings.
11. Determine the Wavelengths of various spectral lines by using diffraction grating.
12. Resolving power of grating.
13. Determine the acceptance angle and numerical aperture of a fiber.
14. Measure the bending losses in the optical fiber cable at different wavelengths.

B.Tech. (I Sem.)	20EE51 - BASIC ELECTRICAL ENGINEERING LAB	L	T	P	Cr.
		0	0	3	1.5

Pre-requisites: Nil

COURSE OBJECTIVE: This is a course to expose basic circuit concepts, circuit modeling and methods of circuit analysis in time domain and frequency domain for solving simple circuits including DC and AC circuit theory and network theorems.

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

CO1: Interpret the behavior of passive components of electrical circuits, inductance of magnetic circuits, two port networks and principle of DC machines using fundamental electrical laws and mathematical models.**(Understand – L2)**

CO2: Apply Kirchhoff's laws, Network theorems to verify the linear electrical circuits using fundamental electrical laws and mathematical equations.**(Apply – L3)**

CO3: Examine the active & reactive powers of single phase electrical circuits and resonant frequency, bandwidth & quality factor of electrical circuits.**(Apply – L3)**

CO4: Adapt effective Communication, presentation and report writing skills.**(Apply – L3)**

List of Experiments

(Any of the 10 experiments are required to be conducted)

1. Identify and test passive elements in linear electrical circuits.
2. Determination of closed Loop voltages and node currents using Kirchhoff's laws.
3. Determination of node voltages and branch currents using voltage division and current division rules.
4. Determination of Self inductance, Mutual inductance and Coefficient coupling factor of a Magnetic circuits.
5. Determination of Active and Reactive powers in a Single phase series R-L/R-C circuits.
6. Determination of Resonant frequency, Bandwidth and Quality factor of RLC circuits.
7. Analysis of linear circuit branch response using Superposition theorem.
8. Determination and verification of Voltage & Resistance using Thevenin's theorems, and current & resistance using Norton's theorem.
9. Determination and verification of power transfer using Maximum power transfer theorem.
10. Determination and verification of Z parameters and Y Parameters of two port network.
11. Measurement of efficiency of DC machines using Swinburne's test.
12. Measurement of Torque, Speed and Armature current of DC shunt motor from its characteristics.

B.Tech. (I Sem.)	20EC51 - ELECTRONIC DEVICES AND CIRCUITS LAB	L	T	P	Cr.
		0	0	3	1.5

Pre-requisites: Nil

Course Educational Objective: This course introduces the characteristics and applications of semiconductor devices; emphasis is placed on characteristics and testing practically to strengthen the knowledge.

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

CO1: Demonstrate the characteristics of Diodes, BJT, FET, Voltage regulators, Diode applications. **(Understand – L2)**

CO2: Analyze the device parameters of Diodes, Bipolar Junction Transistors, and Field Effect Transistors for its electrical parameters using VI characteristics. **(Analyze – L4)**

CO3: Apply the knowledge of diodes, Capacitors and transistors for the realization of rectifiers, regulators, Clippers and Clampers circuits. **(Apply – L3)**

CO4: Adapt effective Communication, presentation and report writing skills.**(Apply – L3)**

List of Experiments

(Any of the 10 experiments are required to be conducted)

1. Identification of components, Active and Passive Devices, Study and operation of Regulated Power Supplies, CRO and Function generators.
2. Determination of Cut-in Voltage, Forward and Reverse resistances of PN Junction diode using Characteristics.
3. Realization and performance evaluation of Half wave rectifier with and without Capacitor filter.
4. Realization and performance evaluation of Full wave rectifier with and without Capacitor filter.
5. Analysis of Transistor CB Configuration for its Input and Output resistances and Current gains using VI Characteristics.
6. Analysis of Transistor CE Configuration for its Input and Output resistances and Current gains using VI Characteristics.
7. Analysis of Drain and Transfer Characteristics of Field Effect Transistor for its Drain Resistance, Transconductance and Amplification factor.
8. Determination of Breakdown voltage of Zener diode and Design of Zener Voltage regulator.
9. Design and Realization of Series Voltage Clippers with and without bias voltage.
10. Design and Realization of Shunt Voltage Clippers with and without bias voltage.
11. Design and Realization of Voltage Clampers circuits using Diode and capacitors.
12. Realization of Voltage multiplier using Clampers.

B.Tech. (IISem.)	20FE02 - PROFESSIONAL COMMUNICATION – II	L	T	P	Cr.
		2	0	0	2

Pre-requisites: Nil

Course Educational Objective: To improve English language proficiency of the students in various aspects like vocabulary, grammar, communication skills, listening skills, reading & writing skills.

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

- **CO1:** Produce a coherent paragraph interpreting a figure/graph/chart/table (**Understand – L2**)
- **CO2:** Comprehend the given texts thoroughly by guessing the meanings of the words contextually (**Understand – L2**)
- **CO3:** Use language appropriately fordescribing /comparing/contrasting/givingdirections & suggestions (**Remember – L1**)
- **CO4:** Write formal/informal dialogues with an understanding of verbal/non-verbal features of communication. (**Understand – L2**)
- **CO5:** Write well structured essays; Reports &Résumé (**Apply – L3**)

UNIT - I

Fabric of Change- 'H.G. Wells and the Uncertainties of Progress – Peter J. Bowler'; Reading: Studying the use of Graphic elements in texts; Grammar & Vocabulary**:** Quantifying Expressions; Adjectives and adverbs; Comparing and Contrasting; Degrees of Comparison; Writing: Information Transfer

UNIT - II

Tools for Life - 'Leaves from the Mental Portfolio of a Eurasian – Sui Sin Far'; Reading: Global Comprehension; Detailed Comprehension; Grammar & Vocabulary**:** Active & Passive Voice; Idioms & Phrases; Writing: Structured Essays using suitable claims and evidences

UNIT - III

'Homi Jahangir Bhabha';

Grammar & Vocabulary: Words often confused; Common Errors; Writing**:** Incident & Investigation Reports

UNIT - IV

'Jagadish Chandra Bose'; Grammar & Vocabulary: Use of Antonyms; Correction of Sentences; Writing**:** Dialogue Writing

UNIT - V

'**Prafulla Chandra Ray'**; Grammar & Vocabulary: Analogy; Sentence Completion; Writing**:** Writing a Résumé

TEXT BOOKS:

1. Prabhavati. Y & et al, "English All Round – Communication Skills for Undergraduate Learners", Orient Black Swan, Hyderabad, 2019.
2 "The Great Indian Scientists" published by Cengage Learning India Pvt. Ltd., Delhi, 2017

REFERENCE BOOKS:

1. Swan, M., "Practical English Usage", Oxford University Press, 2016.
2. Kumar,S and Latha, P, "Communication Skills", Oxford University Press, 2018.
3. Rizvi Ashraf M., "Effective Technical Communication", Tata Mc Graw Hill, New Delhi, 2008.
4. Baradwaj Kumkum, "Professional Communication", I.K.International Publishing House Pvt.Ltd., New Delhi, 2008.
5. Wood,F.T., "Remedial English Grammar", Macmillan, 2007.

B.Tech. (II Sem.)	20FE04 - LINEAR ALGEBRA AND TRANSFORMATIONTECHNIQUES	L	T	P	Cr.
		2	1	0	3

Pre-requisites: Nil

Course Educational Objective: In this course, students learn Matrix Algebra and introduced with transformation techniques such as Laplace Transforms and Z – Transforms.

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

CO1: Investigate the consistency of the system of equations and solve them. **(Apply – L3)**

CO2: Determine the eigen vectors and inverse, powers of a matrix using Cayley-Hamilton theorem.**(Apply – L3)**

CO3: Use the concepts of Laplace Transforms to various forms of functions.**(Understand – L2)**

CO4: Solve ordinary differential equations by using Laplace Transforms.**(Apply – L3)**

CO5: Apply Z - Transforms to solve difference equations.**(Apply – L3)**

UNIT – I

System of Linear Equations

Matrices - Rank- Echelon form, Normal form, PAQ form– Solution of Linear Systems – Homogeneous system of equations and Non-Homogeneous system of equations.

UNIT – II

Eigen Values and Eigen Vectors

Eigen values – Eigen Vectors – Properties – Cayley-Hamilton Theorem – Inverse and Powers of a matrix by using Cayley-Hamilton Theorem.

UNIT – III

Laplace Transforms

Laplace transforms of standard functions –Linear Property - Shifting Theorems, Change of Scale Property

Multiplication and Division by‘t’ - Transforms of derivatives and integrals – Unit step function –Dirac’s delta function.

UNIT – IV

Inverse Laplace Transforms

Inverse Laplace transforms– Linear Property - Shifting Properties - Convolution theorem, Applications of Laplace transforms to ordinary differential equations.

UNIT – V

Z-Transforms

Z-transform – properties – Damping rule – Shifting rule – Initial and final value theorems - Inverse Z –transform - Convolution theorem – Solution of difference equation by Z-transforms.

Text Books:

1. B.S. Grewal, "*Higher Engineering Mathematics*", 42nd Edition, Khanna Publishers, New Delhi, 2012.
2. B. V. Ramana, "*Higher Engineering Mathematics*", 1st Edition, TMH Publications, New Delhi, 2010.

Reference Books:

1. M. D. Greenberg, "*Advanced Engineering Mathematics*", 2nd Edition, TMH Publications, New Delhi,2011.
2. Erwin Kreyszig, *"Advanced Engineering Mathematics"*, 8th Edition, John Wiley & sons, New Delhi,2011.
3. W.E. Boyce and R. C. Diprima, "Elementary *Differential Equations"*, 7th Edition, John Wiley & sons, New Delhi,2011

B.Tech. (IISem.) **20FE06 - ENGINEERING CHEMISTRY**

L	T	P	Cr.
3	0	0	3

Pre-requisites:Nil

Course Educational Objectives: It enables the students to understand the fundamental concepts of chemistry and to provide them with the knowledge of industrial problems and finding the solutions. It helps to strengthen thebasic concepts ofelectrochemistry, corrosion, nanotechnology, polymers, liquid crystals and analytical techniques.

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

- **CO1:** Apply Nernst Equation for calculating electrode cell potentials and compare batteries for different applications.**(Apply – L3)**
- **CO2:** Apply principles of corrosion for design and effective maintenance of various equipment.**(Apply – L3)**
- **CO3:** Analyse the suitability of advanced materials like nano materials in electronics and medicine.**(Understand – L2)**
- **CO4:** Identify the importance of liquid crystals, polymers in advanced technologies.**(Understand – L2)**
- **CO5:** Apply the principles of analytical techniques in chemical analysis.**(Apply – L3)**

UNIT – I

Electro Chemistry & Batteries

Types of Electrodes -Calomel Electrode, Glass Electrode,Calculation of EMF of Cell,Applications of Nernst Equation & Electro chemical Series, Batteries -Lead-acid Battery, Lithium ion Battery, H_2 – O_2 Fuel Cell, Mg - Cu reserve battery.

UNIT – II

Science of Corrosion

Dry Corrosion (Direct Chemical corrosion) - Types of dry corrosion-oxidative corrosion, Pilling Bed worth rule, corrosion by other gases and liquid metal corrosion; Wet Corrosion (Electro Chemical corrosion) - Mechanism- oxygen absorption, hydrogen evolution, types of wet corrosion, Galvanic Corrosion, Concentration Cell Corrosion, passivity and Galvanic series; Factors Influencing Corrosion - Nature of metal (Purity, position in galvanic series, relative area of cathode & anode, nature of surface film) and nature of environment (temperature, humidity, atmospheric pollution and nature of ions in the medium); Control of Corrosion: Cathodic Protection - Sacrificial anode and impressed current methods, electro plating and metal cladding.

UNIT – III

Chemistry of Engineering Materials

Nano Materials - Extraordinary changes observed at nano size of materials and reasons, types of nano-materials, Gas-Phase Synthesis of nanomaterials, Applications; Materials in Electronic devices: Very brief note on raw materials that make IC units of CPU, GPU, RAM, PCBs, hard disks and other electronic devices with special reference to polymers;

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, molecular elevator, automated light-powered molecular motor.

UNIT – IV

Liquid Crystals & Polymers

Liquid crystals -Identification and structural aspects of molecules to form liquid crystals; Classification of liquid crystals - Thermo tropic liquid crystals and types, lyotropic liquid crystals. Mechanism of working of liquid crystals and applications; Polymers - Differences between thermoplasts and thermosets, Types of polymerization with examples; Plastics - Preparation properties and engineering applications of P.M.M.A, Teflon, Polycarbonate; Rubbers - Structure of raw rubber and vulcanized rubber, Preparation properties and engineering applications of Polyurethane, Buna-S, conducting polymers; Bio-degradable polymers - PLA & PGA (Polylactic Acid and Polyglycolic Acid).

UNIT – V

Analytical Techniques

Types of analysis; Physical analysis: Analysis of physical characteristics; Chemical analysis: Gravimetric and volumetric analysis (basic concept only);Instrumental analysis: Electro analytical techniques – Introduction; Conductometric techniques: strong acid-strong base and strong acid-weak base, weak acid -strong base and weak acid -weak base & advantages; Potentiometric techniques: Acid-base and oxidation-reduction titrations-advantages; Colorimetric techniques: Principle and determination of iron by using thiocynate as a reagent.

TEXT BOOKS

1. Shikha Agarwal, "A Text book of Engineering Chemistry", Cambridge University Press, New Delhi, 1st Edition, 2015.
2. Jain, Jain, "A textbook of Engineering Chemistry", Dhanpat Rai Publishing Company, New Delhi, 16th Edition, 2015.

REFERENCEBOOKS

1. Shashi Chawla, "A Text book of Engineering Chemistry", Dhanpat Rai Publishing Company, New Delhi, 3rd Edition, 2003.
2. S.S. Dara, S.S. Umare, "A Text book of Engineering Chemistry", S. Chand Publications, New Delhi, 12th Edition, 2010.
3. PrasantaRath, B. Rama Devi, Ch. VenkataRamana Reddy, SubhenduChakroborty, "Engineering Chemistry", Cengage Learning India, 1st Edition, 2019.

20CS01 - PROGRAMMING FOR PROBLEM SOLVINGUSING C

B.Tech. (II Sem.)

L	T	P	Cr.
3	0	0	3

Pre-requisites: Nil

Course Educational Objective: The Objective of the course is to make learn the basic elements of C programming, control structures, derived data types, Modular programming, user defined structures, basics of files and its I/O operations.

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

CO1: Familiar with syntax and semantics of the basic programming language constructs.**(Understand - L2)**

CO2: Construct derived data types like arrays in solving a problem.**(Apply - L3)**

CO3: Decompose a problem into modules and reconstruct it using various ways of user-defined functions.**(Apply - L3)**

CO4: Define user-defined data types like structures and unions and its applications to solve problems.**(Apply - L3)**

CO5: Discuss various file I/O operations and its application.**(Understand - L2)**

UNIT – I

Introduction to Problem solving through C-Programming: Problem Specification, Algorithm / pseudo code, flowchart, examples.

C-Programming: Structure of C program, identifiers, basic data types and sizes, Constants, variables, Input-output statements, A sample c program, operators, expressions, type conversions, conditional expressions, precedence of operators and order of evaluation.

Control statements: if, if else, else if ladder and switch statements, while, do-while and for statements, break, continue, goto and labels.

UNIT – II

Arrays- concept, declaration, definition, accessing elements, storing elements, two dimensional and multi-dimensional arrays.

Character Arrays: declaration, initialization, reading, writing strings, string handling functions, Pre-processor Directives, and macros.

Applications of Arrays: Linear search, Binary search, Bubble Sort.

UNIT – III

Pointers- concepts, declaring and initialization of pointer variables, pointer expressions, pointer arithmetic, pointers and arrays, pointers and character arrays, pointers to pointers.

Functions: basics, category of functions, parameter passing techniques, recursive functions-comparison with Iteration, Functions with arrays, Standard library functions, dynamic memory management functions, command line arguments.

Storage classes - auto, register, static and extern,

UNIT – IV

Derived types- structures- declaration, definition, and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self-referential structures, unions, typedef.

UNIT – V

Files – concept of a file, text files and binary files, streams, standard I/O, Formatted I/O, file I/O operations, error handling.

TEXT BOOKS

1. ReemaThareja, Programming in C, Oxford University Press, 2nd Edition, 2015.

REFERENCE

1. Jeri R.Hanly, Elliot B.Koffman, Problem Solving and Program Design in C, Pearson Publishers, 7th Edition, 2013.
2. E Balagurusamy, Computer Programming, McGraw Hill Education, 8th Edition.
3. C: The Complete Reference, McGraw Hall Education, 4th Edition.
4. PradeepDey, Manas Ghosh, Programming in C, Oxford University Press, 2nd Edition, 2011.
5. Stephen G.Kochan, Programming in C, Pearson Education, 3rd Edition, 2005.

B.Tech. (II Sem.) **20EC02 - DIGITAL LOGIC CIRCUITS**

L	T	P	Cr.
3	0	0	3

Pre-requisites: Nil

Course Educational Objective: In this course student will learn about the basic concepts of number systems and Boolean algebra, logic gates and realization of Boolean expressions using logic gates, realization of combinational and sequential circuits and concepts of Finite State Machines and ASM Charts

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

CO1: Summarize the key differences between number systems and their usage in Digital electronics circuits.**(Understand – L2)**

CO2: Identify the minimization techniques of Boolean expressions to implement digital circuits using basic logic gates and logic circuits.**(Apply – L3)**

CO3: Apply the minimization and realization methods for design of Combinational and Sequential logic circuits.**(Apply – L3)**

CO4: Analyze the Combinational, Sequential, Finite state machines and Algorithmic State Machines for implementation of digital logic circuits.**(Analyze – L4)**

UNIT – I

Number Systems: Number systems (binary, Octal, Hexadecimal) 1's and 2's complement of binary numbers, Signed Binary numbers, Binary codes –BCD, Excess-3 code, Gray code, Error detecting and correcting codes – Hamming code.

UNIT – II

Boolean Algebra: Boolean postulates, De-Morgan's Theorem, Principle of Duality, Minimization of Boolean expressions – Sum of Products (SOP), Product of Sums (POS), minterm and maxterm, implementation of Boolean functions using Karnaugh map, minimization (up to 4 variables), K-map with don't care conditions, minimization of Boolean expressions using Quine-Mc Cluskey Tabular Method (5 variable).

Logic Gates: basic logic gates, realization of Boolean functions using logic gates, Multi-level gate implementations.

UNIT – III

Combinational Logic Circuits: Design procedure, Adders and Subtractors, Parallel adder/ Subtractor- Carry look ahead adder, BCD adder, Magnitude Comparator, Decoder, Encoder, Multiplexer, Demultiplexer, Parity generator/checker, code converters- binary to gray, gray to binary, BCD to Excess-3 codes.

UNIT – IV

Sequential Logic Circuits: Latches, Flip flops-SR, JK, T, D – Characteristic and excitation tables, Realization of one flip flop using other flip flops, Shift Registers, Universal Shift Register, Counters- Synchronous and Asynchronous counters. Implementation of 4-bit Counters.

UNIT – V

Finite state machines: Introduction to Mealy and Moore machines, Difference between Mealy and Moore machines, Conversion between Mealy and Moore machines.

Algorithmic State Machines: Features of ASM chart, System design using data path and control subsystems, control implementations.

TEXT BOOK

1. Morris Mano, "Digital Design", PHI Publishers, 4th Edition.
2. Ananda Kumar, "Switching Theory and Logic Design", PHI Publishers.

REFERENCES

1. ZviKohavi, Switching and Finite Automata Theory, TMH Publishers, 2nd Edition.
2. Charles H. Roth, "Fundamentals of Logic Design", Cengage learning Publishers.
3. M. Subramanyam, "Switching Theory and Logic Design", University Science Press Publishers.
4. John M. Yarbrough, "Digital Logic: Applications and Design", Thomson Publications.

B.Tech. (II Sem.) **20MC01 - CONSTITUTION OF INDIA**

L	T	P	Cr.
2	0	0	0

Pre-requisites: Nil

Course Educational Objectives

• To enable the student to understand the importance of constitution.

• To understand the structure of Executive, Legislature and Judiciary.

• To understand Philosophy of fundamental rights and duties.

• To understand the autonomous nature of constitution bodies like SupremeCourt and High Court Controller and Auditor General of India and ElectionCommission of India.

• To understand the Central and State relation, financial and administrative.

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

CO1: Understand history and philosophy of constitution with reference to Preamble,Fundamental Rights and Duties(**Understand – L2**).

CO2: Understand the concept of Unitary and Federal Government along with therole of President, Prime Minister and Judicial System(**Understand – L2**).

CO3: Understand the structure of the state government, Secretariat, Governor and Chief Ministerand their functions(**Understand – L2**).

CO4: learn local administration viz. Panchayat, Block, Municipality and Corporation (**Understand – L2**).

CO5: learn about Election Commission and the process and about SC, ST, OBCand women(**Understand – L2**).

UNIT – I:

Introduction to Indian Constitution: 'Constitution' meaning of the term, IndianConstitution – 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: FederalismCentre – State relationship, President: Role, Power and Position. Prime Minister(PM) and Council of Ministers, Cabinet and Central Secretariat, Lok Sabha, RajyaSabha. The Supreme Court and High Court: Powers and Functions.

UNIT – III:

State Government and its Administration Governor – Role and Position – ChiefMinister (CM) and Council of Ministers. State Secretariat: Organization, Structureand Functions.

UNIT – IV:

A Local Administration -- Role and Importance,Municipalities – Mayor and Role of Elected Representative,Panchayati Raj: Functions of PanchayatiRaj Institution, Zilla Panchayat, Elected Officials and their roles, Villagelevel – Role of Elected and Appointed officials.

UNIT – V:

Election Commission: Election Commission – Role of Chief Election Commissionerand Election Commissionerate State Election Commission: Functions andCommissions for the welfare of SC/ST/OBC and Women.

Reference Books

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall ofIndia Pvt.Ltd., New Delhi.
2. Subash Kashyap, Indian Constitution, National Book Trust.
3. J.A. Siwach, Dynamics of Indian Government and Politics.
4. D.C. Gupta, Indian Government and Politics.
5. H.M.Sreevai. Constitutional Law of India, 4th edition in 3 volumes (UniversalLaw 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), Challengesto Civil Right). Challenges to Civil Rights Guarantees in India, OxfordUniversity 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-indianconstitution.

* * *

B.Tech. (IISem.) **20FE53 - ENGINEERING CHEMISTRY LAB**

L	T	P	Cr.
0	0	3	1.5

Pre-requisites: Nil

Course Educational Objectives: This course enables the students to analyze water samples and perform different types of volumetric titrations. It provides them with an overview of preparation of polymers and analytical techniques.

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

CO1: Assess alkalinity of water based on the procedure given (Understand – L2).
CO2: Distinguish different types of titrations in volumetric analysis after performing the experiments listed in the syllabus (Understand – L2).
CO3: Acquire practical knowledge related to preparation of polymers. (Understand – L2).
CO4: Exhibit skills in performing experiments based on theoretical fundamentals. (Understand – L2).

List of Experiments
(Any of the 10 experiments are required to be conducted)

Model Experiment
1. Determination of Na2CO3 using standard HCl solution.

Water Analysis
2. Determination of alkalinity of water sample.

Complexometric Titrations
3. Estimation of Mg+2/Zn+2/Ca+2 in given solution by using standard EDTA solution.

Preparation of Polymers (only demonstration)
4. Nylon Fibers
5. Bakelite

Redox Titrations
6. Estimation of Mohr's salt by using potassium permanganate.
7. Estimation of Mohr's salt by using potassium dichromate.
8. Estimation of copper (II) ion using standard hypo solution.

Conductometric Measurements
9. Estimation of amount of HClconductometrically using standard NaOH solution.
10. Estimation of amount of HClconductometrically using NH4OH solution.

Potentiometric Measurements
11. Estimation of amount of HClpotentiometrically using NaOH solution.

Estimations
12. Measuring pH of the given sample solution using pH meter (demonstration only).
13. Estimation of Vitamin C in a given sample.

Colorimetric Analysis
14. Determination of Iron (III) by colorimetric method.

REFERENCES
1. LAB Manual

B.Tech. (II Sem.)	20CS51 - PROGRAMMING FOR PROBLEM SOLVING USING C LAB	L	T	P	Cr.
		0	0	3	1.5

Pre-requisite : NIL

Course Educational Objective: The objective of the course is to learn the basic elements of C Programming Structures like Data Types, Expressions, Control Statements, and Various I/O Functions and to solve simple mathematical problems using control structures. Design and implementation of various software components, which solve real world problems.

Course Outcomes (CO): *At the end of this course, the student will be able to:*

CO1: Apply control structures of C in solving computational problems.**(Apply– L3)**

CO2: Implement derived datatypes & use modular programming in problem solving. **(Apply– L3)**

CO3: Implement user defined datatypes and perform file operations.**(Apply– L3)**

CO 4: Improve individual / teamwork skills, communication & report writing skills with ethical values.**(Apply– L3)**

# of modules at most 10can be taught and all the modules should be in line with theory.

Module 1: Introduction to Raptor Tool.

Module 2: Problem solving using Raptor Tool

Module 3: Exercise Programs on Basics of C-Program.

Module 4: Exercise Programs on Control Structures.

Module 5: Exercise Programs on Loops & nesting of Loops.

Module 6: Exercise Programs on Arrays & Strings.

Module 7: Exercise Programs on Pointers.

Module 8: Exercise Programs on Functions.

Module 9: Exercise Programs on user defined data types.

Module 10: Exercise Programs on Files.

L	T	P	Cr.
0	0	2	1

B.Tech. (II Sem.) **20EC52 - DIGITAL LOGIC CIRCUITS LAB**

Pre-requisites : Nil

Course Educational Objective: This course gives the ability to design and verify digital logic circuits like; logic gates, combinational and sequential logic circuits using discrete components and Integrated Circuits.

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

CO1: Demonstrate the functionality of Logic gates, Flip-flops, Shift registers and Counters.**(Understand – L2)**

CO2: Apply the Boolean minimization methods to implement Combinational and Sequential logic circuits using logic gates.**(Apply – L3)**

CO3: Analyze the behavior of Combinational and Sequential logic circuits.**(Analyze – L4)**

CO4: Adapt effective Communication, presentation and report writing skills. **(Apply – L3)**

List of Experiments

(Any of the 10 experiments are required to be conducted)

1. Realization of logic gates using universal logic gates.
2. Realization of Adder and Subtractor circuits using basic / universal gates.
3. Implementation of Binary to Gray and Gray to Binary code converters.
4. Realization of Boolean expressions using Decoder.
5. Implementation of 8×1 Multiplexer and Demultiplexer.
6. Realization of Boolean Expressions using Multiplexers.
7. Verification of flip-flops.
8. Conversion of SR to D flip-flop and SR to T flip-flop.
9. Implementation of shift register.
10. Implementation of Universal shift register.
11. Implementation of Up/Down counter.
12. Implementation of Synchronous /Asynchronous counter.

B.Tech. (II Sem.) **20ME51 - ENGINEERING WORKSHOP**

L	T	P	Cr.
0	0	3	1.5

Pre-requisites : Nil

Course Educational Objective: The objective of this course is to get familiarized with various trades used in Engineering Workshop and learn the safety precautions to be followed in the workshops while working with the different tools.

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

CO1: Develop different prototypes in the carpentry section.**(Understand – L2)**
CO2: Fabricate various basic prototypes in fitting trade. **(Understand – L2)**
CO3: Demonstrate various operations related to plumbing, tin smithy and black smithy.**(Understand – L2)**
CO4: Perform various basic house wiring techniques.**(Apply– L3)**

List of Experiments

(Conduct at least 4 Trades with 2 exercises from each Trade and demonstrate about 2 Trades)

Trade –1: CARPENTRY SHOP

Introduction to various types of wood such as Teak, Sal, Oak, Beach, Neam, Wallnut Mango, Shisham, Deodar, Babul. Demonstration, function and use of carpentry hand-tools and their safety precautions. Introduction to various types of wooden joints, their relative advantages and uses.

Job I - Marking, sawing, plaining and chiselling operations.
Job II - Preparation of half lap-joint
Job III – Preparation of Mortise and Tenon Joint

Trade –2: FITTING SHOP

Introduction to fitting shop tools, common materials used in fitting shop, description, demonstration, care, use of tools and safety precautions.

Job I- Making a L-Fit from a rectangular piece of Mild Steel (MS).
Job II-Making a T-Fit from a rectangular piece of MS.
Job III-Making a V-Fit from a rectangular piece of MS
Job IV-Making a Half round fit from a rectangular piece of MS.

Trade -3: TIN- SMITHY SHOP

Introduction to tin-smithy, specification and use of hand tools, accessories and the safety precautions.

Job I - Preparation of a rectangular tray.
Job II- Preparation of an open scoop/ funnel.
Job III - Preparation of a Single Seam Joint and Double Seam Joint.
Job IV - Preparation of a Corner Seam Joint.

Trade –4: PLUMBING SHOP

Introduction to plumbing – demonstration, use of hand tools, accessories and safety precautions.

Job I – preparation of pipe layout.
Job II – Pipe threading.

Trade -5: BLACK SMITHY

Introduction–demonstration of tools, equipment and safety precautions.

Job I – Preparation of S–Hook.

Job II – Preparation of Chisel

Trade -6: HOUSE WIRING

Demonstration and identification of common electrical materials such as wires, cables, switches, fuses, PVC Conduits. Study of electrical safety measures and demonstration about use of protective devices such as fuses, and relays including earthling.

Job I – One lamp controlled by one one-way switch.

Job II – Two lamps in series and parallel connection with one-way switch.

Job III- Florescent lamp and calling bell circuit.

Job IV - One lamp connection with two 2- way switches (stair case connection).

Job V -- House wiring circuit.

REFERENCES

1. LBRCE Workshop Lab Manual.
2. S.K.HajraChoudary and A.K.Choudary, –Workshop Technology-I, MediaPromotersand Publishers Pvt.Ltd., Mumbai,2012.
3. B.S.Raghuvamsi, –Workshop Technology-I, Dhanpatrai and company, New Delhi, 2014.
4. P.Khannaiah,K.L.Narayana,–WorkshopManual,ScitechPublicationsIndiaPvt.Ltd, 2015.

20FE10 –Numerical Methods and Integral Calculus

B.Tech. (III-Sem.)

L	T	P	Cr.
2	1	0	3

Pre-requisites : None

Course Educational Objective: The main objective of this course is to enable the students learn
Numerical Techniques for solving the equations and apply interpolation techniques. They will also learn about the Fourier analysis of single valued functions, Multiple Integrals in different coordinate systems and Vector differentiation.

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

CO1: Estimate the best fit polynomial for the given tabulated data using Interpolation.(Understand – L2)
CO2: Apply numerical techniques in solving of equations and evaluation of integrals. (Apply – L3)
CO3: Discriminate among Cartesian, Polar and Spherical coordinates in multiple integrals and their respective applications to areas and volumes. (Apply – L3)
CO4: Generate the single valued functions in the form of Fourier series and obtain Fourier series representation of periodic function. (Apply – L3)
CO5: Evaluate the directional derivative, divergence and angular velocity of a vector function. (Apply – L3)

UNIT – I

Interpolation and Finite Differences
Interpolation: Introduction – Finite differences- Forward Differences- Backward Differences- Central differences – Symbolic relations and separation of symbols-Differences of a polynomial- Newton's formulae for interpolation – Lagrange's Interpolation formula.

UNIT – II

Numerical Solution of Equations and Numerical Integration
Solutions of Algebraic and Transcendental Equations – Regula Falsi method and Newton Raphson Method in one variable.

Numerical Integration
Trapezoidal rule – Simpson's 1/3 Rule –Simpson's 3/8 Rule.

UNIT – III

Multiple Integrals
Multiple integrals - double and triple integrals (Cartesian, polar, spherical coordinates) – Changing the order of Integration.

UNIT IV

Fourier series

Determination of Fourier coefficients – Fourier series – even and odd functions – Fourier series in an arbitrary interval– Half-range sine and cosine series

UNIT – V

Vector Differentiation

Vector Differentiation: Gradient- Directional Derivatives -Divergence – Solenoidal fields- Curl –Irrotational fields-potential surfaces - Laplacian and second order operators

Text Books:

1. B.S. Grewal, "*Higher Engineering Mathematics*", 42nd Edition, Khanna Publishers, New Delhi, 2012.
2. B. V. Ramana, "*Higher Engineering Mathematics*", 1st Edition, TMH Publications, New Delhi, 2010.
3. S. S. Sastry, *"Introductory Methods of Numerical Analysis"* 5th Edition, PHI Learning Private Limited, New Delhi, 2012.

Reference:

4. M. D. Greenberg, " *Advanced Engineering Mathematics*", 2nd Edition, TMH Publications, New Delhi,2011.

5. Erwin Krezig, *"Advanced Engineering Mathematics"* , 8th Edition, John Wiley & sons, New Delhi,2011.

6. W.E. Boyce and R. C. Diprima, " *Elementary Differential Equations"* , 7th Edition, John Wiley & sons, New Delhi,2011.

B.Tech. (III-Sem.) **20CS03 – DATA STRUCTURES**

L	T	P	Cr.
3	0	0	3

Pre-requisite : Programming Language

Course Educational Objectives:

The objective of the course is to make students familiar with writing algorithms to implement different data structures like stacks, queues, trees and graphs, and various sorting techniques.

Course Outcomes (COs): *At the end of this course, the student will be able to*

CO 1	Write the algorithms for various operations on list using arrays and linked list and analyze the time complexity of its operations.**(Understand-L2)**
CO 2	Apply linear data structures like stack and queue in problem solving. **(Apply -L3)**
CO 3	Demonstrate various searching and sorting techniques and compare their computational complexity in terms of space and time. **(Understand-L2)**
CO 4	Write the algorithms for various operations on binary trees,binary search trees and AVL trees. **(Understand-L2)**
CO 5	Demonstrate graph traversal techniques and hashing techniques. **(Understand-L2)**

UNIT - I

Algorithm Analysis:

Introduction to Algorithm, Algorithm Analysis , Asymptotic Notations.

Introduction to arrays and Abstract Data Type(ADT)

Lists: List using arrays and linked list- Singly Linked List, Doubly Linked List, Circular LinkedList.

UNIT – II

Stacks: Stack ADT,Implementation using arrays and linked list.

Applications of stacks : Infix to postfix expression conversion, Evaluation of Postfix expressions and balancing the symbols.

Queues:

Queue : Queue ADT,Implementation of Queue using arrays and linked list,circular queue, DEQUE

UNIT - III

Sorting: Bubble sort**,** Insertion Sort, Selection sort, Merge Sort, Quick Sort & Heap Sort

UNIT - IV

Trees: Introduction, Tree traversals, Binary Trees, Binary Search Trees, Balanced Binary search tree - AVL Trees and its operations.

UNIT - V

Graphs: Fundamentals, Representation of graphs, Graph Traversals: BFS, DFS.
Hashing: Hash Table, Hash Function, Collision resolution Techniques- separate Chaining, Open addressing, rehashing.

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education, 2nd edition[1,2,3 units].
2. ReemaThareja, Data Structures using c, Oxford Publications[3,4,5].

REFERENCES:

1. Langson, Augenstein&Tenenbaum, 'Data Structures using C and C++', 2nd Ed, PHI.
2. RobertL.Kruse, Leung and Tando, 'Data Structures and Program Design in C', 2ndedition, PHI.

B.Tech. (III-Sem.) **20EC03 – ANALOG CIRCUIT DESIGN**

L	T	P	Cr.
3	0	0	3

Pre-requisites: Fundamentals of Electronics.

Course Educational Objective: This course provides focus on h-parameter models, analysis, selection and proper biasing of transistors like BJT and FET, emphasis on working principles of BJT / FET amplifiers using appropriate equivalent models, gives importance to feedback in amplifiers to improve the amplifier characteristics, design of Oscillators, linear wave shaping Circuits and Multivibrators.

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

CO1: Understand the concept of amplifier, Oscillator and linear wave shaping circuits. **(Understand – L2)**

CO2: Apply the suitable models of the transistor for estimating gain, input resistance, and output resistance and feedback concepts at amplifier and oscillator circuits. **(Apply – L3)**

CO3: Analyze feedback concepts in amplifier, oscillator circuits, and Multivibrators. **(Analyze – L4)**

CO4: Apply knowledge of transistor for the design of amplifiers, oscillator circuits, linear wave shaping Circuits and Multivibrators**. (Apply – L3)**

COs	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	2	3	1	-	-	3	1	-	-	-	1	2	-	2	-
CO2	3	1	-	-	-	-	-	-	-	-	-	1	-	2	-
CO3	3	1	1	-	-	-	-	-	-	-	-	2	-	3	-
CO4	3	-	-	-	-	-	-	-	-	-	1	1	-	3	-

UNIT – I

Small Signal Amplifiers: Small signal modeling of transistor, h- parameter model of a Transistor; Analysis and Design of CE, CB and CC Amplifiers using exact & approximate models and analysis of CE Amplifier with emitter resistance.

FET Amplifiers: Analysis of CS and CD FET amplifiers.

UNIT – II

Multistage Amplifiers: Analysis and Design of Cascade Amplifier (RC Coupled Amplifier), Cascode Amplifier and Darlington Pair.

Frequency Response of Amplifiers: Frequency response of Single stage and Multi stage amplifiers; Effect of coupling capacitor and bypass capacitor on frequency response. The hybrid- π Common Emitter Transistor model; Hybrid- π Conductance in terms of low frequency h- parameters; The CE hybrid-π model - f_β , f_T and $f\alpha$; Current gain with resistive load.

UNIT – III

Feedback Amplifiers: Classification of Amplifiers; The feedback concept; General characteristics of Negative feedback Amplifiers; Qualitative analysis of feedback Amplifiers- Voltage Series feedback Amplifier, Voltage Shunt feedback Amplifier, Current Series feedback Amplifier, Current Shunt feedback Amplifier and their analysis; and effect of feedback on frequency response of an amplifier.

Oscillator: Qualitative analysis of BJT based RC, LC Oscillators and Crystal Oscillators.

Power Amplifiers: Introduction to Class A, Class B, Class C and Class S Power amplifiers.

UNIT – IV

Linear wave shaping Circuits: Low pass and High pass RC circuits and their response for sinusoidal, step, pulse, square and ramp inputs. RC circuit as differentiator, integrator and double differentiator.

UNIT – V

Multivibrators

Bistable Multivibrator- self-biased transistor binary, Principle of operation of Bistable Multivibrators. Triggering types, Schmitt trigger circuit-Principle of operation, calculation of UTP, LTP and applications, Principle of operation of Monostable Multivibrator, Design and Analysis of Astable Multivibrator.

TEXT BOOKS

1. Jacob Millman, Christos C Halkias, Electronic Devices and Circuits, Fourth reprint, Tata McGraw Hill, Publishers, New Delhi, 2011.
2. Anand Kumar A., Pulse and Digital Circuits, Third edition, PHI Publishers, 2005

REFERENCE

1. Donald A.Neamen, Electronic Circuit Analysis and Design, Second Edition, Tata McGraw Hill Publishers, 2014.
2. J.Millman and H.Taub, Pulse, Digital and Switching Waveforms, Second Edition McGraw-Hill Publishers, 2012.

B.Tech. (III-Sem.) **20EC04 – SIGNALS AND SYSTEMS**

L	T	P	Cr.
3	0	0	3

Pre-requisites : Vectors, Scalars, Approximation of a vector by another vector, Differentiation and Integration of signals

Course Educational Objectives:

This course introduces signals and the way to perform mathematical operations on them. Further, it also introduces representation of signals in both time and frequency domains using orthogonal functions and describes Fourier series, the Fourier Transform and Laplace Transforms along with their properties. The course characterizes system behavior by estimating system response. It also introduces the concepts of sampling.

COURSE OUTCOMES (COs): At the end of the course, students are able to

CO1: Summarize the basic concepts of signals, systems and sampling **(Understand – L2)**
CO2: Examine the operations on signals and approximate using orthogonal functions.**(Apply – L3)**
CO3: Apply the concept of impulse response to analyze the linear time invariant systems **(Apply – L3)**
CO4 Analyze continuous time periodic and aperiodic signals using Fourier series, Fourier transform and Laplace transforms **(Analyze – L4)**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	-	-	-	-	-	-		1
CO2	2	1	1	-	-	-	-	-	-	-	-		1		2
CO3	3	1	1	1	-	-	-	-	-	-	-	1			2
CO4	3	2	1	1	-	-	-	-	-	-	-	2	2		3

UNIT – I

Signal Analysis: Concept of Signal, Classification of Signals-Continuous Time Signals, Discrete Time and Digital Signals; Representation of Signals- Impulse, Unit Step, Unit Ramp, Signum, Decaying Exponential, Raising Exponential, Double Exponential, Triangular, Rectangular, Sinc and Sampling Signals; Operations on Signals– Time Shifting, Time Scaling, Time Reversal (Folding), Amplitude Scaling, Convolution; Graphical Method of Convolution, Properties of Signals- Even and Odd, Causal and Non Causal, Bounded and Unbounded, Periodic and Aperiodic, Energy and Power, Deterministic and Random Signals.

UNIT – II

Signal Approximation: Approximation of a Signal by another signal-Mean square error, Condition for orthogonal signals, Approximation of a Signal by a set of mutually orthogonal signals-Evaluation of Mean square error, Gibbs Phenomena, Orthogonality in complex signals-Approximation of a complex signal by another complex signal, Approximation of a complex signal by a set of mutually orthogonal complex signals.

Fourier Series: Concept of Fourier Series, Trigonometric Fourier Series, Exponential Fourier Series, Relations among coefficients of Trigonometric Fourier Series and Exponential Fourier

Series, Existence of Fourier Series, Representation of Periodic signal by Fourier series over the entire interval, Symmetry conditions of Fourier Series, Parseval's Theorem.

UNIT – III

Fourier Transform: Need for Transform, Deriving Fourier Transform from Fourier Series, Existence of Fourier Transform, Properties of Fourier Transform- Symmetry, Linearity, Scaling, Time Reversal, Time Shifting, Frequency Shifting, Time Differentiation, Time Integration, Frequency Differentiation, Frequency Integration, Time Convolution, Frequency Convolution and Parseval's Theorem, Fourier Transform of Periodic Signals.

Sampling Theorem: Representation of continuous time signals by its samples, Graphical and analytical proof of sampling theorem for Band Limited Signals, Nyquist rate and interval ,Types of sampling-Ideal sampling, flat top sampling, natural sampling, Reconstruction of signal from its samples, effect of under sampling- Aliasing, Difference between low pass sampling and band pass sampling.

UNIT – IV

Signal Transmission Through Linear Systems: Definition of System, Classification of Systems - Linear and Non Linear, Time Invariant and Variant, Causal and Non Causal, Stable and Unstable, Static and Dynamic, Invertible and Non-invertible; Signal and System Bandwidth, Response of Linear Systems-Transfer Function, Impulse Response, Response of Linear Systems with an arbitrary input, Distortion less Transmission through a system, Physically Realizable System and Poly-Wiener Criterion.

UNIT – V

Laplace Transform: Concept of Laplace Transform on Non-Causal, Causal and Anti-Causal Signals, Relation between Laplace Transform and Fourier Transform, Existence of Laplace Transform; Properties of Laplace Transform- Linearity, Time Scaling, Time shifting, Shifting in S domain, Conjugate, Differentiation in time domain, Integration in time domain, Differentiation in S-domain, Integration in S-domain, Convolution in time domain, Convolution in S-domain, Initial value and Final value theorem. Laplace Transform of various classes of Signals, Concept of Region of Convergence and Properties, Inverse Laplace Transform using Partial Fractions Method. Applications of Laplace Transform: Causality of a System, Stability of a System, Solving of Differential Equations and Analysis of RLC Circuits.

TEXT BOOKS

1. A V Oppenheim, A S Wilsky and IT Young, "*Signals and Systems*", PHI learning, 2nd Edition,2018.
2. B P Lathi,"*Signals, Systems and Communications*", BS Publications, 2003.

REFERENCES

1. Simon Haykin, Barry Van VeenBairy , "*Signals and Systems*", John Wiley, 1st edition,2005.
2. P. Ramesh Babu, R.Ananda Natarajan "*Signals and Systems*", Scitech Publications, 2nd edition,2006.

B.Tech. (III-Sem.)	20EC05 – Random variables and stochastic processes	L	T	P	Cr.
		3	0	0	3

Pre-requisites: Probability theory, Basics of differentiation and integration

Course Educational Objectives:

This course provides the knowledge on random variables and their statistical properties. It will also give an idea about differences between random variables and random processes. It also describes the information of temporal and spectral characteristics of random variables and processes. The course explains about the response of a system for given input.

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

CO1: Summarize the concepts of random variables, random processes and noise.**(Understand – L2)**

CO2: Use the mathematical concepts of random variables and random processes for determining statistical parameters and spectral characteristics of random processes. **(Apply – L3)**

CO3: Analyze the behavior of random variables and random processes using distribution and density functions.**(Analyze – L4)**

CO4: Apply the knowledge of random variables and processes for analyzing the system behavior **(Apply – L3)**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	1	1	-	-
CO2	3	2	1	1	-	-	-	-	-	-	-	2	2	-	-
CO3	3	2	1	1	-	-	-	-	-	-	-	2	1	-	-
CO4	3	3	1	1	-	-	-	-	-	-	-	2	-	-	3

UNIT – I

Random Variables: Concept of random variable, Condition for a function to be a random variable, Classification of a random variable, Cumulative distribution function and properties, Probability density function and properties, Different distributions-Binomial, Poisson, Uniform, Exponential, Rayleigh, Gaussian functions.

Operations on One Random Variable: Expectation, Moments, Moment about the origin, Central moments, Variance, Skew, Skewness, Characteristic function, Moment generating function (Proofs not expected).

UNIT – II

Multiple Random Variables: Introduction, Joint distribution function and properties, Marginal distribution function, Joint density function and properties, Marginal density function, statistical independence, Distribution and density of sum of random variables, Central Limit Theorem (Proof not expected).

Operations on Multiple Random Variables: Expected value of a function of random variables, Joint moment about the origin, Correlation, Joint central moments, Covariance, Correlation coefficient.

UNIT – III

Stochastic Processes-Temporal Characteristics: Concept of stochastic processes, Classification of stochastic processes, Distribution and density of stochastic processes, Statistical independence, Stationarity - First-Order stationery processes, Second-Order and wide-Sense stationery processes, N^{th} – Order and Strict-Sense stationery processes, Time Averages, Ergodicity - Mean-Ergodic processes, Correlation Ergodic Processes, Correlation Functions- Autocorrelation function and properties, Cross-Correlation function and properties, Covariance function- Auto covariance function, Cross covariance function.

UNIT – IV

Stochastic Processes-Spectral Characteristics: Power density spectrum of processes and properties, Wiener-Khintchine relation, Bandwidth of power density spectrum, Cross Power density spectrum and properties, Relation between cross Power density spectrum and cross-correlation function.

UNIT – V

Linear Systems with Random Inputs: Response of a Linear system**,** Mean value of system response, Mean squared value of system response, Autocorrelation function of response, Cross correlation function of input and output, Power spectral density of response, Cross power spectral density of input and output.

Noise: Classification of Noise, Modeling of Noise Sources-Resistive (Thermal) Noise, Arbitrary Noise Sources, Effective Noise Temperature, Available Power Gain, Noise Figure, White Noise, Introduction to additive white Gaussian Noise.

TEXT BOOKS

1. Peyton Z. Peebles, Jr, *"Probability, Random Variables and Random Signal Principles"*, Tata Mc Graw-Hill, 4^{th} edition,2010.
2. Y Mallikarjuna Reddy, "*Probability theory and Stochastic Processes*", Universities Press (India), Pvt Ltd,2010.

REFERENCES

1. George Kennedy, Davis, *"Electronic Communication Systems"*, Tata McGraw Hill Education, 4^{th} edition, 1999.
2. Hwei Hsu, "*Probability, Random Variables and Random Processes*", Schaum's Outline series, Tata McGraw-Hill Publishers, 3^{rd} Edition, 2014.

B.Tech. (III-Sem.)	20CS53 – DATA STRUCTURES LAB	L	T	P	Cr.
		0	0	3	1.5

Pre-requisite : Programming Language

Course Educational Objectives :

The objective of this course is to make students familiar with writing algorithms to implement different data structures like stacks, queues, trees and graphs, and various sorting techniques.

Course Outcomes (COs): *At the end of this course, the student will be able to*

CO 1	Implement Linear Data Structures using array and Linked list.
CO 2	Implement Various Sorting Techniques.
CO 3	Implement Non Linear Data Structure such as Trees &Graphs.

I)Exercise Programs on List ADT

a) Implementation of List using Arrays.

b) Implementation of List using Linked List.

II) Exercise Programs on Stacks & Queue ADT

a) Implementation of Stack Operations using Arrays.

b) Implementation of Stack Operations using Linked List.

c) Implementation of Queue Operations using Arrays.

d) Implementation of Queue Operations using Linked List.

III) Exercise Programs on Stack Applications

a) Conversion of Infix Expression to postfix Expression.

b) Conversion of Infix Expression to prefix Expression.

c) Evaluation of Postfix Expression

d) Implementation of Balancing Symbols.

IV) Exercise Programs on Types of Queues

a) Implementation of Circular Queues Linked List.

b) Implementation of Double Ended Queue using Arrays.

c) Implementation of Double Ended Queue using Linked List.

V) Exercise Programs on Sorting Techniques.

a) Implementation of Insertion Sort and

b) Implementation of Selection Sort.

c) Implementation of Merge Sort.

d) Implementation of Quick Sort.

e) Implementation of Bubble Sort.

f) Implementation of Heap Sort.

VI) Exercise Programs on Trees

a) Implementation of Binary Tree Traversals.

b) Implementation of Binary Search Tree Operations.

VII) Exercise Programs on Graph Traversal Techniques.

a) Breadth First Search (BFS) b) Depth First Search (DFS)

B.Tech. (III-Sem.) **20EC53 – ANALOG CIRCUIT DESIGN LAB**

L	T	P	Cr.
0	0	2	1

Pre-requisites: Fundamentals of Electronic Devices

Course Educational Objective: This course provides the practical exposure on designing of different single stage and multistage stage amplifiers, effect of capacitances on frequency response, analysis of power and feedback amplifiers.

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

CO1: Demonstrate the characteristics of Amplifiers, Oscillators, feedback amplifiers, and Multivibrators. **(Understand – L2)**

CO2: Apply the knowledge of devices for the design of Timer circuits, Oscillators and Multivibrators. **(Apply – L3)**

CO3: Analyze feedback amplifiers and waveform generators using Electronic devices and components. **(Analyze – L4)**

CO4: Adapt effective Communication, presentation and report writing skills. **(Apply – L3)**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	1	1	-	-	-	-	-	-	-	-	-	-	1	-
CO3	1	1	1	2	-	-	-	-	-	-	-	1	-	2	-
CO4	-	-	-	-	-	-	-	-	3	2	-	-	-	3	-

LIST OF EXPERIMENTS

(The following experiments are to be simulated using PSPICE/MULTISIM software and Verified by hardware modules)

(Any of the 10 experiments are required to be conducted)

1. Determination of Gain and Bandwidth of Common Emitter (CE) Amplifier from the frequency response.
2. Determination of Gain and Bandwidth of Common Source (CS) FET Amplifier from the frequency response.
3. Design of two stage RC Coupled amplifier.
4. Design of Transistorized Current series Feedback amplifier for Bandwidth improvement.
5. Analysis of Stabilization of Gain of Transistorized Voltage series Feedback amplifier.
6. Analysis of Stabilization of Gain of Transistorized Current shunt Feedback amplifier.
7. Design and Realization of Transistorized RC Phase shift Oscillator to generate a sinusoidal signal.
8. Design and Realization of Transistorized Colpitts Oscillator to generate a sinusoidal signal.
9. Design of Low pass RC circuits and verify its response for sinusoidal and square wave inputs.
10. Design of High pass RC circuits and verify its response for sinusoidal and square wave inputs.
11. Design and Realization of Transistorized Astable Multivibtartor for the generation of square waveform.
12. Design and Realization of Transistorized Monostable Multivibrator for the generation of voltage pulses.

B.Tech. (III-Sem.) **20EC54 – DIGITAL SYSTEM DESIGN LAB**

L	T	P	Cr.
1	0	2	2

Pre-Requisites: Digital Electronics

Course Objectives: This course provides practical exposure in Xilinx compiler and in-built simulator to describe the simulation of digital circuits using Verilog HDL and explain Verilog HDL programs to generate test bench simulations.

Course Outcomes (COs): At the end of the course, students are able to

- **CO 1** Demonstrate the functionality of logic gates using Verilog HDL simulator.**(Understand – L2)**
- **CO 2** Analyze the behaviour of combinational and sequential circuits using Verilog HDL simulator.**(Analyze – L4)**
- **CO 3** Understand the functionality of memories using Verilog HDL simulator.**(Understand – L2)**
- **CO 4** Adapt effective communication, presentation and report writing.**(Apply – L3)**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1	2	-	-	-	-	-	-	1	-	2	-
CO2	3	2	3	2	3	-	-	-	-	-	-	2	-	3	-
CO3	3	2	3	2	3	-	-	-	-	-	-	2	-	3	-
CO4	3	2	2	1	-	-	-	-	-	-	-	2	-	2	-

Unit-I:

Introduction to Verilog HDL, levels of design abstraction, System Tasks, Test benches, Language constructs and conventions.

Gate level Modeling: Logic gate primitives, Module structure, Tri state gates, array of Instances of Primitives

Unit-II:

Switch level modeling: Basic switch primitives, CMOS switch, Bi directional gates, Time delays with switch primitives, CMOS NOT, NAND, NOR gate using switch primitives.

Behavioral level modeling: Operations and assignments, functional bifurcation, multiple always blocks, blocking and non blocking assignments, case statement.

Data flow level modeling: Continuous assignments structures, Delays and continuous assignments, assignments to vectors, operators.

Note: Minimum 12 experiments to be conducted.

1. Implementation of Logic Gates – data flow model and behavioral model.
2. Combinational logic circuits – adders and subtractor.
3. Code converters- binary to gray and gray to binary.
4. 3 to 8 Decoder –74138.
5. 4 Bit Comparator –7485.
6. 8 x 1 Multiplexer – 74151 and 1X4 Demultiplexer – 74155.
7. 16 x 1 Multiplexer – 74150 and 1X16 Demultiplexer –74154.
8. Sequential circuits -Flip-Flops.
9. Decade counter –7490.
10. Synchronous & Asynchronous counters using D & T- Flip Flops.
11. Shift registers –7495.
12. Universal shift registers –74194/195.
13. RAM (16 x 4) – 74189 (Read and Write operations).
14. Creating a Hierarchical Design.

	Skill Oriented Course-1:	L	T	P	Cr.
B.Tech. (III-Sem.)	20ECS1-SIGNAL MODELING AND ANALYSIS	1	0	2	2

Pre-requisites: Matrices and trigonometric functions.

Course Educational Objectives:

In this course, student will learn about basic signal modeling and analysis concepts like generations of signals using trigonometric function, solving linear equations and analyzing time function in frequency using MATLAB software.

Course Outcomes (COs): At the end of this course, students will be able to:

CO1: Understand the programming concept of plotting trigonometric function, linear equations solutions in MATLAB. **(Understand – L2)**

CO2: Analyze the time frequency relations of signals. **(Analyze – L4)**

UNIT – I: MATLAB Basics
Introduction to MATLAB, MATLAB windows, On-line help, Input-output, File types, platform dependence, General command, Programming in MATLAB, Script Files and Function Files: Executing a function. Plotting Graphs.

UNIT – II: Linear Algebra and Signal Operations
Solving a linear system, Gaussian elimination, Cramer's rule, Finding Eigen values and eigenvectors, Vector operations, Element-by-element operations, Continuous time signals, operations on signals, convolution, frequency analysis.

TEXTBOOK:

1. Rudra Pratap., Getting started with MATLAB: A Quick Introduction for Scientists and Engineers, 10th Edition, Oxford University Press.
2. B.P. Lathi., Principles of Linear Systems and Signals, 2nd Edition, Oxford University Press.

REFERENCES:

1. Larry E. Knop .,Linear Algebra: A First Course with Applications.

HANDS – ON LABORATORY SESSIONS

1. Plot the graph for the given function

   $f(t)=sin\ (2\pi 10t + \pi/6\ )$

2. Generate function f(t) by performing product operation on two given functions h(t) and g(t).

   $h(t) = sin\ (2\pi 10t + \pi/6\ )$ and $g(t) = e^{-10t}$

3. Consider $h_k(t) = e^{-\beta t} sin\ (2\pi 10t + \pi / 6)$ where β=[0,1,….,10] and plot the family of curves over a time over $0 \leq t \leq 0.2$.
4. Solving linear equations using inverse method

   $5x - 3y + 2z = 10$

   $-3x + 8y + 4z = 20$

   $2x + 4y - 9z = 9$

5. Solving linear equations using Cramer's methods

   $x + y + z = 11$

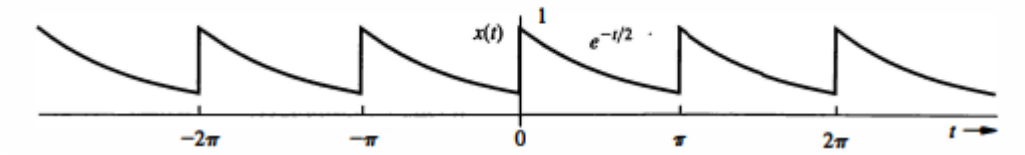
   $2x - 6y - z = 0$

   $3x + 4y + 2z = 0.$

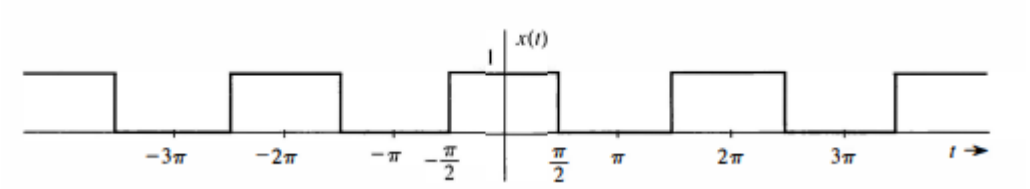
6. Compute Eigen values and Eigen vectors of given matrix.

   A= [5 -3 2; -3 8 4; 4 2 -9];

7. Basic operations on the signals.
8. Convolution of signals.
9. Transformation of signals from time to frequency domains.
10. Compute and plot the Fourier coefficients for the given periodic signal.



11. Demonstrate the synthesis of the square wave by successively adding the Fourier components of given signal.



B.Tech. (IV-Sem.)	20HS01 – Universal Human Values 2: UNDERSTANDING HARMONY	L	T	P	Cr.
		3	0	0	3

Pre-requisites: Nil

Course Educational Objective: To become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

COURSE OUTCOMES: At the end of the course, the student will be able to-

CO1: Apply the value inputs inlife and profession **(Apply – L3)**

CO2: Distinguish between values and skills, happiness and accumulation of physical facilities, the self, and the Body**(Understand – L2)**

CO3: Understand the role of a human being in ensuring harmony in society **(Understand – L2)**

CO4: Understand the role of a human being in ensuring harmony in the nature and existence. **(Understand – L2)**

CO3: Distinguish between ethical and unethical practices (**Apply – L3**)

UNIT-I:Need, Basic Guidelines, Content and Process for Value Education

'Natural Acceptance' and ExperientialValidation- as the process for self-exploration; Continuous Happiness and Prosperity- A look at basic Human Aspirations; Right understanding, Relationship and Physical Facility, Understanding Happiness and Prosperity

UNIT-II: Understanding Harmony in the Human Being - Harmony in Myself!

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

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 the harmony in the society: Resolution, Prosperity, fearlessness and co-existence as comprehensive Human Goals; Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family,Gratitude as a universal value in relationships.

UNIT-IV: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

Understanding the harmony in the Nature; Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and selfregulation 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, Strategy for transition from the present state to Universal Human Order

Text Book:

Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference Books:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

B.Tech. (IV-Sem.) **20EE09 – CONTROL SYSTEMS**

L	T	P	Cr.
2	1	0	3

Pre-requisites: Electrical circuit Analysis and Applied Physics

Course Educational Objective: The objective of this course is to introduce to the students the principles and applications of control systems in everyday life, the basic concepts of block diagram reduction, time domain analysis solutions to time invariant systems and also deals with the different aspects of stability analysis of systems in frequency domain and time domain.

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

CO1: Develop mathematical models of systems in terms of transfer function and state-space. **(Apply-L3)**

CO2: Analyze control systems in time domain **(Apply-L3)**

CO3: Analyze control systems in frequency domain **(Apply-L3)**

CO4: Understand the concepts of controllers and compensators. **(Understand-L2)**

UNIT-I: MATHEMATICAL MODELLING OF CONTROL SYSTEMS

Concepts of Control Systems- Open Loop and Closed Loop control systems. Mathematical modeling –Transfer function, Modeling of electrical systems, mechanical systems, Electrical analogy of mechanical systems. Block diagram representation of systems - Block diagram algebra. Signal flow graph – reduction using Mason's gain formula. Feedback Control System Characteristics- Sensitivity of Control Systems to Parameter Variations, Disturbance Signals in a Feedback Control System.

UNIT – II: TIME RESPONSE ANALYSIS-I

Standard test signals, Step response of first order and second order systems, Time response specifications, Time response specifications of second order systems, steady state errors and error constants. Introduction to PI, PD and PID Controllers (excluding design).

UNIT – III: TIME RESPONSE ANALYSIS-II

Concepts of stability, Necessary conditions for Stability, Routh stability criterion, Relative stability analysis- Introduction to Root Locus Technique, Construction of root loci.

UNIT – IV: FREQUENCY RESPONSE ANALYSIS

Frequency domain specifications, Frequency response of standard second order system. Bode Plot - determination of frequency domain specifications - phase margin and gain margin, determination of transfer function from the Bode Plot. Polar plot, Nyquist plot- Nyquist Stability criteria. Introduction to Lag, Lead, Lead-Lag Compensator (excluding design).

UNIT – V: STATE SPACE ANALYSIS

Concept of state variables – State models for linear and time invariant Systems – The Transfer Function from the State Equation, Solution of state equation– State transition matrix and it's properties Concepts of controllability and observability.

TEXT BOOKS:

1. B. C. Kuo , "Automatic Control Systems" John Wiley and Sons ,9th edition,2014.
2. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International (P) Limited Publishers,6th edition,2018.

REFERENCE BOOKS:

1. Katsuhiko Ogata , "Modern Control Engineering", Prentice Hall of India Pvt. Ltd., 5th edition,2009
2. Norman S. Nise, Control Systems Engineering, 8th Edition, John Wiley, New Delhi,
3. Richard C Dorf, Robert H Bishop, Modern control systems , 12thedition, Prentice Hall (Pearson education, Inc.), New Delhi 2010.
4. Benzamin C. Kuo and Farid Golnaraghi, Automatic Control Systems,10th Edition, John Wiley, New Delhi, 2017.
5. Rao V. Dukkipati,"Analysis and Design of Control Systems using MATLAB", NewAge Publishers, 2e, 2009.

B.Tech. (IV-Sem.) **20EC06 – DIGITAL SIGNAL PROCESSING**

L	T	P	Cr.
3	0	0	3

Pre-requisites : Signals & Systems

Course Objectives:

This course introduces discrete time signals and systems and operations performed on them. It introduces Discrete time Fourier Transform, Discrete Fourier transform and Z transform meant for spectral analysis of discrete time signals and systems. Fast Fourier Transform that is an efficient way of implementing DFT is also introduced. It also provides the basic knowledge about the design of both IIR and FIR filters.

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

CO1: Interpret the basics of discrete time signal processing techniques.**(Understand – L2)**

CO2: Examine Discrete Time Signals in time and frequency domain using DTFT, DFT, FFT and Z-transforms **(Apply – L3)**

CO3: Apply DFT, FFT and Z-Transform techniques to solve and realize discrete Systems **(Apply – L3)**

CO4: Construct the IIR Filters using Butterworth, Chebyshev Approximation techniques and FIR Filters using Fourier series method and windowing Techniques **(Apply – L3)**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	-	-	-	-	-	2	-	-	1
CO2	2	1	1	-	-	-	-	-	-	-	-	2	-	-	2
CO3	3	3	1	1	-	-	-	-	-	-	-	2	-	-	2
CO4	3	3	2	1	-	-	-	-	-	-	-	3	-	-	2

UNIT – I

Digital Signal Processing System (DSP) – Block diagram, Advantages, Limitations and Applications of DSP system.

Discrete Time Signals: Discrete time signals - Impulse, Unit Step, Unit Ramp, Rectangular, Exponential signals, Representation of discrete time signals, Operations on signals - Time shifting, Time scaling, Time reversal, Amplitude scaling, Properties of signals - Even/Odd signals, Causal/Non-Causal signals, Bounded/Unbounded signals, Periodic/Aperiodic signals, Energy/Power signals.

Discrete Time Systems: Properties of discrete time systems- Linear and Nonlinear, Shift Invariant and Variant, Causal and Non Causal, Stable and Unstable, Static and Dynamic, IIR and FIR systems. Analysis of LTI Systems through LCCDE – Natural Response, Forced Response, Response of Linear shift invariant systems-Linear convolution

Discrete Time Fourier Transform: DTFT of a sequence and system, Frequency response, Magnitude response and Phase response. Properties of DTFT- Linearity, Periodicity, Time shifting, Frequency shifting, Time reversal, Conjugate and Parseval's theorem.

UNIT – II

Z-Transform: Z-Transform of Causal, Anti-Causal and Non-Causal sequence. Region of Convergence and Properties, Properties of Z-Transform - Linearity, Time shifting, Time reversal, Multiplication by exponential sequence, Scaling in Z-domain, Conjugate, Differentiation in Z-domain, Time Convolution, Initial Value and Final Value Theorem, Inverse Z-Transform through Long Division, Partial Fractions and Residue Methods, Analysis of LTI system using z-transforms – system function, causality, stability , solution of difference equation, impulse response and step response.

Realization of Discrete Systems: Direct Form-I, Direct Form-II or Canonic Form, Cascade Form and Parallel Form for IIR and FIR systems.

UNIT – III

Discrete Fourier Transform: Frequency sampling - DFT, Computation of DFT, Computation of IDFT, Relation between DTFT and DFT, Properties of Twiddle factor, Properties of DFT- Linearity, Periodicity, Time shifting, Frequency shifting, Time reversal, differentiation in frequency domain, Conjugate, Parseval's theorem, Circular convolution, Additional DFT properties, Linear Convolution through Circular Convolution, Circular Convolution through DFT and IDFT, Linear Convolution through DFT and IDFT.

Fast Fourier Transform: Need for FFT, Radix-2 Decimation in Time FFT Algorithm, Radix-2 Decimation in Frequency FFT Algorithm, Comparison between DIT and DIF Algorithms, Inverse FFT.

UNIT – IV

IIR Filters: Design of IIR digital filters - Impulse Invariant Transformation, Bilinear Transformation. Specifications of Low Pass Filter, Analog Butterworth Filter, Design of Low Pass Digital Butterworth Filter, Analog Chebyshev Filter, Design of Low Pass Digital Chebyshev Filter, Analog Frequency Transformations.

UNIT – V

FIR Filters: Comparison between FIR and IIR Filters, Characteristics of FIR filters with linear Phase, Frequency Response Linear Phase FIR filters, Design of FIR filters - Fourier series method, Windowing Techniques-Rectangular Window, Hanning Window, Hamming Window, Kaiser Window.

TEXT BOOK(S)

1. John G. Proakis, Dimitris G. Manolakis*"Digital Signal Processing, Principles, Algorithms & Applications"*, Pearson education, 4th edition, 2008
2. Alan V Openheim, Ronald W. Schafer, *"Digital Signal Processing"*, PHI learning, 1st edition, 2010.

REFERENCE(S)

1. P.RameshBabu, *"Digital Signal Processing"*, Scitech Publications, 4th edition, 2012Pvt Ltd.
2. A.NagoorKani, *"Digital Signal Processing"*, RBA Publications,1st edition, 2005.

B.Tech. (IV-Sem.) **20EC07 – ANALOG COMMUNICATIONS**

L	T	P	Cr.
3	0	0	3

Pre-requisites : Signals & Systems

Course Educational Objectives: This course provides the knowledge on various analog modulation techniques in both time and frequency domains. The course will give an idea about generation and demodulation methods of various analog modulation techniques. It also gives the complete information regarding the transmitter and receiver types and performance evaluation of continuous wave modulation schemes.

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

CO1	Understand the fundamental concepts of various analog modulation schemes with relevant time and frequency domain representations.**(Understand – L2)**
CO2	Interpret the generation, detection of continuous wave and pulse analog modulation techniques. **(Understand – L2)**
CO3	Apply the concepts of analog modulation and demodulation techniques for calculating communication system related parameters.**(Apply – L3)**
CO4	Analyze the performance of continuous wave modulation schemes in the presence of channel noise.**(Analyze – L4)**

Course Articulation Matrix (Correlation between COs & POs, PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	-	-	-	-	-	2	1	-	-
CO2	2	2	1	-	-	-	-	-	-	-	-	2	2	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	2	3	-	-
CO4	2	3	1	1	-	-	-	-	-	-	-	3	3	-	-

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**
1- Slight (Low), **2 –** Moderate (Medium), **3 -** Substantial (High).

Pre-requisites: Signals and Systems

UNIT-I

Introduction to Communication System: Elements of Communication System, Need for Modulation, Classification of Modulation.

Amplitude Modulation: Time and Frequency Domain Representation of AM, Power relations in AM wave, Generation of AM waves: Square law Modulator, Switching Modulator, and Demodulation of AM wave**:** Square law demodulator, Envelope detector.

Double Side band Suppressed Carrier Modulation: Time and Frequency domain representation, Generation of DSBSC: Balanced modulator & Ring Modulator, Coherent Detection of DSBSC wave, Costas Loop.

UNIT-II

Single Side band Modulation: Time and Frequency domain representation, Generation of SSBSC: Filter Method& Phase-shift Method, Coherent detection of SSB wave.

Vestigial Side Band Modulation:

Introduction to Vestigial Side band Modulation, Generation of VSB modulated wave, Time domain description, Envelop Detection of a VSB plus carrier, Comparisons of AM Techniques, Applications of different AM Systems.

UNIT-III

Angle Modulation: Types of Angle Modulation, Frequency Modulation: Time domain representation, Single tone Frequency Modulation, Time and Frequency Domain representation of Narrow Band Frequency Modulation and wide band Frequency Modulation (Derivation not required), Transmission power and Band width of FM wave, Generation of FM waves: Indirect FM, Direct FM.

Demodulation of FM wave: Frequency Discrimination method: Simple slope detector, Balanced Slope detector, Phase Discrimination method: Foster Seeley Discrimination method, Ratio detector, Phase Locked Loop.

UNIT-IV

Radio Transmitters: Classification of Transmitters, AM Transmitter: Low level, high level AM Transmitters, FM transmitters: Reactance tube and Armstrong Method.

Radio Receivers:

Tuned Radio Frequency receiver and its Limitations, Need for heterodyning, AM Super Heterodyne Receiver, Frequency Changing and Tracking, Concept of Intermediate Frequency, Automatic Gain Control: Simple AGC, Delayed AGC, FM receiver.

UNIT-V

Noise in Analog Communication Systems: Noise in communication system, Signal to Noise ratio calculations in AM, DSBSC, SSBSC and FM receivers, Threshold Effect, Pre-Emphasis and De Emphasis circuits, Introduction to Carrier to Noise Ratio, Signal to Interference plus Noise Ratio.

Analog Pulse Modulation: Need for Pulse Modulation, Types of Pulse analog Modulation**,** Pulse Amplitude Modulation Generation and Demodulation, Pulse Width Modulation Generation and Demodulation, Pulse Position Modulation Generation and Demodulation.

Multiplexing: Frequency Division Multiplexing, Time Division Multiplexing.

TEXT BOOKS

1. Simon Haykin, *"Communication Systems"*, John Wiley & Sons, 2nd Edition, 1983.
2. George Kennedy ,Davis, *"Electronic Communication Systems"*, Tata McGraw Hill Education, 4th edition, 1999

REFERENCE BOOKS

1. G.K.Mithal, *"Radio Engineering", Khanna Publishers,20th Edition,2000*
   Sanjay Sharma, *"Analog Communication Systems",*S.K.Katariya& Sons,2nd Edition, 2007

B.Tech. (IV-Sem.)	20EC08 – ELECTROMAGNETIC WAVES AND TRANSMISSION LINES	L	T	P	Cr.
		3	0	0	3

Pre-requisites: Vector Algebra, Coordinate System, Vector Calculus

Course Objectives: This course is useful to impart knowledge on electric and magnetic fields in both static and dynamic domains. The course will introduce the application of Maxwell's equations. The course gives the complete information regarding the Electromagnetic wave propagation in different mediums. This course will help in the analysis of transmission line using circuit theory and use the Smith chart to find reflection coefficient, VSWR, impedance in easy way.

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

CO1 Define the basic laws that govern Electrostatic and Magnetostatic Fields. **(Understand – L2)**

CO2 Understand the basic concepts of Electro Magnetic fields in static and time varying conditions. **(Understand – L2)**

CO3 Apply the Electromagnetic concepts to different mediums (air, Dielectric media) **(Apply – L3)**

CO4 Analyze the characteristics of EM wave propagation in different unbounded and bounded mediums. **(Analyze – L4)**

COURSE ARTICULATION MATRIX(Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
CO2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
CO3	2	3	2	1	1	1	-	-	-	-	-	2	3	-	-
CO4	2	3	2	1	1	-		-	-	-	-	2	3	-	-

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**
1- Slight (Low), **2 –** Moderate (Medium), **3 -** Substantial (High).

UNIT-I

Electrostatics: Coulombs Law, Electric Field Intensity, Continuous Charge Distributions, Electric Flux Density, Gauss's Law, Applications of Gauss's Law, Electric Potential, Maxwell's Two Equations for Electrostatic Fields, Electric Dipole Moment, Electrostatic Energy Density, Poisson's and Laplace's Equations. Capacitance of different capacitors.

UNIT-II

Magnetostatics: Biot-Savart's Law, Ampere's Circuit Law, Applications of Ampere's Circuit Law, Magnetic Flux Density, Maxwell's two Equations for Magnetostatic Fields, Magnetic Scalar and Vector Potentials. Force due to Magnetic Field, Magnetic Energy Density and Concept of Inductance.

Maxwell's Equations: Faraday's Law, Continuity Equation, Inconsistency of Amperes Law, Differential and Integral Form of Four Maxwell's Equations, Boundary Conditions.

UNIT-III

Electromagnetic Waves – I: Concept of Electromagnetic Wave, Wave Propagation in Lossy Dielectrics, Wave Propagation in Lossless Dielectrics, Wave Propagation in Free Space, Wave Propagation in Good Conductors- Skin Depth, Concept of Polarization- Linear Polarization, Circular Polarization, Elliptical Polarization.

UNIT-IV

Electromagnetic Waves – II: Reflection of a Plane Wave at Normal Incidence (Dielectric-Dielectric & Dielectric-Conductor Interface), Reflection of a Plane Wave at Oblique Incidence (Parallel and Perpendicular Polarization) - Reflection Coefficient, Transmission Coefficient, Brewster Angle, Critical Angle; Surface Impedance, Poynting Theorem, Power Loss in a Plane Conductor.

UNIT-V

Transmission Lines: Types, Transmission line equations, Primary and Secondary Constants, Lossless, Distortion less, Low loss Transmission lines, Concept of Loading, Input Impedance relations, Reflection Coefficient, VSWR, Short Circuit and Open Circuit Lines, UHF Lines as Circuit elements, Matched Lines-$\lambda/4$, $\lambda/2$, $\lambda/8$ lines, Impedance Transformations, Infinite Line Concepts, Power in a Transmission line, Smith Chart, Quarter wave transformer, single stub matching and double stub matching, Microstrip lines-structure, effective dielectric constant, characteristic impedance.

TEXT BOOKS

1. Matthew N.O.Sadiku, "Elements of Engineering Electromagnetics", Oxford University Press, 4th Edition.
2. William Hayt, J A Buck, M JallelAkhtar "Engineering Electromagnetics", TMH Publishers, 8th Edition.

REFERENCE BOOKS

1. Jordan and Balmain, "Electromagnetic fields and Radiating systems", Pearson education.
2. K.Shevgaonkar, "Electromagnetic waves", TMH Publishers.

B.Tech. (IV-Sem.) **20MC02 – ENVIRONMENTAL SCIENCE**

L	T	P	Cr.
2	0	0	0

Prerequisite: Nil

Course Objectives:

In this course the student will learn about

- Environmental issues like over population, human health etc related to local, regional and global levels.
- The necessity of resources, their exploitation and sustainable management.
- The interactions of human and ecosystems and their role in the food web in the natural world.
- The global biodiversity, threats to biodiversity and its conservation.
- Environmental problems like pollution, disasters and possible solutions.
- The importance of environmental decision making in organizations through audits.

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

CO1: Identify environmental problems arising due to engineering and technological activities that help to be the part of sustainable solutions. **(Remember– L1)**

CO2: Evaluate local, regional, and global environmental issues related to resources and their sustainable management **(Understand - L2)**

CO3: Realize the importance of ecosystem and biodiversity for maintaining ecological balance. **(Understand - L2)**

CO4: Acknowledge and prevent the problems related to pollution of air, water, and soil. **(Apply– L3)**

CO5: Identify the significance of implementing environmental laws and abatement devices for environmental management. **(Understand - L2)**

UNIT – I :Nature and scope of Environmental Problems

- Introduction to Environment Science.
- Population explosion, variations among nations
- Resettlement and Rehabilitation - Issues and possible solutions
- Environmental hazards – causes and solutions. Biological hazards – AIDS, Malaria, Chemical hazards- BPA, PCB, Phthalates, Mercury, Nuclear hazards- Risk and evaluation of hazards.
- Role of Information Technology in environmental management and human health

UNIT – II :Natural Resources and Conservation

Introduction and classification of Natural Resources

- Forest resources: Use and over-exploitation, deforestation, Timber extraction, mining, dams and their effects on forests and tribal people
- Water resources: Use and over-utilization of surface and ground water, conflicts over water, interlinking of rivers, dams-benefits and problems, Rainwater harvesting
- 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 modern agriculture, fertilizer-pesticide problems, water logging, soil salinity
- Energy resources: Growing energy needs renewable, non-renewable and alternate energy resources

UNIT – III :Ecology and Biodiversity

- Structure and functions of an Ecosystem, Food chains and Food webs, Ecological succession, Ecological pyramids, Biogeochemical cycles
- Biodiversity, Values of biodiversity, Bio geographical classification of India. Endangered and endemic species of India, Threats to biodiversity; Man and wild life conflicts, Conservation of biodiversity: In-situ and Ex-situ conservation methods

UNIT – IV : Environmental Pollution

Introduction to Environmental Pollution Causes, effects and control measures of:
Air pollution, Water pollution, Noise pollution, Solid Waste Management – Sources, Classification, effects and control measures of Municipal solid waste, Biomedical waste & Hazardous and e-waste, Disaster Management.

UNIT – V : Environmental Management

- Sustainable development and unsustainability
- Climate disruption, Greenhouse effect, Ozone layer depletion and Acid rain.
- Stockholm and Rio Summit
- Environmental Impact Assessment (EIA)
- Green building
- Environmental Law- Air, Water, Wildlife, Forest, and Environmental protection act

TEXTBOOKS:

1. Anubha Kaushik, C.P.Kaushik, "*Perspectives in Environmental Studies*", 5nd edition, New age international publishers, Delhi, 2016.
2. G. Tyler Miller, Scott Spoolman, *"Introduction to Environmental Studies"*, 13th Edition, Cengage Learning, New Delhi, 2009.

REFERENCE BOOKS:

1. M. Anji Reddy, "Textbook of Environmental Sciences and Technology", 2nd Edition, BS Publications, Delhi 2011.
2. Deeshita Dave, P. Udaya Bhaskar, "Environmental Studies", 2nd Edition, Cengage Learning, New Delhi, 2012.
3. S.Deswal, A. Deswal, "A Basic course in Environmental Studies", 2nd Edition, Educational & Technical Publishers, Delhi, 2014.

4. R. Rajagopalan, "Environmental Studies (From Crisis to Cure)", 3rd Edition, Oxford University Press, New Delhi, 2012.
5. De, A.K, "Environmental Chemistry", 5th Edition, New Age International (P) Limited, New Delhi, 2003.
6. Dr.K.V.S.G. Murali Krishna, "Environmental Studies", 1st Edition, VGS Techno Series, Vijayawada, 2010.
7. Mahua Basu, S.Xavier, "Fundamentals of Environmental Studies", 1st edition, Cambridge University Press, Delhi, 2016.

B.Tech. (IV-Sem.)	20AD53 – PROGRAMMING USING PYTHON LAB	L	T	P	Cr.
		1	0	2	2

Pre-requisite : Programming languages like C Language.

Course Educational Objective:

The Objective of Python course is to lead the students from the basics of writing and running Python scripts in problem solving and also to design and implement the modules and understands the working of classes and objects in python.

Course Outcomes (COs):*At the end of the course, the student shall be able to*

CO 1: Identify various programming constructs available in Python and apply them in solving computational problems. (**Apply - L3)**

CO 2: Demonstrate data structures available in Python and apply them in solving computational problems. (**Apply - L3**)

CO 3: Implement modular programming, string manipulations and Python Libraries (**Apply - L3**)

CO 4: Improve individual / teamwork skills, communication & report writing skills with ethical values.

Introduction: Language basics and example problems (Two weeks)

Implement Python Script for checking the given year is leap year or not.

Implement Python Script for finding biggest number among 3 numbers.

Implement Python Script for displaying reversal of a number.

Implement Python Script to check given number is Armstrong or not.

Implement Python Script to print sum of N natural numbers.

Implement Python Script to check given number is palindrome or not.

Implement Python script to print factorial of a number.

Implement Python Script to print all prime numbers within the given range.

Implement Python Script to calculate the series: S=1+x+x2+x3+.....xn

Implement Python Script to print the following pattern:

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

Module 1: Exercise Programs on Lists.

Write a Python script to display elements of list in reverse order.

Write a Python script to find the minimum and maximum elements without using built-in operations in the lists.

Write a Python script to remove duplicates from a list.

Write a Python script to append a list to the second list.

Write a Python script to count the number of strings in a list where the string length is 2 or more.

Module 2: Exercise Programs on Tuples.

Write a Python script to create a tuple with different data types.

Write a Python script to find the repeated items of a tuple.

Write a Python script to replace last value of tuples in a list.

Sample list: [(10, 20, 40), (40, 50, 60), (70, 80, 90)]

Expected Output: [(10, 20, 100), (40, 50, 100), (70, 80, 100)]

Write a Python script to sort a tuple by its float element.

Sample data: [('item1', '12.20'), ('item2', '15.10'), ('item3', '24.5')]

Expected Output: [('item3', '24.5'), ('item2', '15.10'), ('item1', '12.20')]

Module 3: Exercise Programs on Sets.

Write a Python script to add member(s) in a set.

Write a Python script to perform Union, Intersection, difference and symmetric difference of given two sets.

Write a Python script to test whether every element in S is in T and every element in T is in S.

Module 4: Exercise Programs on Dictionaries

Write a Python script to sort (ascending and descending) a dictionary by value.

Write a Python script to check whether a given key already exists or not in a dictionary.

Write a Python script to concatenate following dictionaries to create a new one.

Sample Dictionary : dic1={1:10, 2:20} dic2={3:30, 4:40} dic3={5:50,6:60}

Expected Result : {1: 10, 2: 20, 3: 30, 4: 40, 5: 50, 6: 60}

Write a Python script to print a dictionary where the keys are numbers between 1 and 15 (both included) and the values are square of keys.

Write a Python program to map two lists into a dictionary.

Module 5: Exercise Programs on functions and recursion.

a) Define a function max_of_three() that takes three numbers as arguments and returns the largest of them.

b) Write a program which makes use of function to display all such numbers which are divisible by 7 but are not a multiple of 5, between given range X and Y.

c) Define functions to find mean, median, mode for the given numbers in a list.

d) Define a function which generates Fibonacci series up to n numbers.

e) Implement a python script for factorial of number by using recursion.

f) Implement a python script to find GCD of given two numbers using recursion.

Module 6: Exercise programs on Strings

a) Implement Python Script to perform various operations on string using string libraries.

b) Implement Python Script to check given string is palindrome or not.

c) Implement python script to accept line of text and find the number of characters, number of vowels and number of blank spaces in it.

d)Implement python script that takes a list of words and returns the length of the longest one.

Module 7: Exercise programs on Regular Expressions

a) Write a Python script to check that a string contains only a certain set of characters (in this case a-z, A-Z and 0-9).

b) Write a Python script to check whether password is valid or not.

Conditions for a valid password are:

Should have at least one number.

Should have at least one uppercase and one lowercase character.

Should have at least one special symbol.

Should be between 6 to 20 characters long.

Module 8 : Exercise programs on Matplotlib Library

a) Write a Python program to draw a line with suitable label in the x axis, y axis and a title.

b) Write a Python program to plot two or more lines with legends, different widths and colors.

c) Write a Python program to create multiple plots.

d) Write a Python programming to display a bar chart using different color for each bar.

e) Write a Python programming to create a pie chart with a title.

f)Write a Python program to draw a scatter plot with empty circles taking a random distribution in X and Y and plotted against each other.

****

B.Tech. (IV-Sem.)	20EC55 – DIGITAL SIGNAL PROCESSING LAB	L	T	P	Cr.
		0	0	3	1.5

Pre-Requisites: C – Programming, Basic Definitions of signals and systems.

Course Objectives: This course provides generation of basic signals and operations on signals. This course also provides design of IIR filters using Butterworth and Chebyshev approximation techniques and FIR filters using windowing techniques. This course also gives the knowledge about DSP Processors.

Course Outcomes (COs): At the end of the course, students are able to

CO1: Understand the generation and operations of signals using MATLAB. **(Understand – L2)**

CO2: Analyze the signals in time and frequency domains using MATLAB and Code Composer Studio. **(Analyze – L4)**

CO3: Design IIR and FIR Filters and obtain their frequency response using MATLAB. **(Apply – L3)**

CO4: Adapt effective communication, presentation skills and report writing. **(Apply – L3)**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	-	-	1	-	-	-	-	-	-	-	-	-	1
CO2	2	3	-	-	1	-	-	-	-	-	-	2	-	-	2
CO3	2	2	3	1	2	-	-	-	-	-	-	2	-	-	2
CO4	-	-	-	2	-	-	-	1	2	3	-	1	-	-	-

List of Experiments

Part I: Experiments using MATLAB Software

1. Generation of discrete time (DT) signals and operations on DT signals.
2. Linear Convolution.
3. Circular Convolution.
4. Computation of N-Point DFT and IDFT.
5. Linear and Circular convolution using DFT and IDFT.
6. Power Spectral Density for sinusoidal signal.
7. Design of Digital IIR butter worth filter using Bi-linear Transformation.
8. Design of Digital IIR Chebyshev filter using Bi-linear Transformation.

9. Design of FIR filters using window techniques.

Part II: Experiments using Code Composer Studio Simulation Soft ware and DSP Processors.

1. Linear Convolution.
2. Circular Convolution.
3. Computation of DFT.

B.Tech. (IV-Sem.) **20EC56 – ANALOG COMMUNICATIONS LAB**

L	T	P	Cr.
0	0	2	1

Pre-requisites: signals and systems.

Course Educational Objective: This course provides the practical exposure on analog communication schemes and gives the practical knowledge about pulse modulation techniques used in communication systems. It also gives the knowledge on implementation of continuous wave and pulse modulation schemes using MATLAB.

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

CO1 Demonstrate the practical aspects of continuous wave modulation schemes.**(Understand – L2)**

CO2 Construct the circuits for studying pulse modulation techniques. **(Apply – L3)**

CO3 Apply the programming aspects of MATLAB in simulation of continuous wave and pulse modulation techniques**(Apply – L3)**

CO4 Adapt effective communication, presentation and report writing skills.**(Apply – L3)**

Course Articulation Matrix (Correlation between COs & POs, PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	-	1	-	-	-	-	-	-	-	2	-	-
CO2	2	3	1	-	1	-	-	-	-	-	-	2	2	-	-
CO3	3	2	2	-	2	-	-	-	-	-	-	2	3	-	-
CO4	-	-	-	-	-	-	-	1	2	3	-	1	-	-	-

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**

1- Slight (Low), **2 –** Moderate (Medium), **3 -** Substantial (High).

Pre-requisites: signals and systems.

LIST OF EXPERIMENTS:

Part-A

1. Generate the Amplitude modulated (AM) signal for different modulation indices and reconstruct the original signal.
2. Demonstrate the generation of Frequency modulated signal and reconstruction of original signal.
3. Use product modulator to generate double sideband suppressed carrier AM signal and demodulate the signal using Synchronous detector.
4. Apply phase shift method for generating the Single sideband modulated AM signal and demodulate using coherent detector.
5. Estimate the cutoff frequencies for Pre emphasis and De-emphasis circuits.
6. Generate the Pulse Amplitude Modulated signal and reconstruct the original signal using low pass filter
7. Construct circuits for generating the Pulse width and Pulse position modulated signals using IC555 and perform demodulation to reconstruct the message signal
8. Generation of sampled signal for different sampling rates and verify sampling theorem for efficient reconstruction.

Part-B (Simulation Using MATLAB)

9. Amplitude Modulation and Demodulation.
10. Frequency Modulation and Demodulation.
11. Pulse Amplitude Modulation techniques.
12. Simulation of Pulse Time Modulation techniques.

	Skill Oriented Course-2:	L	T	P	Cr.
B.Tech. (IV-Sem.)	20ECS2- MODELING, DESIGN AND PROTOTYPING	1	0	2	2

Pre-requisites: C-Programming, Pulse and Digital Circuits.

Course Educational Objectives:

In this course, student will learn about how to build an engineering application with LabVIEW software and associated hardware.

Course Outcomes (COs): At the end of this course, students will be able to

CO1: Understand the programming concept of virtual instruments. **(Understand – L2)**

CO2: Develop real time applications using loops, formula nodes, array, clusters and DAQ. **(Apply – L3)**

UNIT – I: LabVIEW Basics:
Virtual instrumentation-front panel, block diagram, data flow programming, Graphical programming, VI& Sub VIs, loops, shift register, feedback node, formula node, case and sequence structures, arrays, clusters.

UNIT – II: LabVIEW Advanced and DAQ
Waveform Graphs, waveform charts, files I/O, local and global variables, Data Acquisition in LabVIEW, DAQ Installation and Configuration, DAQ Assistant, DAQ Hardware.

TEXTBOOK:

1. S. Sumathi, P.Surekha, Virtual Instrumentation with LabVIEW, ACME Learning Pvt. Ltd.,2007.
2. Jeffrey Travis, Jimkring, LabVIEW for Everyone, Pearson Education, 2009.

REFERENCES:

1. Jovitha Jerome, Virtual Instrumentation using LabVIEW, PHI Learning Pvt. Ltd., 2006.
2. Rick Bitter, Taqi Mohiuddin, Matt Nawrocki – LabVIEW Advanced Programming Techniques, CRC Press, 2009.

HANDS – ON LABORATORY SESSIONS

1. VI and Data operations
2. For and While Loops
3. Buttons, Timers and Graphs
4. Flat Sequence & Case Structure Applications
5. Arrays and Clusters
6. Sub VIs and Formula nodes
7. File operations
8. DAQ Installation and Configuration
9. DAQ- Digital applications
10. DAQ- Analog applications

B.Tech. (V Sem.) **20EC09 – DIGITAL COMMUNICATIONS**

L	T	P	Cr.
3	0	0	3

Pre-Requisites: Analog Communications

Course Educational Objective: This course provides the knowledge on different digital modulation techniques. The course provides different concepts on information theory, block codes and convolution codes. It gives the methods of optimum receivers for digital communication systems and performance of probability of error for digital modulation techniques.

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

CO1	**Understand** the concepts of digital communication system **(Understand – L2)**
CO2	**Analyze** the Baseband and Passband digital modulation techniques **(Analyze – L4)**
CO3	**Examine** the optimum reception and probability of error of digital modulation **(Apply – L3)**
CO4	**Apply** source coding and error control coding techniques in digital communication process **(Apply – L3)**

UNIT – I **[9 Hrs]**

Pulse Digital Modulation: Elements of a Digital Communication System, Sampling and Quantization of signals- Quantization noise, Pulse Digital Modulation Systems: Pulse Code Modulation(PCM) System, Encoding, Regenerative repeaters, Decoding, Reconstruction, effect of noise in PCM-Calculation of output SNR in PCM; Need for non-uniform quantization- Companding- μ-law, A-law; Differential Pulse Code Modulation; Delta Modulation; Adaptive Delta Modulation.

UNIT – II **[8 Hrs]**

Optimal Reception of Digital Signal: Model of digital communication system, Gram-Schmidt orthogonalization procedure, Geometric interpretation of signals, Response of bank of correlators to noisy input, Detection of known signals in noise: Maximum likelihood detector, probability of error, Correlation Receiver, Matched Filter Receiver, Probability of error for matched filter.

UNIT – III **[8 Hrs]**

Digital Modulation Techniques: Wave form representation of different digital modulation techniques; Amplitude Shift Keying, Coherent Phase Shift Keying(PSK)- Binary Phase Shift Keying, Quadrature Phase Shift Keying, Differential PSK, Coherent Frequency Shift Keying, Probability of error for BASK, BPSK, BFSK.

UNIT – IV **[8 Hrs]**

Information Theory and Source Coding: Discrete message and information content, Concept of amount of Information- Average Information, Entropy, Information Rate, Mutual Information and its properties; Source Coding to increase Average Information per bit-Source coding theorem, Shannon-Fano Coding, Huffman Coding; Channel Capacity of Gaussian Channel-Band width-S/N trade off.

UNIT – V **[9 Hrs]**

Linear Block Codes and Convolution Codes: Matrix description of Linear Block codes, Syndrome Decoding, Error detection and error correction capabilities of Linear block codes; Binary Cyclic Codes- Algebraic structure, Systematic and Non Systematic form, Encoding, Syndrome calculation; Convolution Codes- Encoding of Convolution Codes- Graphical

approach- State diagram, Code tree and Trellis diagram; Decoding of Convolution Codes- Viterbi decoding algorithm.

TEXT BOOK

1. Simon Haykin, *"Digital Communications",* John Wiley & sons, 2nd Edition.
2. Taub and Schilling, *"Principles of Communication Systems"*, TMH Publications, 3rd edition.

REFERENCE BOOKS

1. J. S. Chitode, *"Digital Communications",* Technical Publications, first edition.
2. V.ChandraSekar, *"Communication Systems",* Oxford University Press.

B.Tech. (V Sem.) **20EC10 – ANTENNAS AND WAVE PROPAGATION**

L	T	P	Cr.
3	0	0	3

Pre-requisites: EM Waves and Transmission Lines.

Course Educational Objective: This course provides the knowledge on Antennas and Radiation fundamentals. The course will expose different types of Antennas and their applications. The course also gives the complete information regarding Propagation of Radio wave in atmosphere.

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

CO1	**Understand** basic antenna parameters**,** radiation mechanism, characteristics of radio wave propagations **(Understand – L2)**
CO2	**Analyze** wire antenna, ground, space, and sky wave propagation mechanism for communication purpose and various Antenna Arrays **(Analyze – L4)**
CO3	**Design** HF, VHF and UHF Antennas **(Apply – L3)**
CO4	**Apply** antenna measurement methods to assess antenna's performance **(Apply – L3)**

UNIT-I **[9 Hrs]**

Antenna Fundamentals: Radiation Mechanism-single wire antenna, Current Distribution on a thin wire antenna, Isotropic Radiators, Directional Antennas, Antenna Parameters**:** Radiation intensity, Radiation Pattern, Total Power radiated, gain, Directivity, Radiation efficiency, Power gain, HPBW, FNBW, effective aperture, effective length, Band Width.

Radiation Fundamentals:

Potential functions-heuristic approach, Maxwell's equation approach, Potential functions for sinusoidal oscillations, Analysis of Radiation fields of a Alternating current element, quarter wave Monopole and half wave dipole, Power radiated by current element, Radiation resistance of current element, quarter wave Monopole and half wave dipole.

UNIT-II **[8 Hrs]**

Antenna Array Analysis: Various forms of Antenna Arrays, Linear Array of Two Point Sources and N-Point Sources, Expression for electric field from two and N element arrays, Broad-side array and End-Fire array, Method of pattern multiplication, Binomial array, Loop Antenna.

UNIT-III **[8 Hrs]**

HF, VHF and UHF Antennas: Resonant Antennas, Non-Resonant Antennas, Helical Antenna, Travelling wave antennas – V Antenna, Inverted V Antenna, Rhombic Antenna, Broadband Antennas-Folded Dipole, Yagi-Uda Antenna, Log-Periodic Antenna.

UNIT-IV **[9 Hrs]**

Microwave Antennas: Horn Antenna & Types, Reflector Antennas- Corner Reflector, Parabolic Reflector – (Geometry, types of feeds, F/D Ratio, Spill Over, Back Lobes), Lens Antenna, Fundamentals of Rectangular Patch antenna.

Antenna Measurements: Measurement of Antenna parameters- Directional pattern, Radiation resistance, Gain (Two Antenna, Three Antenna Methods), Directivity, Beam width, SLR, Polarization, Impedance.

UNIT-V **[8 Hrs]**

Wave Propagation: Concepts of Propagation-frequency ranges and types of propagation
Ground Wave Propagation: Characteristics, Parameters, Wave Tilt
Sky Wave Propagation: Formation of Ionospheric Layers and their Characteristics, Mechanism of Reflection and Refraction, Critical Frequency, MUF & Skip Distance, Optimum Frequency, LUHF, Virtual Height.
Space Wave Propagation: Fundamental Equation for free space Propagation, Basic Transmission Loss Calculations. Space Wave Propagation Mechanism, LOS and Radio Horizon, Duct Propagation.

TEXT BOOKS

1. Constantine A. Balanis, "Antenna Theory: Analysis and Design", John Wiley & sons Publishers,2nd Edition.
2. G.S.N Raju, “Antennas and Wave Propagation”, Pearson Education Publishers.

REFERENCE BOOKS

1. Jordan and Balmain, Electromagnetic fields and Radiating systems, Pearson Education Publishers.
2. John D. Kraus, "Antennas and Wave Propagation", TMH Publishers

B.Tech. (V Sem.) **20EC11 – LINEAR IC APPLICATIONS**

L	T	P	Cr.
3	0	0	3

Pre-requisites: Analog Circuit Design

Course Educational Objective: This course provides knowledge on Integrated Circuit (IC), Op-amp internal structure and various applications of it; Design of Op-Amp based Active Filters and waveform generators, applications of 555 timers and Phased Locked Loop.

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

CO1: Identify the building blocks of linear integrated circuits, characteristics and application of Op-Amps **(Understand – L2)**

CO2: Apply the concepts of feedback to op-amps for linear and non-linear applications **(Apply – L3)**

CO3: Analyze Op-Amp, 555 timer applications, phase locked loops to perform addition and multiplication of signals and voltage regulators using Linear ICs **(Analyze – L4)**

CO4: Design active filters, waveform generators and data converters using Op Amps **(Apply – L3)**

UNIT – I **[9 Hrs]**

Transistor Current Sources: Basic Current Source, Widlar Current Source, Cascode Current Source, Wilson Current Source.

Differential Amplifiers: Classification, DC and AC analysis of differential amplifier Configurations, specifications, FET differential amplifier, Level translator and current mirror circuit.

UNIT – II **[9 Hrs]**

Operational Amplifiers: Block Diagram, Ideal and Practical characteristics, DC and AC characteristics of Op-Amp, IC 741 specifications, Measurement of slew rate and CMRR.

Applications of OP Amps: Inverting and Non-inverting amplifier, Integrator and differentiator, Difference amplifier, Instrumentation amplifier, Analog multiplier, V to I, I to V converters, Rectifiers, Sample and Hold circuit, Log and Anti log amplifiers.

UNIT – III **[9 Hrs]**

Op Amp Active Filters: Design and analysis of 1st order & 2nd order Low pass and High pass filters, Band pass filter, Band reject filter and all pass filters.

Op Amp Waveform Generators: Comparator, design and analysis of Schmitt trigger, Astable, Monostable Multivibrators and Triangular wave Generator.

Op Amp Sine wave Oscillators: Design and analysis of RC Phase shift Oscillator, Wien Bridge Oscillator.

UNIT – IV **[8 Hrs]**

555 Timers: Functional Diagram, Monostable and Astable multivibrators and Applications, VCO - IC 566 & its features, IC 565 PLL Block Schematic, Applications of PLL.

IC Voltage Regulators: Fixed Voltage Regulators, IC723 General Purpose Regulator.

UNIT – V **[7 Hrs]**

Digital to Analog Converters: Weighted resistor DAC, R-2R Ladder DAC, Inverted R-2R DAC.

Analog to Digital Converters: Flash Type ADC, Counter Type ADC, Successive Approximation ADC, Charge Balancing ADC, Dual Slope ADC.

TEXT BOOKS

1. Ramakanth A.Gayakwad, Op-amps and Linear Integrated Circuits, Third edition, PHI Publishers, 2006.
2. Roy Choudhury D., Linear Integrated Circuits, Second edition, New Age International (P) Ltd.

REFERENCE

1. Adel S. Sedra and Kenneth Carless Smith, Microelectronic Circuits, Fifth Edition. Oxford University Press.
2. Rashid M. H., Microelectronic Circuits: Analysis and Design, Second edition, PWS Publishing Company.

B.Tech. (V Sem.)	20EC12 - ELECTRONIC MEASUREMENTS AND INSTRUMENTATION	L	T	P	Cr.
		3	0	0	3

Pre-requisites: Basic knowledge on network analysis and measuring Instruments

Course Educational Objective: This course provides the knowledge on basic characteristics of instruments, voltmeter, ammeter and ohmmeter and various methods of signal generation. This course will give an idea about measuring electrical parameters like R, L, C, f etc. using bridges and wave analyzers. This course provides knowledge about oscilloscopes, different types of transducers in detail.

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

CO1: Understand the concepts of measurements and working principle of different voltmeters, ammeters, signal generators, Wave analyzers, Oscilloscopes and Transducers **(Understand-L2)**.
CO2: Analyze the working of different measuring instruments and bridges using mathematical models **(Analyze-L4)**.
CO3: Apply appropriate passive or active transducers for measurement of physical parameters **(Apply-L3)**.
CO4: Design ammeter, voltmeter, ohmmeters and bridges for the given specifications **(Apply-L3)**.

UNIT – I **[9 Hrs]**

Characteristics of Instruments: Static characteristics-Accuracy, Resolution, Precision, Expected Value, Error, Sensitivity; Dynamic characteristics-Speed of response, Fidelity, Lag, Dynamic error; Errors in Measurement-Absolute Error, Percentage of Error; Types of Errors-Gross errors, Systematic errors, Random Errors.
DC Voltmeters: PMMC Movement, Basic Meter as DC Voltmeter, Multirange Voltmeter, Extending Voltmeter ranges, Concept of loading and Sensitivity; Types of DC Voltmeters-solid state voltmeter, Basic Differential Voltmeter.
AC Voltmeters- AC Voltmeter using half wave and full wave rectifiers, Multirange AC Voltmeter.

UNIT – II **[9 Hrs]**

Ammeters: DC Ammeter-Basic Meter as DC Ammeter, Multirange Ammeter, Aryton Shunt Ammeter, AC Ammeter- RF Ammeter using Thermocouple instruments.
Ohmmeters: Series and Shunt Type Ohmmeters.
Multimeters: Measurement of Voltage, Current, Resistance.
AC Bridges: Measurement of Impedance-Wheatstone Bridge; Measurement of Inductance-Maxwell's bridge, Anderson Bridge. Measurement of Capacitance- Schering Bridge, Wien Bridge; Errors and precautions.

UNIT – III **[8 Hrs]**

Signal Generators: Fixed and variable AF Oscillator, Standard Signal Generator, Modern Laboratory Signal Generator, AF Sine and Square wave Generator, Function Generator, Square and Pulse Generator, Random noise Generator, Sweep Generator, Arbitrary Waveform Generator.
Wave Analyzers: Frequency selective wave analyzer, Heterodyne wave analyzer, Distortion analyzer-Harmonic distortion analyzer; Spectrum analyzer.

UNIT – IV **[8 Hrs]**

Oscilloscopes: Block diagram, Vertical Amplifier, Horizontal Deflection System-Sweep/Time Base Generator, Triggered pulse circuit. Delay line in Triggered sweep, Dual Beam CRO, Dual Trace Oscilloscope, Digital Storage Oscilloscope Measurement of Amplitude and Frequency; Sampling Oscilloscope, Lissajous method of frequency measurement, standard specifications of CRO. Attenuators-Uncompensated Attenuator, Simple compensated Attenuator.

UNIT – V **[8 Hrs]**

Transducers: Parameters, Classification, Resistive transducer- Measurement of displacement, Strain Gauge, Thermistors, Sensistors, Resistance thermometer, Inductive transducer- Measurement of displacement, LVDT, Capacitive transducer, Piezo electric Transducer, Photo electric Transducer, Temperature measurement Transducers-Thermocouple. Linear Velocity Measurement-Moving coil type and Moving magnet type.

TEXT BOOKS

1. H S Kalsi, Electronic Instrumentation, Tata Mc Graw Hill Publishers, 3rd Edition.
2. Albert.D. Helfrick and Willam D. Cooper, Modern Electronic Instrumentation and Measurement Techniques – PHI

REFERENCE

1. AK Sawhney, "A Course in Electrical & Electronic Measurements and Instrumentation", Dhanpat Rai and Company, 2004.
2. David A. Bell, Electronic Instrumentation and Measurements, Oxford University Press, 2nd Edition

B.Tech. (V Sem.) **20EC13 – DIGITAL IC DESIGN**

L	T	P	Cr.
3	0	0	3

Pre-requisites: Digital Logic Circuits and Electronic Devices and Circuits

Course Educational Objective:

COURSE OUTCOMES: At the end of the course, the student will be able to-

CO1: Understand the parameters of MOS transistors. **(Understand – L2)**

CO2: Design of Combinational and Sequential Circuits using MOS transistors. **(Apply – L3)**

CO3: Examine the Dynamic logic circuits and their characteristics. **(Apply – L3)**

CO4: Summarize Semiconductor memories and their organization. **(Understand – L2)**

UNIT –I **[9 Hrs]**

MOS Design: Pseudo NMOS Logic – Inverter, Inverter threshold voltage, Output high voltage, Output Low voltage, Gain at gate threshold voltage, Transient response, Rise time, Fall time, Pseudo NMOS logic gates, Transistor equivalency, CMOS Inverter logic.

UNIT –II **[8 Hrs]**

Combinational Logic Circuits: MOS logic circuits with NMOS loads, Primitive CMOS logic gates – NOR & NAND gate, Realization of Boolean expressions using NMOS and CMOS gates, AOI and OAI gates.

UNIT –III **[8 Hrs]**

Sequential Logic Circuits: MOS Logic circuits - SR Latch circuit, Clocked latch and flip flop circuits: Clocked SR Latch, Clocked JK Latch, and Master slave flip-flop; CMOS D latch and edge triggered flip-flop.

UNIT –IV **[9 Hrs]**

Dynamic Logic Circuits: Basic principles of pass transistor circuits: charge storage and charge leakage; Voltage Bootstrapping; Synchronous dynamic techniques: Dynamic CMOS Logic (Precharge-Evaluate Logic); High performance Dynamic CMOS circuits: Domino CMOS Logic, NORA CMOS Logic (NP- Domino Logic), Zipper CMOS Circuits, and True Single Phase Clock (TSPC) Dynamic CMOS.

UNIT –V **[8 Hrs]**

Semiconductor Memories: RAM array organization, DRAM – Types, Operation, Leakage currents in DRAM cell and refresh operation, SRAM operation Leakage currents in SRAM cells, Flash Memory- NOR flash and NAND flash.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Ming-BO Lin, "Introduction to VLSI Systems: A Logic, Circuit and System Perspective", CRC Press, 2011
2. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuits – A Design Perspective", 2nd Edition, PHI.

B.Tech. (V Sem.)	20EC14 – DATA COMMUNICATION AND COMPUTER NETWORKS	L	T	P	Cr.
		3	0	0	3

Pre-requisites: Digital Communications

Course Educational Objective: This course provides knowledge on communication networks and various protocols used in different layers.

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

CO1	**Understand** the functions of the OSI, TCP/IP reference models **(Understand – L2)**
CO2	**Summarize** design issues for layer protocols **(Understand – L2)**
CO3	***Examine*** the routing algorithms to find shortest paths for packet delivery **(Apply– L3)**
CO4	***Interpret*** the operations of application layer protocols **(Understand – L2)**

UNIT-I **[9 Hrs]**

Introduction: Network hardware, Network software, Reference models-OSI reference model, TCP/IP model, Comparison between OSI and TCP/IP, Critique of the OSI reference model and TCP/IP model.

Physical Layer: Guided transmission medium, Wireless transmission medium.

UNIT-II **[8 Hrs]**

Data Link Layer: Design issues, Error detection and correction codes, Elementary data link protocols, Sliding window protocols.

Medium Access Control Sub layer: Channel allocation problem, multiple access protocols, Ethernet, Wireless LANs, Bluetooth.

UNIT-III **[8 Hrs]**

Network Layer: Design issues, routing algorithms-Optimality principle, shortest path algorithm, Flooding, Distance vector routing, Link state routing, Hierarchical routing, Broadcast routing, Multicast routing. Congestion control algorithms.

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UNIT-IV **[8 Hrs]**

Internetworking, Network layer in the internet- IPV4, IPV6, Comparison between IPV4 & IPV6, Internet control protocols, OSPF, BGP.

Transport Layer: Services provided to the upper layers, elements of transport protocol-addressing, connection establishment, connection release, Crash recovery.

UNIT-V **[9 Hrs]**

The Internet Transport Protocols UDP-RPC, Real Time Transport Protocols The Internet Transport Protocols-Introduction to TCP, the TCP Service Model, the TCP Segment Header.

Application Layer: Domain name system, Electronic mail-Architecture and services, SMTP, World Wide Web - Architecture overview, FTP, FTP Commands & replies.

Structure of management information, management information base and simple network management protocol.

TEXTBOOKS

1. Tanenbaum and Wetherall, "Computer Networks", Pearson Education, 5th Edition.
2. Behrouz. A. Forouzan, "Data Communication and Networking", 4th Edition, Tata McGraw-hill, New Delhi, 2006

REFERENCES

1. S.Keshav,"An Engineering Approach to Computer Networks", Pearson Education, 2nd Edition,
2. W.A.Shay,"Understanding communications and Networks", Cengage Learning, 3rd Edition

B.Tech. (V Sem.) **20EC57 – DIGITAL COMMUNICATIONS LAB**

L	T	P	Cr.
0	0	3	1.5

Pre-Requisites: Analog Communications, Signals and Systems

Course Educational Objective: This Course provides practical exposure on different aspects of digital communications. It demonstrates the importance of different modulation techniques in digital communication systems. It also gives the knowledge about different encoding and decoding techniques used in digital communication systems.

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

CO1	**Interpret** baseband and passband modulation and demodulation techniques **(Understand – L2)**
CO2	**Apply** coding techniques for error detection and correction in digital data transmission **(Apply – L3).**
CO3	**Implement** frequency and phase shift keying techniques using Software Defined Radio **(Apply – L3).**
CO4	**Adopt** effective communication, presentation and report writing skills **(Apply – L3).**

LIST OF EXPERIMENTS

PART-A

1. Generate digital signal from analog using Pulse Code Modulation and reconstruct original signal.
2. Demonstrate the analog to digital conversion using Delta Modulation and Demodulation
3. Perform Adaptive Delta Modulation and obtain the reconstructed original signal.
4. Generate the Amplitude Shift Keying Modulated signal and reconstruct the original signal using demodulation.
5. Obtain the modulated and demodulated signals for Frequency Shift Keying
6. Perform a digital modulation using Binary Phase Shift Keying and reconstruct the original signal using coherent detection.
7. Generate the digital modulated signal using Quadrature Phase shift Keying Modulation and reconstruct the original signal.
8. Examine the error detection and correction process using Linear Block Code.
9. Apply the Binary Cyclic Code for error detection and correction of digital data.

PART-B (Implementation using Software Defined Radio**)**

10. Binary Frequency Shift Keying Modulation and Demodulation
11. Binary Phase Shift Keying Modulation and Demodulation
12. Quadrature Phase Shift Keying Modulation and Demodulation

L	T	P	Cr.
0	0	3	1.5

B.Tech. (V Sem.) **20EC58 – LINEAR IC APPLICATIONS LAB**

Pre-requisites: Fundamentals of Electronic Devices, Analog Circuits.

Course Educational Objective: This course provides the practical exposure on development of Integrated Circuit (IC) based arithmetic applications realization, Design of Active Filters and different waveform generators and design of multivibrators using 555 timer and its applications.

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

CO1: Demonstrate the characteristics and applications of Op-Amps **(Understand – L2)**

CO2: Apply the 555 Timer circuit concepts for the realization of waveform generators **(Apply – L3)**

CO3: Design Active filters, arithmetic circuits, waveform generators and data converters using Op-Amp **(Apply – L3)**

CO4: Adapt effective Communication, presentation and report writing skills **(Apply – L3)**

LIST OF EXPERIMENTS

(Any of the 10 experiments are required to be conducted)

1. Verification of functionality of Inverting and Non-inverting amplifiers for the Sine and Square wave inputs.
2. Realization of Adder and Subtractor using Op-Amp.
3. Realization of Differentiator and Integrator using Op-Amp.
4. Design, Realization and plot the frequency response of First order Low pass and High pass filters using Op-Amp.
5. Design and plot the frequency response of Band pass filter using Op-Amp.
6. Design and Realization of Op-Amp based Astable multivibrator for Square wave generation.
7. Design and Realization of 555 timer based Monostable multivibrator for Pulse generation.
8. Construction of Schmitt Trigger using Op-Amp and calculate UTP and LTP values.
9. Design and Realization of 555 timer based Astable multivibrator for square wave generation.
10. Design and Realization of RC phase shift Oscillator for sinusoidal signal generation using Op-Amp.
11. Design and Realization of Function generator for square wave and triangular waves using Op-Amps.
12. Design and Realization of Pulse generators using Op-Amp.
13. Design and Realization of 3-bit Digital to Analog converter using Op-Amp.

B.Tech. (V Sem.)

20ECS3 – DESIGN AND SIMULATION OF ANTENNAS

L	T	P	Cr.
1	0	2	2

Pre-requisites: Electromagnetic waves and Transmission Lines.

Course Educational Objectives: In this course, student will learn about how to design and analyze various transmission lines and antennas using Ansys HFSS Software.

Course Outcomes (COs): At the end of this course, students will be able to

CO1	Understand the basic concepts of transmission lines and antennas according to Requirement and applications. **(Understand – L2)**
CO2	Apply software tools for different transmission lines and antennas. **(Apply – L3)**
CO3	Design and analyze the different parameters of transmission lines and antennas. **(Analyze – L4)**
CO4	Adapt effective communication, presentation and report writing skills. **(Apply – L3)**

UNIT – I: Introduction to S parameters, return loss, Voltage standing wave ration(VSWR),transmission coefficient, Basic of HFSS simulation software, Transmission lines-short circuit, open circuit

UNIT – II: Introduction to micro strip patch antennas, Design specifications, Rectangular and circular patch antennas, Dual band and wide band Patch antennas.

TEXTBOOK:

1. Constantine A. Balanis, "Antenna Theory: Analysis and Design", John Wiley &sons Publishers, 2nd Edition
2. JR James, PS Hall “Handbook of Microstrip Antennas” IEE Electromagnetic waves series, 1986.

REFERENCES:

1. Matthew N.O. Sadiku, “Elements of Engineering Electromagnetics”, Oxford University Press, 4th Edition..
2. David. M. Pozar “Microwave Engineering”, 4th edition, WILEY Publication, 2013.

HANDS – ON LABORATORY SESSIONS

Design and Simulation using HFSS:

1. Micro strip patch antennas using strip line feed.
2. Micro strip patch antennas using coaxial feed.
3. Rectangular micro strip patch.
4. Patch Antenna for Wi-Fi Application
5. Patch Antenna for Wi-Max Application
6. Circular micro strip patch.
7. Dipole antenna.
8. Dual band antennas.
9. Microstrip line
10. Open and short circuit transmission line
11. Multi stub unit
12. Study of characteristic impedances of transmission line

B.Tech. (VI Sem.)	20EC15 – MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	Cr.
		3	0	0	3

Pre requisite: Digital Logic Circuits

Course Educational Objective: In this course student will learn about the architecture of 8086 Microprocessor, 8051 Microcontroller and ARM, programming using assembly language, interfacing of devices for real time applications.

Course Outcomes: (COs): At the end of the course, students are able to:

CO 1 Understand the architecture of 8086, 8051 and ARM Controller **(Understand – L2)**
CO 2 Apply Assembly Language instructions for Processor and Controller based applications **(Apply – L3)**
CO 3 Analyze the operating modes and interrupt structures of processors and controllers **(Analyze – L4)**
CO 4 Develop the ARM based interfacing systems for Real time applications **(Apply – L3)**

UNIT-I: 8086 MICROPROCESSOR [9 HRS]

Architecture, Pin diagram, Register organization, Minimum mode and Maximum mode, timing diagrams. Addressing modes, Instruction set, Interrupt vector table, Assembly language programming - data transfer, arithmetic, logical and decision making operations.

UNIT- II: 8051 MICROCONTROLLER [8 HRS]

Architecture, Input/output Ports, Registers, Counter and Timers, Serial port, Interrupts, addressing modes, instruction set and Programming - data transfer, arithmetic, logical and decision making operations.

UNIT – III: ARM ARCHITECTURE & PROGRAMMING MODEL [9 HRS]

History, Architecture, ARM design philosophy, Registers, Program status register, Instruction pipeline, Interrupts and vector table, ARM processor families, Instruction set: Data processing instructions, Addressing modes, Branch, Load-Store instructions, PSR instructions, and Conditional instructions.

UNIT – IV: ARM PROGRAMMING [8 HRS]

Assembly programming, General structure of assembly language, Writing programs, Branch instructions, Loading constrains, load and store instructions, Read only and read/write Memory, Multiple Register Load and Store.

UNIT – V: INTERFACING ARM WITH EXTERNAL PERIPHERALS [8 HRS]

Interfacing - A/D and D/A converter, LEDs, Switches, Relays, LCD, Stepper Motors, Real Time Clock, Serial Communication, GSM and GPS.

Text Books:

1. Ray and Burchandi, "Advanced Microprocessors and Interfacing", Tata McGraw–Hill.
2. M.A.Mazidi,S.Naimi and S.Naimi, "The AVR Microcontroller and Embedded Systems Using Assembly and C", 1st Edition Pearson Publications, 2013.

Reference Books:

1. N.Sentil Kumar, M.Saravanan, S.Jeevananthan, "Microprocessors and Microcontrollers", Oxford University Press, 2010.
2. Dhananjay V. Gadre, "Programming and Customizing The AVR Microcontroller", Tata McGraw-Hill publications, 2012.

L	T	P	Cr.
3	0	0	3

B.Tech. (VI Sem.) **20EC16 – VLSI DESIGN**

Pre-requisites: Electronic Devices and Circuits**,** Digital Circuits

Course Educational Objective: This course provides the knowledge on IC Fabrication Technologies and gives a complete idea about combinational and sequential sub system CMOS circuit designs used in VLSI Design. This course also gives the complete information regarding design tools and CMOS testing techniques.

COURSE OUTCOMES: At the end of the course, the student will be able to-

CO1: Understand semiconductor technology and MOS fabrication process **(L2-Understand)**

CO2: **Apply** layout design rules for NMOS, CMOS logic circuit designs. **(L3-Apply)**

CO3: Analyze the IC building blocks. **(L4-Analyze)**

CO4: **Apply** CMOS testing techniques to test different digital designs. **(L3-Apply)**

UNIT-I **[9 Hrs]**

IC fabrication Technology: Silicon semiconductor technology–wafer processing, oxidation, epitaxy, lithography, ion implantation, and diffusion, the silicon gate process; NMOS and CMOS fabrication, BiCMOS technology, Comparison between CMOS and bipolar technologies.

Basic Electrical Properties of MOS and BiCMOS Circuits: $\mathbf{I_{ds}}$ $\mathbf{-V_{ds}}$ relationships, MOS transistor threshold Voltage, $\mathbf{g_m}$, $\mathbf{g_{ds}}$; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, BiCMOS Inverters.

UNIT-II **[8 Hrs]**

VLSI Circuit Design Processes: VLSI design flow, MOS Layers, Stick Diagrams, Design Rules and Layout, 5μm CMOS Design rules for wires, Contacts, Transistor; Layout Diagrams for NMOS, CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.

Basic Circuit Concepts: Sheet Resistance, Area Capacitance calculations, Inverter Delays.

UNIT-III **[8 Hrs]**

Digital IC Building Blocks: Logic gates: combinational logic functions, static complementary gates, switch logic, standard cell based layout, logic and interconnect design, power optimization; Realization of Latches and Flip-Flops using switch logic; Sub system design flow, 4x4 array multiplier, Design of 4bit ALU using adder, synchronous up/down counters, and registers.

UNIT-IV **[9 Hrs]**

Analog IC Building Blocks: MOS Diode/Active resistor, Simple current sinks, Basic and Advanced current mirrors, Current and Voltage references, band-gap references; Op-Amp, One Stage OP-Amp. Two Stage OP-Amp, Gain boosting, Common Mode Feedback and Noise in Op Amps.

UNIT-V **[8 Hrs]**

Test and Testability : System Partitioning, Layout and Testability, Reset/Initialization, Design for Testability (DFT), Testing Combinational Logic, Testing Sequential Logic, Practical Design for Test Guidelines, Scan Design Techniques, Built-In-Self-Test (BIST), Future Trends.

TEXT BOOKS

1. Kamran Eshraghian, Eshraghian Dougles and A. Pucknell, Essentials of VLSI circuits and systems, PHI Publishers, 2005.
2. "Design of Analog CMOS Integrated Circuits", Behzad Razavi, TMH, 2007.

REFERENCE BOOKS

1. Neil. H. E. Weste and Kamaran Eshraghian, Principles of CMOS VLSI Design (2/e), Pearson Education Publishers, 3rd Edition.
2. Wayne Wolf, Modern VLSI Design (3/e), Pearson Education Publishers.

B.Tech. (VI Sem.) **20EC17 – MICROWAVE ENGINEERING**

L	T	P	Cr.
3	0	0	3

PRE-REQUISITES: Vector calculus, Coordinate Systems, Basics of electromagnetics.

COURSE OBJECTIVE: This course provides the knowledge on different types of waveguides and resonators. The course will give an idea about microwave communication in terms of various bands, advantages, applications. The course also gives the complete information regarding the microwave tubes and passive devices along with microwave bench setup and microwave measurements.

COURSE OUTCOMES: At the end of the course, student will be able to

CO1	**Understand** the microwave sources, components and measurements of microwave parameters **(Understand – L2)**
CO2	**Develop** the TE, TM fields in waveguides and microwave signals using microwave tubes and solid state devices **(Apply – L3)**
CO3	**Apply** the properties of S-parameters to model the S-matrix of waveguide components **(Apply – L3)**
CO4	**Analyze** the flow of microwave fields in waveguides, components and efficiency of microwave tubes **(Analyze – L4)**

UNIT-I **[9 Hrs]**

Introduction, Microwave Spectrum and Bands, Advantages and Applications of Microwaves.

Rectangular Waveguides: Impossibility of TEM waves in waveguides, Transverse Magnetic and Transverse Electric Waves in Rectangular Waveguides, Field Expressions, characteristics of TE and TM Waves-Cutoff frequency, Dominant mode in Rectangular Waveguides, phase velocity, group velocity, relation between cutoff, guided and free space wavelengths, Wave impedances for TE and TM cases.

Circular Waveguides: TM and TE waves in circular guides, Field Expressions, Dominant mode in circular waveguide.

UNIT-II **[8 Hrs]**

Resonators: Rectangular and circular cavity resonators, Field Expressions, Re-entrant Cavities

Microwave Tubes: Limitations of conventional tubes at microwave frequencies. Microwave tubes – O type and M type classifications.

Klystron Tubes: Two Cavity Klystrons – Structure, Velocity Modulation Process and Applegate Diagram, output Power and Efficiency. Reflex Klystrons – Structure, Applegate Diagram and Principle of working, Power Output, Efficiency, output Characteristics.

UNIT-III **[8 Hrs]**

Helix TWT: Types and Characteristics of Slow Wave Structures; Structure of TWT and Amplification Process

M-Type Tubes: Cross-field effects, Magnetrons – Different Types, 8-Cavity Cylindrical Travelling Wave Magnetron: Hull Cut-off and Hartee Conditions, PI-Mode Operation, Strapping.

UNIT-IV **[8 Hrs]**

Microwave Solid State Devices: Negative resistance region, Classification, Applications.

Transferred Electron Devices: Gunn Diode – Principle, Two Valley Model Theory, RWH Theory, Characteristics.

Avalanche Transit Time Devices: IMPATT and TRAPATT Diodes – Principle of Operation and Characteristics, related expressions.

UNIT-V **[9 Hrs]**

Waveguide Components: Scattering Matrix– Significance, Formulation and Properties. S Matrix Calculations for E plane and H plane Tees, Magic Tee, Directional Coupler. Fundamentals of branch line, rat-race couplers, microwave filters. Ferrites– Composition and Characteristics, Faraday Rotation; Ferrite Components – Gyrator, Isolator, Circulator. Microwave attenuators.

Microwave Measurements: Description of Microwave Bench setup, Precautions; Measurement of Attenuation, Frequency, VSWR, Impedance, Power.

TEXT BOOKS

1. Samuel Y. Liao, "Microwave Devices and Circuits", PHI Publishers, 3rdEdition, 2003.
2. David M.Pozar, "Microwave Engineering", John Wiley Publishers,4thEdition.

REFERENCE BOOKS

1. M Kulakarni, "Microwave and Radar Engineering", Umesh Publications, New Delhi 5th Edition
2. Jordan and Balmain, "Electromagnetic fields and Radiating systems", Pearson education.

B.Tech. (VI Sem.) **20EC18 - IMAGE PROCESSING**

L	T	P	Cr.
3	0	0	3

Pre-Requisites: Signals and Systems, Digital Signal Processing.

Course Objective: This course provides the fundamental concepts of Image Processing. Image enhancement which is the most prominent preprocessing step will be learnt in both time and spectral domain. The course also gives the color image fundamentals and knowledge about compression as well as segmentation.

Course Outcomes: At the end of the course, the student will be able to
CO1: Interpret the fundamental concepts of digital Image Processing. **(L2-Understand)**
CO2: Apply the concepts of masking and filtering for image enhancement. **(L3-Apply)**
CO3: Summarize the image segmentation methodologies. **(L2-Understand)**
CO4: Understand the underlying concepts of image restoration and compression techniques. **(L2-Understand)**

UNIT-I **[9 Hrs]**

Introduction: Introduction to Digital Image and its representation, Fundamental Steps and Components of an Image Processing System, Applications of Image Processing, Image Sampling and Quantization, Spatial and intensity Resolution, Relationship between pixels, Distance measures.

Image Transforms: Two-Dimensional Discrete Fourier Transform (2D-DFT), Two-Dimensional Discrete Cosine Transform (2D-DCT), Properties (Proof not required).

UNIT-II **[8 Hrs]**

Image Enhancement in Spatial Domain: Point processing, Intensity Transformation Functions, Histogram equalization, Smoothing Spatial Filters: linear filters, order-statistic filters, Sharpening Spatial Filters: Gradient, Laplacian.

Image Enhancement in Frequency Domain: Filtering in Frequency domain, Image Smoothing: Ideal low pass filter, Butterworth low pass filter, Gaussian low pass filter, Image Sharpening: Ideal high pass filter, Butterworth high pass filters, Gaussian high pass filter, Laplacian in the frequency domain.

UNIT-III **[8 Hrs]**

Image Segmentation: Detection of discontinuities, Edge Linking and Boundary Detection: Local Processing, Global Processing via the Hough Transform, Thresholding: Basic Global Thresholding, Optimal global Thresholding (OTSU method), Region based segmentation: Region growing, Region splitting and merging.

UNIT-IV **[9 Hrs]**

Image Restoration: Image Degradation and Restoration model, Noise Models, Restoration in the Presence of Noise-Spatial Filtering: Mean Filter, Order-Statistics Filter, Adaptive Filter, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering.

Image Compression: Redundancy - Coding, Interpixel and Psychovisual; Image Compression Model, Error free compression: Huffman coding, Loss less Predictive Coding, Lossy Compression: Lossy Predictive Coding, Transform coding, JPEG compression.

UNIT-V **[8 Hrs]**

Color Image Processing: Color Fundamentals, Color Models: RGB, CMY, CMYK, and HSI color models, conversions.

Morphological Image Processing: Dilation and Erosion, Opening and Closing.

TEXT BOOK(S)

1. Rafel.C.Gonzalez and Richard.E.Woods, "*Digital Image Processing*", PHI Pvt. Ltd, 2nd Edition, 2005.
2. Anil K. Jain, "*Fundamentals of Digital Image Processing*", PHI Publications.

REFERENCE(S)

1. S.Jayaraman, E.Esakkirajan, T.Veerakumar, "*Digital Image Processing*", TMHedition,2011
2. S Sridhar, "*Digital Image Processing*", Oxford University press,2011

L	T	P	Cr.

B.Tech. (VI Sem.) **20EC19 – SATELLITE COMMUNICATIONS**

3	0	0	3

Pre-Requisites: Analog Communications & Digital Communications.

Course Educational Objective: This course provides the technical knowledge of orbital dynamics, launching of satellite in to the orbit, various subsystems used in space segment, uplink and downlink aspects of satellite. This course will also give an idea about different multiple access techniques, design requirements for the selection of earth station and various real time applications.

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

CO1	**Understand** the orbital mechanics, concepts of satellite communication and its applications **(Understand – L2)**
CO2	**Summarize** the concepts of satellite space segment, earth segment and satellite services **(Understand – L2)**
CO3	**Examine** the satellite link budget calculations and orbital dynamics **(Apply – L3)**
CO4	**Apply** the multiple-access techniques and mobile services for satellite Communications **(Apply – L3)**

UNIT-I **[8 Hrs]**

Introduction to Satellite Communication: Need of satellite communication, Definition of a satellite and orbit, Frequency allocations for satellite services, General structure of satellite communication system, Merits and demerits of satellite communication, types of launch vehicles: ELV &RLV.

UNIT-II **[8 Hrs]**

Orbital Dynamics and Satellite Launching: Kepler's Laws, Definitions of Terms for Earth-Orbiting Satellites, Orbital Elements, Apogee and Perigee Heights, Effects of non spherical earth, Atmospheric drag, Orbital perturbations-need for station keeping, Non geostationary orbits and geostationary orbits, Orbital effects; Doppler shift, Range variation, solar eclipse and sun transit outage, Look angle determination: elevation angle and azimuth angle calculation, launching of geostationary satellites.

UNIT-III **[9 Hrs]**

Space Segment and Link Design: Introduction to space segment, Power supply, Attitude and orbital control: spinning satellite stabilization and momentum wheel stabilization, Station keeping, Thermal control, TT&C subsystem, Transponders, The wideband receiver, The input demultiplexer, The power amplifier, Antenna subsystem, Equivalent Isotropic Radiated Power, Free-space transmission, Feeder losses, Antenna misalignment losses, Fixed atmospheric and ionospheric losses, Link power budget equation, System Noise, Carrier-to-Noise Ratio, The Uplink, Saturation flux density, Input backoff, Downlink, Output back-off, Combined Uplink and Downlink C/N Ratio.

UNIT-IV **[9 Hrs]**

Earth Segment: Design requirements for the selection of earth segment, Transmit only earth station, Receive only earth station, Transmit -Receive (T/R) earth station.

Satellite Access: Single Access, Preassigned FDMA, Demand-Assigned FDMA, Spade System, TDMA, Preassigned TDMA, Demand-assigned TDMA, Satellite-Switched TDMA, CDMA.

UNIT-V **[8 Hrs]**

Satellite Services & Applications: Global Positioning System, architecture and location principle, Direct Broadcast Satellite (DBS/DTH)-Home receiver block (Indoor & Outdoor Unit), Satellite Mobile Services, VSAT, MSAT, RADARSAT, IRNSS constellation, Orbcomm, Iridium.

TEXT BOOKS

1. Timothy Pratt, Charles Bostian, Jeremy Allnutt , "Satellite communications", John Wiley & Sons,2nd edition, 2003.
2. Dennis Roddy , "Satellite communications", Tata McGraw Hills, 4th Edition, 2009.

REFERENCES:

1. D.C Agarwal , "Satellite communications", Khanna Publications, 5th Edition,2006.
2. M. Richharia, "Satellite Communications Systems: Design principles", BS Publications, 2nd Edition, 2005.

B.Tech. (VI Sem.) 20EC20 - PRINCIPLES OF ROBOTIC SYSTEMS

L	T	P	Cr.
3	0	0	3

PREREQUISITE: EMI, MPMC.

COURSE EDUCATIONAL OBJECTIVE (CEO):
In this course, student will learn about Robotics concepts to analyze and design the components and other building blocks.

Course Outcomes (COs): At the end of this course, students will be able to

CO1: Understand the Robotic components and modules **(Understand – L2)**
CO2: Analyze the working of Modules and Control techniques **(Analyze – L4)**
CO3: Summarize the concepts of Robotic sensors for vision related applications (**Understand – L2)**
CO4: Apply the concepts and algorithms to develop Robot designs **(Apply – L3)**

UNIT I: **[8 Hrs]**
INTRODUCTION: Brief history, Robot - Types, Technology, classifications, specifications, Design and control issues, Various manipulators – Sensors, work cell, Programming languages.

UNIT II: **[8 Hrs]**
COORDINATE FRAMES, MAPPING, SYMBOLIC MODELLING OF ROBOTS: Coordinate frames, Description of Objects in space, Mechanical structure and notations, Description of Links and Joints, Manipulator workspace.

UNIT III: **[9 Hrs]**
PATH PLANNING AND CONTROL: Definition, Joint space technique, Use of p-degree polynomial, Cubic polynomial, Cartesian space technique, Parametric descriptions, Straight line and circular paths, Position and orientation planning, Manipulator control problem, Linear control schemes, PID control scheme, Force control of robotic manipulator.

UNIT IV: **[9 Hrs]**
ROBOTIC SENSORS AND VISION: Classification, Selection, Vision controlled Robotics, Architecture of vision systems, Image Acquisition, Vision systems, Image representation and processing

UNIT V: **[8 Hrs]**
ROBOT APPICATIONS: Industrial applications, Material handling, Processing, Assembly and Inspection Applications, Justification and Safety

TEXT BOOKS:
1. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi, 2017.
2. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis‘, Oxford University Press, Sixth impression, 2010.

REFERENCE BOOKS:
1. K. K.Appu Kuttan, Robotics, I K International, 2007. 3. Edwin Wise, Applied Robotics, Cengage Learning, 2003.
2. S.Ghoshal, ―Embedded Systems & Robotics‖ – Projects using the 8051 Microcontroller‖, Cengage Learning, 2009.

		L	T	P	Cr.
B.Tech. (VI Sem.)	**20EC59 – MICROPROCESSORS AND**	0	0	3	1.5

MICROCONTROLLERS LAB

Pre requisite: Digital Logic Circuits

Course Educational Objective:
In this course student will learn about the architecture of 8086 Microprocessor, 8051 Microcontroller and ARM, programming using assembler language, interfacing of devices for real time applications.

Course Outcomes: (COs): At the end of the course, students are able to:

CO 1 Demonstrate the MASM/TASM tool for developing Assembly Language Programs. **(Understand – L2)**
CO 2 Apply the Assembly Language instructions of Processor and Controller for logical operations. **(Apply – L3)**
CO 3 Develop the ARM based interfacing systems for Real time applications. **(Apply – L3)**
CO 4 Adapt effective communication, presentation and report writing skills. **(Apply – L3)**

List of Experiments:

Part – 1:

Programming using MASM:

1. Display, comparison and reverse the string.
2. Factorial using Procedures.
3. Sorting the signed and unsigned numbers.
4. Checking the given string for Palindrome.

Programming using 8051:

5. Arithmetic operations like Addition, Subtraction, Multiplication and Division.
6. Byte checking by using 8051
7. Addition of series of numbers
8. Checking the given numbers for Odd or Even

Part – II: Interfacing using ARM:

1. Interfacing of A/D and D/A converter
2. Interfacing of LEDs and Switches
3. Interfacing of LCD
4. Interfacing of Stepper Motors
5. Interfacing of traffic Light controller
6. Interfacing of Real Time Clock
7. Data loggers – Rollover display

Note: Minimum of 6 experiments from each part to be conducted.

L	T	P	Cr.
0	0	3	1.5

B.Tech. (VI Sem.) **20EC60 – VLSI DESIGN LAB**

Pre-requisites: Electronic Devices and Circuits**,** Digital Circuits.

Course Educational Objective: The course explores the design and implementation aspects of various combinational and sequential circuits used in VLSI Design. It also develops the knowledge in VLSI Front End and Back End Design in semi-custom and full-custom design.

COURSE OUTCOMES: At the end of the course, the student will be able to:

CO1: Implement combinational and sequential circuits on FPGA/CPLD boards. **(Apply – L3)**

CO2: Design the Combinational and Sequential logic using NMOS and CMOS Technology. **(Apply – L3)**

CO3: Analyze combinational and sequential circuits using Static CMOS logic from schematic to layout. **(Analyze – L4)**

CO4: Adapt effective communication, presentation and report writing skills. **(Apply – L3)**

LIST OF EXPERIMENTS

PART-1: VLSI FRONT END DESIGN USING XILINX TOOL:

1. Implementation of Carry-Look-Ahead adder.
2. Implementation of 4x4 Array Multiplier.
3. Implementation of a 4-bit ALU.
4. Implementation of Zero /One Detector.
5. Implementation of flip flops: SR, D, JK, T.

PART-2: VLSI BACK END DESIGN USING CADENCE/MENTOR GRAPHICS TOOLS:

PART-2.1: Full Custom Design:

1. Design and analysis of NMOS Inverter.
2. Design and analysis of CMOS Inverter
3. Design and analysis of CMOS NOR gate.
4. Design and analysis of CMOS NAND gate.
5. Design and analysis of CMOS D- Flip Flop

PART-2.2: Semi Custom Design

1. Design and analysis of Full Adder
2. Design and analysis of Decoder
3. Design and analysis of 8- bit Binary Counter
4. Design and analysis of Shift Register
5. Design and analysis of Sequence Detector

Note: Minimum of 3 experiments from part-1 and 7 experiments from part-2 are to be conducted

B.Tech. (VI-Sem.) **20EC61 – MICROWAVE ENGINEERING LAB**

L	T	P	Cr.
0	0	3	1.5

Pre-requisite: EM Waves and Transmission Lines

COURSE OBJECTIVE: This Lab deals with the measurements of the EM signals at microwave frequency range. It involves measurement of frequency, wave length, VSWR, Impedance and scattering parameters of various micro wave devices like Circulator, Direction Coupler, and Magic-Tee. Even the latest trend of software tool i.e. HFSS is also introduced and microwave devices will be verified by evaluating the related parameters.

COURSE OUTCOMES: At the end of the course, student will be able to

CO1	Demonstrate the functions of microwave bench setup **(Understand – L2)**
CO2	Examine the properties of microwave passive devices using HFSS **(Apply – L3)**
CO3	Estimate the frequency, wave length, VSWR, impedance and scattering parameters of microwave devices **(Apply – L3)**
CO4	Adapt effective communication, presentation and report writing skills **(Apply – L3)**

List of Experiments

1. Reflex Klystron Characteristics
2. Gunn diode Characteristics
3. Attenuation measurement
4. VSWR measurement
5. Directional coupler characteristics
6. Impedance and frequency measurement
7. Scattering parameters of circulator
8. Scattering parameters of Magic tee

Using HFSS Simulation software:

9. Scattering parameters of branch line coupler
10. Scattering parameters of rat-race coupler
11. Design and S-parameter measurement of microwave band stop filter
12. Design and S-parameter measurement of microwave balun

B.Tech. (VI Sem.) **20HSS1- SOFT SKILLS (SOC)**

L	T	P	Cr.
1	-	2	2

Course Educational Objectives:
The Soft Skills Laboratory course equips students with required behavioral, interpersonal & Intrapersonal skills, communication skills, leadership skills etc. It aims at training undergraduate students on soft skills leading to enhanced self-confidence, esteem, and acceptability in professional circles.
Course Outcomes (COs): At the end of the course, student will be able

CO1: To Develop self-awareness and personality traits for professional growth
(Understand – L2)
CO2: Work effectively in multi-disciplinary and heterogeneous teams through knowledge of teamwork, Inter-personal relationships, conflict management and leadership quality.
(Apply – L3)
CO3: Communicate through verbal/oral communication with good listening skills and empathy (Apply – L3)
CO4: Apply skills required to qualify in recruitment tests, Interviews & other professional assignments (Apply – L3)

Personality Development Skills
Role of language in Personality – How language reflects, impacts Personality – Using gender-neutral language in MNCs – being culturally-sensitive-Personality Traits - Grooming & Dress code
Activities: Group Discussion/Role play/Presentations (authentic materials: News papers, pamphlets and news clippings)

Impactful Communication
Activities : Extempore / Story Telling/ Group Discussion (Case studies/Current affairs etc.)/ Elocution on Interpretation of given quotes/ Critical Appreciation and Textual Analysis/ Writing reviews on short story/videos/book/Social Media profiling/ Pronunciation Practice

Professional Skills:
Career Planning- job vs. career- goal setting- SWOT analysis-Time management – self-management – stress-management.
Activities: SWOT analysis of the self/Goal setting-Presentation/Writing Report/Listening exercises/Effective Resume-Writing and presentation/ Interview Skills: Mock interviews/Video samples.

REFERENCES :

1. Edward Holffman, "Ace the Corporate Personality", McGraw Hill,2001
2. Adrian Furnham, Personality and Intelligence at Work, Psyc 2. hology Press, 2008.
3. M.Ashraf Rizvi, "Effective Technical Communication", 1 st edition, Tata McGraw Hill, 2005
4. Ace of Soft skills Gopalaswamy Ramesh, Pearson Education India, 2018
5. Soft Skills for the Workplace, Goodheart-Willcox Publisher · 2020.
6. How to Win Friends and Influence People, Dale Carnegie · 2020

B.Tech. (VII Sem.) **20EC21 – ASIC DESIGN**

L	T	P	Cr.
3	0	0	3

Pre-Requisites: VLSI Design

Course Objectives: In this course, the student will learn various ASIC architectures, ASIC design flow, issues in ASIC design and testing of ASICs and also about SOC Design.

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

CO1	:	Understand ASIC Design Styles, Design Issues, Design Techniques and Construction. **(Understand – L2)**
CO2	:	Apply design techniques, resources and tools to develop ASIC modules. **(Apply – L3)**
CO3	;	Analyze the characteristics and Performance of ASICs and judge independently the best suited device for fabrication of smart devices. **(Analyze – L4)**
CO4	:	Evaluate Design issues, simulation and Testing of ASICs. **(Apply – L3)**

UNIT-I: **[9 Hrs]**

ASIC DESIGN STYLES: Introduction – categories-Gate arrays-Standard cells- Cell based ASICs-Mixed mode and analogue ASICs – PLDs.

ASICS– PROGRAMMABLE LOGIC DEVICES: Overview – PAL –based PLDs: Structures; PAL Characteristics – FPGAs: Introduction, selected families –design outline.

UNIT-II: **[8 Hrs]**

ASICS–DESIGN ISSUES: Design methodologies and design tools – design for testability – economies.

ASICS-CHARACTERISTICS AND PERFORMANCE: Design styles, gate arrays, standard cell -based ASICs, Mixed mode and analogue ASICs.

UNIT-III: **[8 Hrs]**

ASICS-DESIGN TECHNIQUES: Design flow and methodology- Hardware description languages- simulation and checking-commercial design tools- FPGA Design tools: XILINX, ALTERA.

UNIT-IV: **[9 Hrs]**

LOGIC SYNTHESIS, SIMULATION AND TESTING: Verilog and logic synthesis -VHDL and logic synthesis - types of simulation -boundary scan test-fault simulation-automatic test pattern generation.

ASIC-CONSTRUCTION: Floor planning, placement and routing system partition.

UNIT-V: **[8 Hrs]**

FPGA PARTITIONING: Partitioning Methods-Floor Planning- Placement- Physical Design Flow-GlobalRouting-Detailed Routing –Special Routing-Circuit Extraction-DRC.

TEXT BOOK:

1. M.J.S.Smith, "Application - Specific integrated circuits", Addison-WesleyLongman Inc 1997.
2. L.J.Herbst, "Integrated circuit engineering", OXFORD SCIENCE Publications,1996.

REFERENCE BOOKS:

1. Wayne Wolf, ―FPGA-Based System Design , Prentice Hall PTR, 2009.
2. Farzad Nekoogar and Faranak Nekoogar,-From ASICs to SOCs: A Practical Approach, PrenticeHall PTR, 2003.

B.Tech. (VII Sem.)

20EC22 – ADVANCED DIGITAL SIGNAL PROCESSING

L	T	P	Cr.
3	0	0	3

Pre-requisites: Signals and Systems, Probability and Random Processes, Digital Signal Processing

Course Educational Objective: This course provides the knowledge on random signals, correlations functions and power spectrum. The course will give an idea about linear prediction models. The course also gives non-parametric methods and parametric methods for the estimation of Power spectrum.

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

CO1: Understand random signals, correlation functions and power spectrum.**(Understand – L2)**

CO2: Interpret forward and backward linear prediction models. **(Understand – L2)**

CO3: Apply the concepts of normal equation solution for analyzing Wiener Filter. **(Apply-L3)**

CO4: Examine the Power Spectrum by making use of parametric methods and non-parametric methods.**(Apply-L3)**

UNIT - I: [9 Hrs]

Random Signals, Correlations functions and Power Spectrum: Random processes, Stationary random processes, Statistical Averages, Statistical Averages for Joint Random Processes, Power density spectrum, Discrete-Time signals, Time Averages for Discrete-Time Random Processes, Mean-Ergodic Process, and Correlation-Ergodic processes.

UNIT -II: [8 Hrs]

Linear Prediction: Representation of a stationary random process: Rational power spectra, relationship between the filter parameters and the autocorrelation sequences, forward linear prediction, backward linear prediction.

UNIT –III: [8 Hrs]

Normal Equations and Wiener Filters: Solutions of Normal equations: Levinson-Durbin Algorithm, FIR Wiener Filter, Orthogonality Principle in Linear Mean-Square Estimation, IIR Wiener Filter, Noncausal Wiener Filter.

UNIT –IV: [9 Hrs]

Nonparametric Methods for Power Spectrum Estimation: Bartlett Method: Averaging Periodograms, Welch Method: Averaging Modified Periodograms, Blackman and Tukey Method: Smoothing the Periodogram, Performance Characteristics of Nonparametric Power Spectrum Estimators.

UNIT –V: [8 Hrs]

Parametric Methods for Power Spectrum Estimation: Relationships Between the Autocorrelation and the Model Parameters, Yule-Walker Method for the AR Model Parameters, Burg Method for the AR Model Parameters, Unconstrained Least-Squares Method for the AR Model Parameters.

TEXTBOOKS:

1. J.G.Proakis & D. G. Manolokis, "*Digital Signal Processing: Principles,Algorithms and Applications*", PHI Publishers.

REFERENCES:

1. Alan V Oppenheim & Ronald W Schaffer, "*Discrete Time signal processing*", PHI Publishers.
2. Dimitris G. Manolakis & Vinay K. Ingle "*Applied Digital Signal Processing*", Cambridge University Press.

L	T	P	Cr.

B.Tech. (VII Sem.) **20EC23 – OPTICAL COMMUNICATIONS**

3	0	0	3

Pre-requisites: EMWTL, **A**nalog Communications and Digital Communications.

Course Educational Objective: This course gives knowledge on optical communication fundamentals, fiber types and materials. This course also describes about transmission losses in the fiber, optical sources, source to fiber coupling scheme, and optical receivers. This course also provides understanding of digital optical link, analog optical systems, wavelength division multiplexing and optical networks.

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

CO1	**Describe** the fundamental concepts of optical fiber communication systems, WDM systems, and optical networks **(Understand –L2**).
CO2	**Apply** knowledge of signal transmission characteristics of fibers, sources, and detectors in the optical communication system parameters calculations. **(Apply –L3)**
CO3	**Interpret** the operation of optical sources, detectors in the presence of channel degradation mechanisms in analog and digital optical systems **(Understand –L2).**
CO4	**Examine** the parameters of source to fiber launching, Power-Coupling Calculations, attenuation, and dispersion measurement. **(Apply –L3)**

UNIT-I: **[9 Hrs]**

Overview of Optical Fiber Communications: Elements of Optical Fiber Link, Merits and demerits of Optical Fiber Communications, Applications of optical fiber communications. Refractive index, Refraction, Reflection, Critical Angle and Total internal Reflection. Optical Fiber structures. Acceptance Angle, Numerical Aperture, Meridional and Skew Rays. Overview of Modes, Summary of Key Modal Concepts. Single-Mode Fibers, Cutoff Wavelength, Mode-Field Diameter.

UNIT-II: **[8 Hrs]**

Fiber Materials and Signal Degradation in Optical Fibers: Fiber Materials, Glass Fibers, Active Glass Fibers, Plastic Optical Fibers. Attenuation: Absorption, Scattering Losses, Bending Losses, Core and Cladding losses. Signal Distortion in Optical Waveguides, Information Capacity determination, Group Delay, Material Dispersion, Polarization-Mode Dispersion, Intermodal Distortion, Mode Coupling, Design Optimization of Single-Mode Fibers, Refractive-Index Profiles.

UNIT-III: **[9 Hrs]**

Optical Sources, Power Launching and Coupling: Requirement of optical sources, LED Structures, Light Source Materials, Quantum Efficiency and LED Power, Modulation of an LED, LASER Diodes, Laser Diode Modes and Threshold Conditions, Semiconductor Laser Diodes, Fabry Perot Lasers, Distributed Feedback (DFB) Lasers, Laser diode rate equations, External quantum efficiency, and resonant frequencies. Source to fiber power launching, Source Output Pattern, Power-Coupling Calculation, Lensing Schemes for Coupling improvement, Laser Diode-to-Fiber Coupling.

UNIT-IV: **[8 Hrs]**

Optical detectors and receivers: Photo detectors, Physical Principles of Photodiodes, PIN Photo detector, Avalanche Photo diodes, Detector Response time, Temperature effect on Avalanche gain, Comparison of Photo detectors. Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration, Digital receiver performance: Probability of error, The Quantum limit, Analog Receivers.

UNIT-V: **[8 Hrs]**

Digital Transmission Systems and measurements: Point to point links, systems considerations, Link Power budget, Rise time budget, Line coding, NRZ Codes, RZ Codes. WDM Features, Operational principles of WDM, Types of WDM, SONET/SDH Networks. Measurement of attenuation and dispersion.

Text Books:

1. Gerd Keiser, Optical Fiber Communications, Mc Graw-Hill International edition, 4th Edition, 2008.
2. John M. Senior, Optical Fiber Communications, PHI, 2nd Edition, 2002.

Reference Books:

1. Joseph C. Palais, Fiber Optic Communications, Pearson Education, 4th Edition, 2004.
2. Govind P. Agarwal, Fiber Optic Communication Systems, John Wiley, 3rd Edition, 2004.

B.Tech. (VII Sem.)	20EC24 – MICRO-ELECTRO-MECHANICAL SYSTEMS	L	T	P	Cr.
		3	0	0	3

Prerequisite: Applied Physics, Transducers, VLSI Design.

Course Educational Objective (CEO): In this course students will learn about fundamentals of Micro-Electro-Mechanical-Systems, importance of miniaturization, scaling laws, Bulk & Surface Micromachining techniques including structures and working details of MEMS based sensors & actuators.

COURSE OUTCOMES (COs): After completion of the course, students will be able to:
CO1: Understand the micro systems, microelectronics & miniaturization technique. **(Understand –L2)**
CO2: Illustrate the scaling laws necessary for micro systems including Bulk and Surface micromachining techniques used for MEMS fabrication. **(Understand –L2)**
CO3: Classify and discuss the properties of materials suitable for Microsystems. **(Understand – L2)**
CO4: Examine the design aspects, sensing mechanisms and limitations of MEMS based devices. **(Apply –L3)**

UNIT – I: [8 Hrs]
OVERVIEW OF MEMS: Microsystems definitions and examples, Difference between Microsystems and Microelectronics, Benefits of miniaturization.
SCALING LAWS IN MINIATURIZATION: Introduction to Scaling, Scaling in Geometry, Scaling in Electrostatic forces. MEMS Design Considerations.

UNIT – II: [9 Hrs]
MICRO FABRICATION –I: Introduction, Photolithography, Photoresist and Application, Light Sources, Photoresist Removal, Ion Implantation, Diffusion, Oxidation, Chemical Vapour Deposition (CVD), Sputtering, Deposition by Epitaxial, Etching.

UNIT – III: MICRO FABRICATION – II [9 Hrs]
Bulk Micromachining: Etching-Isotropic and Anisotropic, Wet Etching and Dry Etching-Plasma, Deep reactive ion, comparison.
Surface Micromachining: Process, Associated Mechanical Problems, LIGA Process, MEMS Packaging.

UNIT – IV: MATERIALS FOR MEMS:
Introduction, Substrates & wafers, Active Substrate Materials, Silicon as a Substrate Material, Silicon Compounds, Piezoelectric Crystals, Polymers, Packaging Materials.

UNIT – V: MEMS DEVICES AND STRUCTURES
Micro sensors: Biomedical Sensors, Chemical sensors, Optical Sensors, Pressure Sensors, Thermal Sensors.
Micro actuation: Actuation using thermal forces, Piezoelectric crystals, MEMS with microactuators: Microgrippers, Micromotors, Microgears, Micropumps.

TEXTBOOKS
1. Tai-Ran Hsu, "MEMS & Microsystems: Design, Manufacture and Nanoscale Engineering", John Wiley & Sons, New Jersey, 2nd Edition, 2008.

2. G.K. Ananthasuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat, V.K. Aatre, "Micro andSmart Systems", John Wiley & Sons, India, 2010.

REFERENCES

1. Mark Madou, "Fundamentals of Micro fabrication", CRC Press, New York, 1997.
2. Dilip Kumar Bhattacharya, Brajesh Kumar Kaushik, "Micro-Electro-mechanical Systems", CLIndia; 1st Edition,2014.

B.Tech. (VII Sem.) **20EC25 – RADAR SYSTEMS**

L	T	P	Cr.
3	0	0	3

Pre-requisites: Antennas, Microwave Engineering

Course Educational Objective: This course provides the knowledge on different types of RADARs with their operation and applications. The course gives an idea about different Tracking techniques and Radar subsystems. The course also gives the way to detect Radar signals in the presence of noise.

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

CO1	Understand the basic concepts of Radar systems. **(Understand – L2)**
CO2	Analyze the CW Radar and FMCW Radar system for the measurement of speed and distance. **(Analyze – L4)**
CO3	Apply the techniques to remove the clutter using MTI Radar and Pulse Doppler Radar. **(Apply – L3)**
CO4	Design the matched filter for radar echoes. **(Apply – L3)**

UNIT – I **[9 Hrs]**

Radar fundamentals: Radar range, Maximum Unambiguous Range, Multiple time around echo, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies, Radar Applications, Prediction of Radar Range Performance, Minimum Detectable Signal, Receiver Noise and SNR, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets-sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses.

UNIT – II **[9 Hrs]**

Continuous Wave and Frequency Modulated Continuous Wave Radar: Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar. FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/Receding Targets), FM-CW altimeter, Measurement Errors, Multiple Frequency CW Radar.

UNIT – III **[8 Hrs]**

MTI and Pulse Doppler Radar: MTI Radar – Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters, MTI Radar Parameters, Limitations to MTI Performance, Non-coherent MTI, MTI versus Pulse Doppler Radar.

UNIT – IV **[8 Hrs]**

Tracking Radar: Sequential Lobing, Conical Scan, Monopulse Tracking Radar – Amplitude Comparison Monopulse (one- and two coordinates), Phase Comparison Monopulse. Target Reflection Characteristics and Angular Accuracy, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

Detection of Radar Signals: Matched Filter Receiver Response Characteristics, Correlation function and Cross-correlation Receiver, Efficiency of non-matched Filter, Matched Filter with non-white Noise.

UNIT-V **[8 Hrs]**

Radar Equipment: Radar receivers -Noise Figure and Noise Temperature, Radar displays-types, significance; Radar duplexers-Branch type and Balanced type and Circulator type; Radar antennas- Radiation Pattern, Beam steering and Beam width changes, Series versus Parallel Feeds, Applications, Advantages and Limitations.

TEXT BOOK

1. Merrill I. Skolnik ,"Introduction to Radar Systems", Second edition, McGraw-Hill, 1981.
2. GSN Raju, "Radar Engineering and Navigational aids", IK International Publishers, New Delhi.

REFERENCES

1. G. Sasibhushana Rao, "Microwave and Radar Engineering", Pearson Education publishers.
2. M Kulakarni, "Microwave and Radar Engineering", Umesh Publications, New Delhi 5th Edition

B.Tech. (VII Sem.) **20EC26 – WIRELESS SENSOR NETWORKS**

L	T	P	Cr.
3	0	0	3

Pre-Requisites: Digital communications and Computer Networks

Course Educational Objective: This course provides the knowledge on applications, architectures, and protocols of wireless sensor networks, controlling, clustering, localization in sensor networks, software platforms and tools required for wireless sensor networks.

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

CO1: Interpret the operation of wireless sensor network elements. (**Understand-L2**).
CO2: **Examine** different communication protocols of wireless sensor networks and its applications (**Apply-L3**).
CO3: **Outline** sensor tasking and techniques used to establish infrastructure of wireless sensor networks (**Understand-L2**).
CO4: **Apply** the knowledge of sensor network platforms and tools for sensor network application development (**Apply-L3**).

UNIT-I **[8 Hrs]**
Overview of Wireless Sensor Networks: Applications, Unique constraints and Challenges, Characteristic Requirements and mechanisms; Advantages of Sensor Networks, Collaborative processing and Key definitions, Difference between Mobile Ad-hoc and Sensor Networks, Classification, Enabling technologies.

UNIT-II **[8Hrs]**
Architectures: Single Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes- Operating states with different Power Consumption, Energy consumption of Transceiver, Micro controller; Memory; Dynamic Voltage Scaling, Relation between Computation and Communication, commercially available sensor nodes; Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

UNIT-III **[10Hrs]**
Networking Sensors: Wireless channel and Communication fundamentals, Physical Layer and Transceiver design considerations in WSNs; MAC Protocols for Wireless Sensor Networks, Low Duty Cycle protocols and Wakeup concepts- S-MAC, The IEEE 802.15.4 MAC protocol, Wakeup Radio Concepts; Routing Protocols- Energy efficient routing, Geographic routing, Routing Challenges and Design Issues in wireless sensor networks.

UNIT – IV **[8Hrs]**
Infrastructure Establishment: Topology Control, Clustering, Time Synchronization, Localization & Positioning, Sensor Tasking & Control- Task driven sensing, Role of sensor nodes & utilities, Information based sensor tasking.

UNIT – V **[8Hrs]**
Sensor Network Platforms and Tools: Operating Systems for Wireless Sensor Networks, Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – network simulator-NS-2, Node-level Simulators, State-centric programming.

TEXT BOOKS

1. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.
2. Holger Karl & Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, 2005.

REFERENCES

1. KazemSohraby, Daniel Minoli, &TaiebZnati, “Wireless Sensor Networks- Technology, Protocols, And Applications”, John Wiley, 2007.
2. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.

B.Tech. (VII Sem.) **20EC27 – LOW POWER VLSI DESIGN**

L	T	P	Cr.
3	0	0	3

Pre-requisites: Digital Electronic Circuits and VLSI Design.

Course Educational Objectives: This course provides knowledge on fundamentals of low power VLSI design concepts, circuits and subsystems.

Course Outcomes (COs): At the end of this course, student will be able to

CO1: Summarize the Fundamental concepts of Low Power VLSI Design.**(Understand – L2)**
CO2: Apply Low Power Design Approaches for IC designs. **(Apply – L3)**
CO3: Analyze low voltage low power memories using mathematical models. **(Analyze – L4)**
CO4: Design low voltage low power adders and multipliers. **(Apply – L3)**

UNIT-I [8Hrs]

Fundamentals of Low Power CMOS VLSI Design: Introduction, Sources of Power Dissipation, Static Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitch Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering, Body effect, Gate-induced Drain Leakage, Active power dissipation.

UNIT-II [8Hrs]

Circuit techniques for Low-Power Reduction: Concepts of leakage power, Circuit techniques for Leakage power reduction-Standby leakage control, Multi-V_{th} technique, Supply voltage scaling, VTMOS circuits, DTMOS circuits, Dynamic-V_{th} technique

UNIT-III [9Hrs]

Low-Voltage Low-Power Adders: Introduction, Standard Adder Cells, CMOS Adder's Architectures - Ripple Carry Adders, Carry Select Adders, Carry Save Adders, Performance evaluation of various adder architectures.

UNIT-IV

Low-Voltage Low-Power Multipliers: Review of Multiplication, Multiplier Architectures - Braun Multiplier, Baugh-Wooley Multiplier, Booth Multiplier; Introduction to Wallace Tree Multiplier.

UNIT-V

Low-Voltage Low-Power Memories: Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

TEXT BOOK

1. Low-Voltage, Low-Power VLSI Subsystems – Kiat-Seng Yeo and Kaushik Roy, Mc Graw Hill Education, 2016.

REFERENCES

1. Low Power CMOS VLSI Circuit Design – Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000.
2. Practical Low Power Digital VLSI Design – Gary K. Yeap, Kluwer Academic Press, 2002.

B.Tech. (VII Sem.) 20EC28 – BIOMEDICAL SIGNAL PROCESSING

L	T	P	Cr.
3	0	0	3

Pre-requisites: Digital Signal Processing

Course Educational Objective: This course provides the fundamental knowledge on biomedical signals with emphasis on processing of EEG and ECG signals including adaptive interference and noise cancellation.

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

- **CO1** Illustrate the characteristics of EEG and ECG signals. **(Understand – L2)**
- **CO2** Describe the behavior of EEG signals with Linear prediction & Autoregressive methods and ECG signals with detection and estimation techniques. **(L2-Understand)**
- **CO3** Apply adaptive filtering and data compression techniques on ECG data. **(L3-Apply)**
- **CO4** Summarize the concepts of Prony's methods for clinical applications. **(L2-Understand)**

Unit-I [9Hrs]

Neurological Signal Processing: Brain and its potentials, Electrophysiological origin of Brain waves, EEG Signals and its Characteristics, EEG Analysis, Linear prediction theory, The autoregressive(AR) method, Recursive Estimation of AR parameters, Spectral Error measure, Adaptive segmentation, Transient Detection and Elimination.

UNIT-II [8Hrs]

Cardiological Signal Processing:

Basic Electrocardiography, ECG Data Acquisition, ECG Lead system, ECG Parameters and their estimation: ECG QRS Detection Technique, Estimation of R-R Interval, Estimation of ST Segmentation Inclination.

UNIT-III [9Hrs]

Adaptive Interference/Noise Cancellation: A review of the Wiener Filtering Problem, Principle of an Adaptive Filter, The Steepest-Descent Algorithm, Widrow-Hoff Least-Mean-Square Adaptive Algorithm, Adaptive Noise Canceller: Cancellation of 60Hz Interference in Electrocardiography, Cancelling Donor - heart Interference in Heart-transplant Electrocardiography, Cancelling of Maternal ECG in Fetal Electrocardiography and High Frequency Noise in Electro-surgery.

UNIT-IV [8Hrs]

ECG Data Reduction Techniques: Direct Data compression Technique, Direct ECG Data Compression Technique, Transformation Compression Technique, Comparison.

UNIT-V [8Hrs]

Prony's Method: Exponential Modeling, Exponential parameter estimation, The original Prony's Problem, Least Squares Prony's Method, The Covariance Method of Linear Prediction, Prony's Method in the Presence of Noise, Clinical Applications of Prony's Method.

TEXT BOOK

1. D.C.Reddy, "*Biomedical Signal Processing- Principles and Techniques*", 2005, Tata McGraw Hill.
2. R.S. Khandpur, Biomedical Instrumentation, McGraw Hill publications

REFERENCE BOOKS

1. Miten Akay, "*Biomedical Signal Processing*", Academic Press, Inc 1994
2. Cohen.A, "*Biomedical Signal Processing -Vol. I Time & Frequency Analysis*", 1986, CRC Press.

B.Tech. (VII Sem.)	20EC29 – CELLULAR AND MOBILE COMMUNICATION	L	T	P	Cr.
		3	0	0	3

Pre-requisites: Analog and digital communications, Fundamentals of antennas.

Course Educational Objective: This course provides the knowledge on operation of cellular systems, techniques to improve the capacity of a cellular system, types of fading and its effects on the radio signal, methods to reduce channel interference, hand-off mechanisms, multiple access techniques and digital cellular systems.

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

CO1	**Outline** the concepts and operational principles of cellular systems **(Understand-L2)**
CO2	**Summarize** the multiple access techniques and evolution of cellular technologies. **(Understand-L2)**
CO3	**Examine** interferences, performance parameters, cell site & mobile antennas and methodologies to improve the cellular capacity. **(Apply-L3)**
CO4	**Analyze** the effects of radio propagation models, Frequency Management, Channel Assignment, handoff, and call drops in cellular communications **(Analyze-L4).**

UNIT – I [8Hrs]

Introduction to Cellular Systems: Basic cellular system, Operation of cellular systems, Call establishment, Operational channels, Performance criteria, concept of Digital cellular system. Hexagonal shaped cells, Frequency Reuse, Cell splitting, Sectoring, Microcell zone concept.

UNIT – II **[9Hrs]**

Mobile Radio Propagation: Basics of mobile radio propagation mechanisms, Free space propagation, Link budget design, Propagation models, small-scale multipath propagation, factors influencing the fading, Types of small-scale fading.

Cell Site Antennas and Mobile Antennas: Types - Omni directional antennas, directional antennas, sectoring, Mobile antenna types.

UNIT – III **[9Hrs]**

Interference in cellular mobile system: Introduction to Co-Channel Interference, procedure to find nearest neighbors of a particular cell, Co-channel Interference Reduction Factor, Desired C/I from a normal and worst case in an omni-directional and directional Antenna system, impact on co-channel interference by lowering the antenna height, non co-channel interference.

UNIT – IV **[8Hrs]**

Frequency Management and Channel Assignment: Numbering and grouping, setup channels, access channels and paging channels, channel assignments to cell sites and mobile units, overlaid cells, channel sharing and borrowing.

Handoffs and Dropped Calls: Types of handoff, initiation, delaying handoff, forced handoff, mobile assigned handoff, Intersystem handoff, dropped call rate.

UNIT – V **[8Hrs]**

Digital Cellular Systems: multiple access schemes: FDMA, TDMA, CDMA. 2G Systems- GSM system architecture. 3G Systems- architecture of WCDMA, 4G system- 4G network standards, LTE architecture, OFDMA, introduction to 5G technologies. Comparison of cellular technologies.

TEXT BOOKS:

1. William C.Y. Lee,"Mobile Cellular Telecommunications", Tata McGraw Hill, 2nd Edition,2006.
2. Gottapu Sasibhushana Rao, "Mobile Cellular Communication", Pearson Education,1stEdition, 2013.

REFERENCES:

1. Theodore S. Rappaport, "Wireless Communications", Pearson Education, 2nd Edition, 2002.
2. R. Vannithamby and S. Talwar, *Towards 5G: Applications, Requirements and Candidate Technologies.*, John Willey & Sons, West Sussex, 2017

B.Tech. (VII Sem.)	20HS02– Management Science for Engineers	L	T	P	Cr.
		3	0	0	3

Course Description:

In this course, students will learn fundamental concepts and contributions of management. This course also teaches human resources practices which play a vital role in the organisation it gives knowledge about use of improve quality of work and project management.

Course Objectives:

1. To make students understand management, its principles, contribution to management, organization, and its basic issues and types
2. To make students understand the concept of plant location and its factors and plant layout and types, method of production and work study importance
3. To understand the purpose and function of statistical quality control. And understand the material management techniques
4. To make students understand the concept of HRM and its functions
5. To make students understand PERT & CPM methods in effective project management and need of project crashing and its consequence on cost of project

Course Outcomes:

CO1: Understand management principles to practical situations based on the organization structures**. (L2)**

CO2: Design Effective plant Layouts by using work study methods. **(L2)**

CO3: Apply quality control techniques for improvement of quality and materials management. **(L3)**

CO4: Develop best practices of HRM in corporate Business to raise employee productivity. **(L2)**

CO5: Identify critical path and project completion time by using CPM and PERT techniques. **(L3)**

UNIT I

Introduction: Management - Definition, Nature, Importance of management Functions of Management - Taylor's scientific management theory, Fayal's principles of management, Contribution of Elton mayo,Maslow, Herzberg, Douglas MC Gregor, Basic Concepts Of Organisation- Authority, Responsibility Delegation of Authority, Span of control, Departmentation and Decentralization - Organisation structures(Line organization, Line and staff organization, Functional organization, Committee organization, Matrix organization)

UNIT II

Operations Management: Plant location, Factors influencing location,Principles and types of plant layouts - Methods of production (job, batch and mass production), Work study - Basic procedure involved in method study and Work measurement

UNIT III

Statistical quality control –Concept of Quality & Quality Control-functions ,Meaningof SQC -Variables and attributes - X chart, R Chart, C Chart, P Chart,(simple Problems) Acceptance sampling, Sampling plans, Deming's contribution to quality.

Materials management –Meaning and objectives,inventory control-Need for inventory control, Purchase procedure, Store records, EOQ, ABC analysis, Stock levels

UNIT IV

Human Resource management (HRM): Concepts of HRM, Basic functions of HR manager:Man power planning, Recruitment, Selection, Training and development, Placement, Wage and salary administration, Promotion, Transfers Separation, performance appraisal, Job evaluation and merit rating.

UNIT V

Project management: Early techniques in project management - Network analysis: Programme evaluation and review technique (PERT), Critical path method (CPM), Identifying critical path, Probability of completing project within given time, Project cost analysis, project crashing (simple problems)

Text Books:

Dr. A.R.Aryasri, Management Science, TMH, 10th edition, 2012

References:

1. Koontz & weihrich – Essentials of management, TMH, 10th edition, 2015
2. Stoner, Freeman, Gilbert, Management, 6th edition Pearson education, New Delhi, 2004
3. O.P. Khana, Industrial engineering and Management L.S.Srinath, PERT & CPM

B.Tech. (VII Sem.) **20EC30 - INTERNET OF THINGS**

L	T	P	Cr.
1	0	2	2

PREREQUISITE: EMI, MPMC, Python Programming.

COURSE EDUCATIONAL OBJECTIVE (CEO):

In this course, student will learn about basics of IoT and procedure to develop prototypes for engineering applications.

Course Outcomes (COs): At the end of this course, students will be able to

CO1: Understand the programming concepts of IOT. (**Understand – L2)**
CO2: Develop real time applications using Internet of Things. (**Apply – L3**
CO3: Demonstrate the integration of sensors with IOT. (**Understand – L2)**
CO4: Adapt effective Communication, presentation and report writing skills **(Apply – L3)**

UNIT – I: IoT Basics:

IoT, Frame work, Architectural View, Technology, Sources, M2M communication, Sensors, Participatory sensing, RFID, Wireless sensor network elements

UNIT – II: IoT Applications:

Prototyping embedded devices for M2M and IoT, M2M and IoT case studies.

TEXTBOOK:

1. Raj Kamal, Internet of Things - Architecture and Design Principles, McGraw Hill Publication, 2017.
2. Zach Shelby, Carsten Bormann: "The Wireless Embedded Internet", Wiley, 1st Edition.

REFERENCES:

1. Arshdeep Bahga and Vijay Madisetti, Internet of Things – A Hands-on Approach, University Press, 2015
2. Reema Thareja, "Python Programming using Problem Solving Approach", Oxford Press.

HANDS – ON LABORATORY SESSIONS

1. Interfacing LED. DHT11- Temperature and, humidity sensor using Arduino
2. Interfacing Ultrasonic sensor and PIR sensor using Arduino
3. Design of Traffic Light Simulator using Arduino
4. Design of Water flow detection using an Arduino board
5. Interfacing of LED, Push button with Raspberry Pi and Python Program
6. Design of Motion Sensor Alarm using PIR Sensor
7. Interfacing DHT11-Temperature andHumidity Sensor with Raspberry Pi
8. Interfacing DS18B20 Temperature Sensor with Raspberry Pi
9. Implementation of DC Motor and Stepper Motor Control with Raspberry Pi
10. Raspberry Pi based Smart Phone Controlled Home Automation
11. Smart Traffic light Controller
12. Smart Health Monitoring System