Scheme of Instruction and Syllabi

Bachelor of Engineering

A FOUR YEAR (I – VIII Semesters) UG Program

in

ELECTRONICS AND COMMUNICATION ENGINEERING

(Revised AICTE Model Curriculum with effect from AY 2024-25)

R-22 (A) Regulation

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
(Autonomous Institution under UGC, Affiliated to Osmania University)
Department of Electronics and Communication Engineering
Accredited by NBA and NAAC-UGC
Chaitanya Bharathi (Post), Gandipet, Hyderabad–500075

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

OUR MOTTO: SWAYAM TEJASWIN BHAVA

Institute Vision		To be a Centre of excellence in technical education and research.
Institute Mission		To address the emerging needs through quality technical education and advanced research.
Department Vision		To emerge as a vibrant model of excellence in education, research and innovation in Electronics and Communication Engineering.
Department Mission	M1	To impart strong theoretical and practical knowledge of the state of art technologies to meet growing challenges in the industry.
	M2	To carry out the advanced and need based research in consultation with the renowned research and industrial organizations.
	M3	To create entrepreneurship environment including innovation, incubation and encourage to patent the work.
PEO 1		Engage successfully in professional career and/or pursue higher education in Electronics and Communication and allied areas.
PEO 2		Pursue research, design and development of state-of-the art systems applying the knowledge of Electronics and Communication engineering.
PEO 3		Begin start-ups and involve in entrepreneurship activities by adopting changing professional and societal needs.
PEO 4		Exhibit professional ethics and values with lifelong learning and work effectively as individuals/team members in multidisciplinary projects.
PSO 1		Ability to apply the acquired knowledge of core subjects in design and development of Communications/Signal processing / VLSI / Embedded systems.
PSO 2		Analyze and solve the complex Electronics and Communication engineering problems using state-of-art hardware and software tools.
PSO 3		Develop innovative technologies for Entrepreneurship based on the research outcomes of Electronics and Communication engineering.

Program Outcomes of BE (ECE) Program

1. Engineering Knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems
2. Problem Analysis	Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/Development of Solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
4. Conduct Investigations of Complex Problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern Tool Usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.
6. The Engineer and Society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and Sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and Teamwork	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication	Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project Management and Finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long Learning	Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

AICTE Model Curriculum with effect from AY 2024-25

BE (Electronics and Communication Engineering)

SEMESTER – I

S.no	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours Per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	22MTC02	Calculus	3	1	-	3	40	60	4
2	22CYC01	Chemistry	3	-	-	3	40	60	3
3	22EEC01	Basic Electrical Engineering	2	1	-	3	40	60	3
4	22CSC40	Problem Solving and Programming using Python	2	1	-	3	40	60	3
PRACTICALS									
5	22CYC02	Chemistry Lab	-	-	3	3	50	50	1.5
6	22MBC02N	Community Engagement	-	-	2	-	50	-	1
7	22CSC41	Problem Solving and Programming using Python Lab	-	-	3	3	50	50	1.5
8	22MEC37N	Robotics and Drones Lab	-	1	3	-	100	-	2.5
9	22EEC02	Basic Electrical Engineering Lab	-	-	2	3	50	50	1
Total			**10**	**4**	**13**	**21**	**460**	**390**	**20.5**
Clock Hours Per Week: 27									

L: Lecture D: Drawing **CIE: Continuous Internal Evaluation**

T: Tutorial P: Practical/Project Seminar/Dissertation SEE: Semester End Examination

22MTC02

CALCULUS
(Common to ECE, EEE, MECH, CHEM, CIVIL)

Instruction	3 L + 1T Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Course Objectives:

This course aims to:

1. To explain the solutions of system of linear equations by Matrix Methods.
2. To discuss mean value theorems.
3. To explain the Partial Derivatives and the extreme values of functions of two variables.
4. To explain the shape of curves, their areas and volumes of revolutions.
5. To discuss the convergence and divergence of the series.

Course Outcomes:

Upon completing this course, students will be able to:

1. Apply the Matrix Methods to solve system of linear equations.
2. Analyze the geometrical interpretation of Mean value theorems and curvature.
3. Determine the extreme values of functions of two variables.
4. Find the shape of the curve, surface areas and volumes of revolution.
5. Examine the convergence and divergence of infinite Series.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	3	-	-	-	-	-	-	-	2	3	3	1
CO 2	3	3	3	3	-	-	-	-	-	-	-	2	3	3	1
CO 3	3	3	3	3	-	-	-	-	-	-	-	2	3	3	1
CO 4	3	3	3	3	-	-	-	-	-	-	-	2	3	3	1
CO 5	3	3	3	1	-	-	-	-	-	-	-	1	3	3	1

UNIT-I

Matrices: Rank of a matrix, Echelon form, consistency of linear system of equations, Linear dependence and independence of vectors. Eigen values, Eigenvectors, Properties of Eigen values and Eigen vectors, Cayley Hamilton theorem, Quadratic form, Reduction of quadratic form to canonical form by linear transformation, Nature of quadratic form.

UNIT-II

Calculus: Rolle's Theorem, Lagrange's Mean value theorem, Cauchy's Mean value theorem (without proofs). Curvature, Radius of curvature, Centre of curvature, Evolute and Involute, Envelopes.

UNIT-III

Partial Differentiation and Its Applications: Functions of two or more variables, Partial derivatives, Higher order partial derivatives, Total derivative, Differentiation of implicit functions, Jacobians, Taylor's expansion of functions of two variables, Maxima and minima of functions of two variables.

UNIT-IV

Applications of definite integrals: Curve tracing of standard curves (Cartesian only), Applications of definite integrals to evaluate length of curves, surface areas and volumes of revolutions.

UNIT-V

Sequences and Series: Convergence of sequence and series. Tests for convergence of series: Comparison test, limit comparison test, D'Alembert's ratio test, Raabe's test, Cauchy's root test, Alternating series, Leibnitz's series, absolute and conditional convergence**.**

Text Books:

1. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

Suggested Reading:

1. B.V.Ramana., Higher Engineering Mathematics, Tata McGraw-Hill, New Delhi, 11th Reprint, 2010.
2. R.K.Jain, S.R.K.Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5th edition, 2016.
3. David.Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/ Cole, 2005.

e-Resources:

1. https://archive.nptel.ac.in/courses/111/107/111107112/(Unit-1,3 and 5)
2. NPTEL :: Mathematics - NOC:Differential Calculus in Several Variables- https:// archive. nptel.ac.in /courses/ 111/104/111104085/(Modules- 1,2,4, and 5)
3. NPTEL :: Mathematics - NOC:Advanced Calculus For Engineers (Week- 1,2,3 and 4)

22CYC01

CHEMISTRY

(Common to All Branches)

Instruction	3L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aims to:

1. This syllabus helps at providing the concepts of chemical bonding and chemical kinetics to the students aspiring to become practicing engineers.
2. Thermodynamic and Electrochemistry units give conceptual knowledge about processes and how they can be producing electrical energy and efficiency of systems.
3. To teach students the value of chemistry and to improve the research opportunities knowledge of stereochemistry and organic reactions is essential.
4. Water chemistry unit impart the knowledge and understand the role of chemistry in the daily life.
5. New materials lead to discovering of technologies in strategic areas for which an insight into Polymers, nanomaterials and basic drugs of modern chemistry is essential.

Course Outcomes:

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

1. Identify the microscopic chemistry in terms of molecular orbitals, intermolecular forces and rate of chemical reactions.
2. Discuss the properties and processes using thermodynamic functions, electrochemical cells and their role in batteries and fuel cells.
3. Illustrate the major chemical reactions that are used in the synthesis of organic molecules.
4. Classify the various methods used in treatment of water for domestic and industrial use.
5. Outline the synthesis of various Engineering materials & Drugs.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	-	-	2	2	-	-	-	-	2	1	1	1
CO 2	3	2	3	-	-	2	2	-	-	-	-	2	1	1	1
CO 3	3	2	2	-	-	2	2	-	-	-	-	2	1	1	1
CO 4	3	2	2	-	-	2	2	-	-	-	-	2	1	1	1
CO 5	3	2	3	-	-	2	2	-	-	-	-	2	1	1	1

UNIT-I

Atomic and molecular structure and Chemical Kinetics:

Atomic and molecular structure: Molecular Orbital theory - atomic and molecular orbitals. Linear combination of atomic orbitals (LCAO) method. Molecular orbitals of diatomic molecules. Molecular Orbital Energy level diagrams (MOED) of diatomic molecules & molecular ions (H_2 , He_2^+ ,N_2 , O_2 , O_2^-, CO, NO). Pi- molecular orbitals of benzene and its aromaticity.

Chemical Kinetics: Introduction, Terms involved in kinetics: rate of reaction, order & molecularity; First order reaction-Characteristics: units of first order rate constant & its half-life period, second order reaction-Characteristics: units of second order rate constant & its half- life period. Numericals.

UNIT-II

Use of free energy in chemical equilibria

Use of free energy in chemical equilibria: Thermodynamic functions: Internal energy, entropy and free energy. Significance of entropy and free energy (criteria of spontaneity). Free energy and emf (Gibbs Helmholtz equations and its applications). Cell potentials, electrode potentials – Reference electrodes (NHE, SCE) - electrochemical series. Nernst equation and its applications. Determination of pH using combined Glass & Calomel electrode. Potentiometric Acid base & Redox Titrations. Numericals.

Battery technology: Rechargeable batteries & Fuel cells.

Lithium batteries: Introduction, construction, working and applications of Li-MnO_2 and Li-ion batteries.
Fuel Cells: Introduction, difference between conventional cell and fuel cell, limitations & advantages.
Construction, working & applications of methanol-oxygen fuel cell.

UNIT- III

Stereochemistry and Organic reactions

Stereochemistry: Representations of 3 dimensional structures, Types of stereoisomerism- Conformational isomerism – confirmations of n-butane (Newman and sawhorse representations), Configurational isomerism - Geometrical (cis-trans) isomerism & Optical isomerism- optical activity, Symmetry and chirality: Enantiomers (lactic acid) & Diastereomers (Tartaric acid), Absolute configurations, Sequence rules for R&S notation.

Types of Organic reactions: Substitution Reactions- Electrophilic substitution (Nitration of Benzene); Nucleophilic Substitution (S_N1& S_N2); Free Radical Substitution (Halogenation of Alkanes)

Addition Reactions: Electrophilic Addition – Markonikoff's rule, Free radical Addition - Anti Markonikoff's rule (Peroxide effect), Nucleophilic Addition – (Addition of HCN to carbonyl compounds)

Eliminations-E1 and E2 (dehydrohalogenation of alkyl halides).

Cyclization (Diels - Alder reaction)

UNIT–IV

Water Chemistry

Hardness of water – Types, units of hardness, Disadvantages of hard water, Alkalinity and Estimation of Alkalinity of water, Boiler troubles - scales & sludge formation, causes and effects, Softening of water by lime soda process (Cold lime soda process), ion exchange method and Reverse Osmosis. Specifications of potable water & industrial water. Disinfection of water by Chlorination; break point chlorination, BOD and COD definition, Estimation (only brief procedure) and significance, Numericals.

UNIT-V

Engineering Materials and Drugs:

Introduction, Terms used in polymer science; Thermoplastic polymers (PVC) &Thermosetting polymers (Bakelite); Elastomers (Natural rubber). Conducting polymers- Definition, classification and applications.

Polymers for Electronics: Polymer resists for integrated circuit fabrication, lithography and photolithography.

Nano materials-Introduction to nano materials and general applications, basic chemical methods of preparation-Sol-gel method. Carbon nanotubes and their applications. Characterisation of nanomaterials by SEM and TEM (only Principle).

Drugs-Introduction, Synthesis and uses of Aspirin (analgesic), Paracetamol (Antipyretic), Atenolol (antihypertensive).

Text Books:

1. P.C. Jain and M. Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company Ltd.,New Delhi,16th edition (2015).
2. W.U. Malik, G.D.Tuli and R.D.Madan, "Selected topics in Inorganic Chemistry", S Chand & Company Ltd, New Delhi, reprint (2009).
3. R.T. Morrison, R.N. Boyd and S.K. Bhattacharjee, "Organic Chemistry", Pearson, Delhi, 7th edition (2019).
4. A Textbook of Polymer Science and Technology , Shashi Chawla,Dhanpat Rai & Co. (2014)
5. T. Pradeep, Nano: The Essentials, Tata McGraw-Hill Education, Delhi, 2012
6. G.L. David Krupadanam, D. Vijaya Prasad, K. Varaprasad Rao, K.L.N. Reddy and C.Sudhakar, "Drugs", Universities Press (India) Limited, Hyderabad (2007).

Suggested Readings:

1. B. H. Mahan, "University Chemistry", Narosa Publishing house, New Delhi, 3rd edition (2013).
2. B.R. Puri, L.R. Sharma and M.S. Pathania, "Principles of Physical Chemistry", S. Nagin Chand & Company Ltd., 46th edition (2013).
3. T.W. Graham Solomons, C.B. Fryhle and S.A. Snyder, "Organic Chemistry", Wiley, 12th edition (2017).
4. P.W. Atkins, J.D. Paula, "Physical Chemistry", Oxford, 8th edition (2006).

22EEC01 **BASIC ELECTRICAL ENGINEERING**

Instruction	2L + 1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aims to:

1. To understand the behaviour of different circuit elements R, L & C, and the basic concepts of electrical AC circuit analysis
2. To comprehend the basic principle of operation of AC and DC machines
3. To infer about different types of electrical wires and cables, domestic and industrial wiring. safety rules and methods of earthing.

Course Outcomes:

After the completion of this course, the student will be able to:

1. Understand the concepts of Kirchhoff's laws and their application various theorems to get solution of simple dc circuits.
2. Predict the steady state response of RLC circuits with AC single phase/three phase supply.
3. Infer the basics of single phase transformer
4. Describe the construction, working principle of DC machine and 3-phase Induction motor.
5. Acquire the knowledge of electrical wires, cables, earthing, Electrical safety precautions to be followed in electrical installations and electric shock and its safety and energy calculations.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	-	-	-	-	-	1	2	-	3	3	3	2
CO 2	3	3	2	-	-	-	-	-	1	2	-	3	3	3	2
CO 3	3	3	2	1	-	-	-	-	1	2	-	3	3	3	2
CO 4	2	1	-	-	-	-	-	-	1	2	-	3	3	3	2
CO 5	2	-	2	-	-	-	-	-	1	2	-	3	3	3	2

UNIT-I

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation, Superposition, Thevenin's and Norton's Theorems.

UNIT-II

AC Circuits: Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, series RL and RC. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-III

Single Phase Transformer: Construction, Working principle, EMF Equation, Ideal and Practical transformer, Equivalent circuit of Transformer, OC and SC tests on a transformer, Efficiency and Regulation

UNIT-IV

DC and AC Machines: DC Generators: Construction, Principle of operation, EMF equation, Classification, Characteristics of shunt generators. DC Motors: Classification, Torque Equation, Characteristics and Speed control of DC Shunt and Series Motors, Losses and efficiency Three - Phase Induction Motors: Principle of operation, Applications

UNIT-V

Electrical Installations: Electrical Wiring: Types of wires and cables, Electrical Safety precautions in handling electrical appliances, electric shock, first aid for electric shock, safety rules.

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, Earthing (Elementary Treatment only), Elementary calculations for energy consumption.

Text Books:

1. L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
2. E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

Suggested Reading:

1. D. P. Kothari & I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989
3. D.C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009
4. P.V. Prasad, S. Sivanagaraju, R. Prasad, "Basic Electrical and Electronics Engineering" Cengage Learning, 1st Edition, 2013.

22CSC40

PROBLEM SOLVING AND PROGRAMMING USING PYTHON

Instruction	2L +1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic Computer Skills.

Course Objectives:

This course aims to:

1. Master the fundamentals of writing Python scripts, learn core Python scripting elements such as variables, data types, operators and flow control structures.
2. Discover how to work with lists and sequence data and write Python functions to facilitate code reuse.
3. Explore Python Arrays, Perform Searching/Sorting using Collections, Use Python to read and write files.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand real world problems and Create algorithms/flowcharts/decision tables for solving those problems.
2. Interpret the data types, operators and tokens of Python for solving basic programming solutions.
3. Apply the constructs like selection, repetition and functions to modularize the programs.
4. Analyze searching/sorting techniques to solve problems that involve finding and manipulating data.
5. Design and build applications with built-in modules and files.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	1	1	1	2	-	-	-	-	1	3	3	2
CO 2	3	3	3	1	1	1	2	-	-	-	-	2	3	3	2
CO 3	3	3	3	1	1	1	2	-	-	-	-	2	3	3	2
CO 4	3	3	2	1	1	-	2	-	-	-	-	2	3	3	2
CO 5	3	3	3	1	2	1	2	-	-	-	-	2	3	3	2

UNIT - I

Techniques of Problem Solving: Algorithms, Flowcharts, Decision Table, Programming methodologies viz. top-down and bottom-up programming.

Software requirements for programming: Operating System, Editor (IDE), Compiler, Linker, Loader.

Introduction to Python: Structure of a Python Program, Python program execution steps, Python Interpreter and Script mode of programming, Lines and Indentation, Identifiers and keywords, Literals, Python suite, comments, quotation in python.

UNIT – II

Data Types in Python: Numeric (integer, float, complex), Sequence type with Functions and Methods (string, list and nested/multidimensional lists, tuple), Boolean, Set with Functions and Methods, Dictionary with Functions and Methods, Binary types (bytearray, bytes, memoryview). Type Conversion, Input-Output functions.

UNIT – III

Python Operators: Arithmetic, Relational, Logical, Bitwise, Assignment, Identity and Membership, Ternary operator. Operator precedence and associativity.

Decision Control Statements: Selection/Conditional Branching, Loop Control Structures, Nested Loops.

Comprehensions: List, Dictionary, Set comprehensions.

UNIT – IV

Arrays: Array Definition, Initialization and Accessing elements:1D arrays using array module, 2D arrays using numpy module.

Functions and Modules: Uses of functions, Function definition, Function call, Parameter types, Variable scope and Lifetime, Recursion, Lambda functions.

UNIT – V

Searching and Sorting Techniques: Linear Search, Binary Search, Selection Sort, Bubble Sort.

File Handling: File types, opening and closing files, reading and writing files, file positions.

Text Books:

1. Taming Python by Programming, Jeeva Jose, Revised Edition 2019, Khanna Book Publications.
2. Python Programming, Reema Thareja, Oxford Press, 2017.
3. Let us Python, Yashavant Kanetkar and Aditya Kanetkar, First Edition, 2019, BPB Publications.

Suggested Reading:

1. Learn Python 3 the Hard Way, Zed A. Shaw, First Edition, 2018, Pearson Education Inc.
2. Python in easy steps: Makes Programming Fun, Mike Mc Grath, Kindle Edition, 2017.
3. The Python Standard Library by Example by Doug Hellmann, Second Edition, June 2017.

e-Resources:

1. https://onlinecourses.swayam2.ac.in/cec24_cs01/preview.
2. https://www.coursera.org/specializations/python.
3. https://www.python.org.
4. https://www.visual-paradigm.com/tutorials/decision-table-in-action.jsp.
5. https://www.coursera.org/specializations/python
6. https://www.python.org

22CYC02

CHEMISTRY LAB

(Common to All Branches)

Instruction	3P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits:	1.5

Course Objectives:

This course aims to:

1. To impart fundamental knowledge in handling the equipment / glassware and chemicals in chemistry laboratory.
2. To provide the knowledge in both qualitative and quantitative chemical analysis.
3. The student should be conversant with the principles of volumetric analysis.
4. To apply various instrumental methods to analyse the chemical compounds and to improve understanding of theoretical concepts.
5. To interpret the theoretical concepts in the preparation of new materials like drugs and polymers.

Course Outcomes:

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

1. Identify the basic chemical methods to analyse the substances quantitatively & qualitatively.
2. Estimate the amount of chemical substances by volumetric analysis.
3. Determine the rate constants of reactions from concentration of reactants / products as a function of time.
4. Calculate the concentration and amount of various substances using instrumental techniques.
5. Develop the basic drug molecules and polymeric compounds.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	-	-	2	2	-	-	-	-	2	1	1	1
CO 2	3	2	1	-	-	1	2	-	-	-	-	2	1	1	1
CO 3	3	2	3	-	-	2	2	-	-	-	-	2	1	1	1
CO 4	3	2	2	-	-	2	2	-	-	-	-	2	1	1	1
CO 5	3	2	3	-	-	2	2	-	-	-	-	2	1	1	1

Chemistry Lab

1. Introduction: Preparation of standard solution of oxalic acid and standardisation of NaOH.
2. Estimation of metal ions (Co^{+2}& Ni^{+2}) by EDTA method.
3. Estimation of temporary and permanent hardness of water using EDTA solution
4. Determination of Alkalinity of water
5. Determination of rate constant for the reaction of hydrolysis of methyl acetate. (first order)
6. Determination of rate constant for the reaction between potassium per sulphate and potassium Iodide. (second order)
7. Estimation of amount of HCl Conductometrically using NaOH solution.
8. Estimation of amount of HCl and CH_3COOH present in the given mixture of acids Conductometrically using NaOH solution.
9. Estimation of amount of HCl Potentiometrically using NaOH solution.
10. Estimation of amount of Fe^{+2} Potentiometrically using $KMnO_4$ solution
11. Preparation of Nitrobenzene from Benzene.
12. Synthesis of Aspirin drug and Paracetamol drug.
13. Synthesis of phenol formaldehyde resin.

Text Books:

1. J. Mendham and Thomas , "Vogel's text book of quantitative chemical analysis", Pearson education Pvt.Ltd. New Delhi ,6th ed. 2002.
2. Senior practical physical chemistry by B.D.Khosla, V.C.Garg&A.Gulati,; R. Chand & Co. : New Delhi (2011).

Suggested Readings:

1. Dr.Subdharani , "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing, 2012.
2. S.S. Dara , "A Textbook on experiment and calculation in engineering chemistry", S.Chand and Company, 9th revised edition, 2015.

22MBC02N

COMMUNITY ENGAGEMENT

Instruction	2P Hours per week
SEE	-
CIE	50 Marks
Credits	1

Course Objectives:

The main Objectives of this Course are to:

1. Develop an appreciation of Rural culture, life-style and wisdom among the Students.
2. Learn about the various livelihood activities that contribute to Rural economy.
3. Familiarize the Rural Institutions and the Rural Development Programmes in India.

Course Outcomes:

After the completion of this Course, Student will be able to:

1. Gain an understanding of Rural life, Culture and Social realities.
2. Develop a sense of empathy and bonds of mutuality with Local Communities.
3. Appreciate significant contributions of Local communities to Indian Society and Economy.
4. Exhibit the knowledge of Rural Institutions and contributing to Community's Socio-Economic improvements.
5. Utilise the opportunities provided by Rural Development Programmes.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	2	2	2	-	3	3	1	2	-	-	2	1	1	2
CO 2	-	1	2	2	-	3	2	-	2	1	-	1	1	1	2
CO 3	-	1	1	2	-	2	2	1	3	1	2	1	1	1	2
CO 4	2	2	3	2	-	2	2	1	2	2	1	-	1	1	2
CO 5	1	2	2	1	-	1	1	-	1	-	1	1	2	2	2

Module I Appreciation of Rural Society

Rural life style, Rural society, Caste and Gender relations, Rural values with respect to Community, Nature and Resources. Rural Infrastructure.

Module II Understanding Rural Economy and Livelihood

Agriculture, Farming, Landownership, Water management, Non-farm Livelihood and Artisans, Rural Entrepreneurs, Rural markets, Rural Credit Societies, Farmer Production Organization/Company.

Module III Rural Institutions

Traditional Rural organizations, Self-Help Groups, Panchayati Raj Institutions (Gram Sabha), Gram Panchayat, Standing Committees.

Module IV Rural Development Programmes

History of Rural Development in India, Current National Programmes: Sarva Shiksha Abhiyan, Beti Bhachao, Beti Padhao, Ayushman, Bharat, Swachh Bharat, PM Awas Yojana, Skill India. NRLM, MNREGA etc.

Text Books:

1. Singh, Katar, Rural Development: Principles, Policies and Management, Sage Publications, New Delhi, 2015.
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002.
3. United Nations, Sustainable Development Goals, 2015, un.org / sdgs.
4. M.P Boraia, Best Practices in Rural Development, Shanlax Publishers, 2016.

Journals:

1. Journal of Rural development (published by NIRD & PR, Hyderabad).
2. Indian Journal of Social Work, (by TISS, Bombay).
3. Indian Journal of Extension Educations (by Indian Society of Extension Education).
4. Journal of Extension Education (by Extension Education Society).
5. Kurukshetra (Ministry of Rural Development, GOI).
6. Yojana (Ministry of Information & Broadcasting, GOI).

22CSC41

PROBLEM SOLVING AND PROGRAMMING USING PYTHON LAB

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Prerequisite: Basic Computer Skills.

Course Objectives:
This course aims to:
1. Master the fundamentals of writing Python scripts.
2. Learn Python elements such as variables, flow controls structures, functions and modules.
3. Discover how to work with lists and sequence data and files.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Inspect and identify suitable programming environment to work with Python.
2. Choose appropriate control constructs, data structures to design and build the solutions.
3. Develop the solutions with modular approach using functions to enhance the code efficiency.
4. Analyze and debug the programs to verify and validate code.
5. Demonstrate use of Standard Template Libraries and modules to build file handling/Searching/Sorting applications.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	-	1	1	-	-	-	-	-	-	2	3	3	2
CO 2	3	3	3	1	1	1	-	-	-	-	-	2	3	3	2
CO 3	3	3	3	1	2	1	-	-	-	-	-	2	3	3	2
CO 4	3	3	3	1	1	1	-	-	-	-	-	2	3	3	2
CO 5	3	3	3	1	2	1	-	-	-	-	-	2	3	3	2

Laboratory / Practical Experiments:
1. Explore various Python Program Development Environments.
2. Design Flowcharts using raptor / draw.io tools.
3. Simple scripts to demonstrate the use of basic data types and operators.
4. Demonstrate the use of control structures.
5. Experiments using Comprehensions with List, Dictionary, Set.
6. Implementation using Functions, Lambda functions and parameter passing.
7. Experiments using Searching and Sorting techniques.
8. Experimentation with Arrays using array and numpy modules.
9. Simple scripts to demonstrate the use of built-in modules.(Ex: math, random).
10. Demonstration of File Handling.

Text Books:
1. Taming Python by Programming, Jeeva Jose, Revised Edition 2019, Khanna Book Publications.
2. Python Programming, Reema Thareja, Oxford Press, 2017.
3. Let us Python, Yashavant Kanetkar and Aditya Kanetkar, First Edition, 2019, BPB Publications.

Suggested Reading:
1. Learn Python 3 the Hard Way, Zed A. Shaw, First Edition, 2018, Pearson Education Inc.
2. Python in easy steps: Makes Programming Fun, Mike Mc Grath, Kindle Edition, 2017.
3. The Python Standard Library by Example by Doug Hellmann, Second Edition, June 2017.

e-Resources:
1. https://onlinecourses.swayam2.ac.in/cec24_cs01/preview.
2. https://www.coursera.org/specializations/python
3. https://www.python.org

22MEC37N

ROBOTICS AND DRONES LAB

Instruction	1 T + 3P Hours per week
Duration of SEE	-
SEE	-
CIE	100 Marks
Credits	2.5

Prerequisite: Nil

Course Objectives:

The objectives of this course are to:

1. To develop a thorough understanding of various autonomous robot structures.
2. To gain expertise in working with various sensors and gain the ability to interface sensors with microcontrollers, read data, and seamlessly integrate them into robotics applications.
3. To acquire proficiency in understanding different types of motors, motor drivers, develop the skills to interface motors with microcontrollers, motors and construct two-wheel robots with controlled movements.
4. To attain proficiency in utilizing OpenCV for advanced image processing tasks master techniques such as RGB value extraction, creating colored shapes, and extracting Regions of Interest (ROI) from images.
5. To develop a thorough understanding of various drone structures/develop autonomous systems.

Course Outcomes:

After completion of course, students would be able to:

1. Understand mechanical structures, motors, sensors, and circuits essential for constructing robots.
2. Demonstrate the utilization of sensors (Ultrasonic, IR, Rotary Encoder) for Arduino interfacing, reading data, and integrating them seamlessly into robotics applications.
3. Demonstrate expertise in operating robot controllers, applying theory to precisely control servo and stepper motors, 2 wheel robots ensuring desired motion.
4. Able to apply Python and OpenCV for image processing, including RGB extraction and ROI tasks.
5. Proficiently assemble a quadcopter drone, showcasing understanding of its classification, parts, and operational principles / Proficiency to develop autonomous systems fostering creativity and practical application.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	1	1	-	-	1	3	3	1	2	2	1	3
CO 2	1	2	2	1	1	-	-	1	3	3	1	2	2	1	3
CO 3	1	2	2	1	1	-	-	1	3	3	1	2	3	1	3
CO 4	2	2	2	1	1	-	-	1	3	3	1	2	2	1	1
CO 5	2	2	2	1	1	-	-	1	3	3	1	2	3	1	3

Lab Experiments:

Experiment No	Title
1.	Introduction to Robotics, Definition and scope of robotics, Robot configurations- Cartesian, cylinder, polar and articulate. Uses and Significance of Robots, Parts of a Robot, Current applications and future trends. Introduction to Arduino, C++, Arduino Programming Environment. Interfacing Arduino with Electronic Devices such as LEDs/Piezo Buzzer
2.	Interfacing Arduino with Electronic Devices such as Push Button/Potentiometer
3.	Introduction to Sensors, Types of Sensors, Reading Data from Sensors, Interfacing Sensors with Microcontrollers. Interfacing Arduino with Ultrasonic Distance Sensor and Reading Sensor Data on Serial Monitor
4.	Interfacing Arduino with IR Sensor and Reading Sensor Data on Serial Monitor
5.	Interfacing Arduino with Rotary Encoder and Reading Sensor Data on Serial Monitor

6. Introduction to motors, Types of motors, Motor drivers, Interfacing motors with Microcontrollers, Introduction to Li-ion, LIPO batteries, uses and safety precaution.
   Implement a system that utilizes an Arduino microcontroller to control the precise movement of a servo motor.

7. Implement a system that utilizes an Arduino microcontroller to control the precise and sequential movements of a stepper motor.

8. Construct a two-wheel robot using DC motors controlled by an Arduino microcontroller. Implement a program that allows the robot to execute specific movements.
   The robot should:
   i. Move forward with controlled acceleration.
   ii. Move backward with controlled deceleration.

9. Construct an Obstacle avoidance robot

10. Construct a Pick and place robot

11. OpenCv for image processing:
   i. Extraction of RGB values of a pixel
   ii. Create colored shapes and save image
   iii. Extraction of ROI

12. Assembly of quad copter drone.

Open-Ended Project on Autonomous System

Note:
- Mandatory Open-Ended Project (20 marks) in CIE.
- Any 10 experiments the students must do among the 12 experiments.

Suggested readings:
1. https://www.geeksforgeeks.org/robotics-introduction.
2. https://www.ohio.edu/mechanical-faculty/williams/html/PDF/IntroRob.pdf.
3. https://www.idtechex.com/en/research-report/new-robotics-and-drones-2018-2038-technologies-forecasts-players/584.
4. https://dronebotworkshop.com.

22EEC02

BASIC ELECTRICAL ENGINEERING LAB

Instruction	2P Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

The objectives of this course are to:

1. To acquire the knowledge on different types of electrical elements and to verify the basic electrical circuit laws and theorems.
2. To determine the parameters and power factor of a coil, calculate the time and frequency responses of RLC circuits and to familiarize with measurement of electric power & energy.
3. To determine the characteristics of Transformers, dc, ac machines and switch gear components.

Course Outcomes:

At the end of the course, the students are expected to:

1. Comprehend the circuit analysis techniques using various circuital laws and theorems.
2. Analyse the parameters of the given coil and measurement of power and energy in AC circuits
3. Determine the turns ration/performance parameters of single-phase transformer
4. Infer the characteristics of DC shunt motor different tests.
5. Illustrate different parts and their function of electrical components, equipment and machines.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	-	-	2	2	-	-	-	-	2	3	3	2
CO 2	3	2	1	-	-	1	2	-	-	-	-	2	3	3	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2	3	3	2
CO 4	3	2	2	-	-	2	2	-	-	-	-	2	3	3	2
CO 5	3	2	3	-	-	2	2	-	-	-	-	2	3	3	2

List of Laboratory Experiments / Demonstrations:

1. Verification of KCL and KVL.
2. Verification of Thevenin's theorem.
3. Verification of Norton's theorem.
4. Charging and discharging of Capacitor.
5. Determination of parameters of a choke or coil by Wattmeter Method.
6. Power factor improvement of single-phase AC System.
7. Active and Reactive Power measurement of a single-phase system using
   (i) 3-Ammeter method (ii) 3-Voltmeter method
8. Measurement of 3-Phase Power in a balanced system
9. Calibration of single-phase energy meter.
10. Verification of Turns/voltage ratio of single-phase Transformer.
11. Open Circuit and Short Circuit tests on a given single phase Transformer
12. Brake test on DC Shunt Motor
13. Speed control of DC Shunt Motor
14. Demonstration of Measuring Instruments and Electrical Lab components.
15. Demonstration of Low-Tension Switchgear Equipment/Components
16. Demonstration of cut - out section of Machines like DC Machine, Induction Machine etc.

Note: TEN experiments to be conducted to cover all five Course Outcomes.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

AICTE Model Curriculum with effect from AY 2024-25

BE (Electronics and Communication Engineering)

SEMESTER – II

S.no	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours Per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	22MTC05	Vector Calculus and Differential Equations	3	1	-	3	40	60	4
2	22PYC06	Electromagnetic Theory and Quantum Mechanics	3	-	-	3	40	60	3
3	22CEC01N	Engineering Mechanics	3	1	-	3	40	60	4
4	22EGC01N	English	2	-	-	3	40	60	2
PRACTICALS									
5	22PYC09	Electromagnetic Theory and Quantum Mechanics Lab	-	-	3	3	50	50	1.5
6	22EGC02N	English lab	-	-	2	3	50	50	1
7	22MEC01N	Engineering Graphics	-	1	3	3	50	50	2.5
8	22MEC38N	Digital Fabrication Workshop	-	-	3	3	50	50	1.5
Total			**11**	**3**	**11**	**24**	**360**	**440**	**19.5**
Clock Hours Per Week: 25									

L: Lecture D: Drawing **CIE: Continuous Internal Evaluation**

T: Tutorial P: Practical/Project Seminar/Dissertation **SEE: Semester End Examination**

22MTC05

VECTOR CALCULUS AND DIFFERENTIAL EQUATIONS
(Common to ECE, EEE, MECH, CHEM, CIVIL)

Instruction	3 L+1T per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Course Objectives:

The objectives of this course are to:

1. To explain scalar and vector functions with its Physical interpretations.
2. To discuss vector line, surface and volume integrals.
3. To explain relevant methods to solve first order differential equations.
4. To discuss the solution of higher order Differential Equations
5. To learn Numerical solution of ODE and Engineering problems.

Course Outcomes:

Upon completing this course, students will be able to:

1. Apply the vector differential operators to Scalars and Vector functions.
2. Solve line, surface & volume integrals by Greens, Gauss and Stoke's theorems.
3. Calculate the solutions of first order linear differential equations.
4. Solve higher order linear differential equations.
5. Find solution of algebraic, transcendental and ODE by Numerical Methods.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	3	-	-	-	-	-	-	-	2	3	3	2
CO 2	3	3	3	3	-	-	-	-	-	-	-	2	3	3	2
CO 3	3	3	3	3	-	-	-	-	-	-	-	2	3	3	2
CO 4	3	3	3	3	-	-	-	-	-	-	-	2	3	3	2
CO 5	2	2	2	2	-	-	-	-	-	-	-	1	3	3	2

UNIT-I

Vector Differential Calculus and multiple Integrals: Scalar and Vector point functions, vector operator Del, Gradient, Directional derivative, Divergence, Curl, Del applied twice to point functions, Del applied to product of point functions (vector identities), Irrotational fields and Solenoidal fields, Double integral, Change of order of integration and Triple integrals.

UNIT-II

Vector Integral Calculus: Line integral, Surface integral and Volume integral. Verification of Green's theorem in a plane (without proof), verification of Stroke's theorem (without proof) and Gauss's divergence theorem (without proof).

UNIT-III

First Order Ordinary Differential Equations: Exact differential equations, Equations reducible to exact equations, Linear equation, Bernoulli's equation, Clairaut's equation, Riccati's equation, Orthogonal trajectories, Rate of decay of Radio-active materials**.**

UNIT-IV

Higher Orders Linear Differential Equations: Higher order linear differential equations with constant coefficients, rules for finding Complementary function, Particular Integral and General solution. Method of variation of parameters, solution of Cauchy- Euler equation, LR and LCR circuits.

UNIT-V

Numerical Methods: Solution of Algebraic and transcendental equations by Bisection method, Regula-Falsi method Newton-Raphson method. Numerical Solutions of First Order Ordinary differential equations by Taylor's series method, Euler's method, Modified Euler's method and Runge-Kutta method of fourth order.

Text Books:

1. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

Suggested Reading:

1. N.P.Bali and Dr. Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, 9th edition, 2017.
2. R.K.Jain, S.R.K.Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5th edition, 2016.

e Resources:

1. https://archive.nptel.ac.in/courses/111/105/111105122/ (Week – 7 to Week 12)
2. NPTEL :: Mathematics - NOC:Advanced Calculus For Engineers (Week 5 and Week 6)
3. https://nptel.ac.in/courses/111107105 (Unit -2 and Unit-8)

22PYC06

ELECTROMAGNETIC THEORY AND QUANTUM MECHANICS (ECE & EEE)

Instruction	3L Hours per week
Duration of SEE	3Hours
SEE	60Marks
CIE	40Marks
Credits	3

COURSE OBJECTIVES:

This course aims to:

1. Understand the fundamentals of wave nature of light.
2. Familiar with static and dynamic nature of electric and magnetic fields.
3. Acquire knowledge of lasers and fiber optics.
4. Learn basics of quantum mechanics and properties of solids.

COURSE OUTCOMES:

Upon the completion of this course, the student will be able to:

1. Interpret the wave nature of the light.
2. Extend the laws of electric and magnetic fields for wireless communication.
3. Explain the principles of lasers and fiber optic communication.
4. Find the applications of quantum mechanics.
5. Identify semiconductors for engineering applications.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	1	1	1	2	2	1	1	2	1	2	3	3	2
CO 2	3	2	2	1	1	1	1	1	1	2	2	3	3	3	2
CO 3	3	1	2	1	2	2	2	1	2	2	2	2	3	3	2
CO 4	2	2	1	1	1	1	1	1	1	2	1	2	3	3	2
CO 5	3	2	2	2	2	1	2	2	1	2	1	2	3	3	2

UNIT-I

Wave Optics: Huygen's principle – Superposition of waves – Interference of light by wavefront splitting and amplitude splitting –Interference in thin films (reflected light) – Newton's rings – Fraunhofer diffraction from a single slit – Double slit diffraction–Concept of N-slits–Diffraction grating. Polarization: Introduction–Malus's law –Double refraction –Nicol's prism–Quarter-wave plate and half-wave plate– Optical activity– Laurent's half shade polarimeter.

UNIT-II

Electrostatics: Calculation of electric field and electrostatic potential for a charge distribution–Divergence and curl of electrostatic field– Laplace's and Poisson's equations for electrostatic potential– Uniqueness theorem.

Magnetostatics: Biot-Savart law–Divergence and curl of static magnetic field –Equation for magnetic vector potential and its solution for given current densities – Ferromagnetic, paramagnetic and diamagnetic materials– B-H curve.

Electromagnetic Theory: Review of steady and varying fields–Conduction current and displacement current– Maxwell's equations in differential and integral forms–Electromagnetic wave propagation in free space, dielectric and conducting media – Poynting theorem – Skin depth.

UNIT-III

Lasers: Characteristics of lasers – Einstein's coefficients –Amplification of light by population inversion – Ruby laser – He-Ne laser – Semiconductor laser –Applications of lasers in engineering and medicine.

Fiber Optics: Introduction –Construction –Principle –Propagation of light through an optical fiber – Numerical aperture and acceptance angle – Step-index and graded-index fibers –Pulse dispersion –Fiber losses –Fiber optic communication system –Applications.

UNIT-IV

Quantum Mechanics: Introduction –Wave nature of particles – de-Broglie hypothesis –Physical significance of ψ –Time-dependent and time-independent Schrodinger equations – Born interpretation – Probability current –Wave-packets –Uncertainty principle –Particle in infinite square well potential.

UNIT-V

Physics of Solids and Semiconductors: Salient features of free electron theory of metals (Classical and Quantum) – Fermi level – Bloch's theorem for particles in a periodic potential –Kronig-Penney model – Origin of energy bands –Classification of solids: metals, semiconductors and insulators –Intrinsic and extrinsic semiconductors–Carrier generation and recombination–Carrier transport: diffusion and drift–P-N junction – Thermistor – Hall effect – LED – Solar cell.

Text Books:

1. B. K. Pandey and S. Chaturvedi, *Engineering Physics*, Cengage Publications, 2012.
2. M. N. Avadhanulu and P.G. Kshirsagar, *A Text Book of Engineering Physics*, S. Chand Publications, 2014.
3. M. Arumugam, *Materials Science*, Anuradha Publications, 2015.
4. S. L. Gupta and Sanjeev Gupta, *Modern Engineering Physics*, Dhanpat Rai Publications, 2011.

Suggested Reading:

1. R. Murugeshan and KiruthigaSivaprasath, *Modern Physics*, S. Chand Publications, 2014.
2. V. Rajendran, *Engineering Physics*, McGraw-Hill Education Publications, 2013.
3. P. K. Palanisamy, *Engineering Physics*, Scitech Publications, 2012.
4. V. Raghavan, *Materials Science and Engineering*, Prentice Hall India Learning Private Limited; 6th Revised edition, 2015.

22CEC01N

ENGINEERING MECHANICS

Instruction	3L+1T Periods per week
Duration of End Examination	3 Hours
End Examination	60 Marks
Sessional	40 Marks
Credits	4

Course Objectives:

This course aim is to:

1. Understand the resolution of forces and to obtain resultant of all force systems.
2. Understand equilibrium conditions of static loads for smooth and frictional surface.
3. Analyse simple trusses for forces in various members of a truss.
4. Obtain centroid, centre of gravity for various regular and composite areas and bodies.
5. Obtain Moment of inertia for various regular and composite areas.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Calculate the components and resultant of coplanar forces system and Draw free body diagrams to analyze the forces in the given structure.
2. Understand the mechanism of friction and can solve friction problems.
3. Analyse simple trusses for forces in various members of a truss.
4. Determine the centroid of plane areas, composite areas and centres of gravity of bodies.
5. Determine moments of inertia of plane and composite areas.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-

UNIT- I

Resolution and Resultant of Force System: Basic concepts of a force system. Components of forces in a plane. Resultant of coplanar concurrent force system. Moment of a force, couple and their applications. Resultant of coplanar non-concurrent force system Equilibrium of force system: Free body diagrams, equations of equilibrium of planar force systems and its applications. Problems on general case of coplanar force systems.

UNIT- II

Theory of friction: Introduction, types of friction, laws of friction, application of friction to a single body & connecting systems. Wedge friction.

UNIT- III

Analysis of Simple Trusses: Introduction to trusses, Assumptions, analysis of simple trusses using method of joints and method of sections.

UNIT- IV

Centroid: Significance of centroid, moment of area, centroid of line elements, plane areas, composite areas, theorems of Pappu's & its applications. Center of gravity of elementary and composite bodies.

UNIT- V

Moment of Inertia: Definition of Moment of Inertia, Area Moment of Inertia, Polar Moment of Inertia, Radius of gyration, Transfer theorem, Moment of Inertia of elementary & composite areas.

Text Books:

1. K. Vijay Kumar Reddy and J. Suresh Kumar, Singer's Engineering Mechanics, BS Publications, Hyderabad, 2011.
2. Ferdinand L Singer, Engineering Mechanics, Harper and Collins, Singapore, 1904.

Suggested Reading:

1. S. Rajashekaran & G. Sankarasubramanyam, Engineering Mechanics, Vikas publications, Hyderabad, 2002.
2. Basudeb Bhattacharyya, Engineering Mechanics, Oxford University Press, New Delhi, 2008.
3. A K Tayal, Engineering Mechanics, Umesh Publications, New Delhi, 2010.

e-Resources:

1. https://archive.nptel.ac.in/courses/112/106/112106286/
2. https://archive.nptel.ac.in/courses/112/106/112106180/

22EGC01N

ENGLISH

(BE/B.Tech - Common to all Branches)

Instruction	2LHours per Week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
CIE	40 Marks
Credits	2

Prerequisite: Basic knowledge of English grammar and vocabulary.

Course Objectives: The course is taught with the objectives of enabling the students to:

1. Improve their understanding of communication skills while developing their usage of English for correct use of grammar and vocabulary.
2. Equip themselves with Reading Comprehension strategies and techniques.
3. Enhance their writing skills through paragraphs, précis and essays by using devices of cohesion and coherence.
4. Build appropriate, longer meaningful sentences for professional writing through formal letters and e-mails.
5. Demonstrate knowledge of drafting formal reports to define, describe and classify the processes by following a proper structure.

Course Outcomes:

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

1. Step-up the awareness of correct usage of English grammar and vocabulary by speaking fluently and comprehensively with a grip on communication skills.
2. Apply effective reading techniques through critical reading exercises to enhance quality of life and to support lifelong learning.
3. Develop their ability to write paragraphs independently on any context with cohesion, edit essays coherently while realizing brevity through précis writing.
4. Construct sentences clearly and comprehensively to write effective business letters and draft emails for a better professional communication.
5. Advance efficiency in writing, distinguish formal from informal reports and demonstrate advanced writing skills by drafting formal reports.

CO PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	1	1	2	3	3	2	3	3	3	3
CO 2	1	1	1	1	1	1	1	1	1	2	1	3	3	3	3
CO 3	1	2	1	1	-	1	1	1	1	3	1	3	3	3	3
CO 4	1	2	1	1	-	1	1	2	2	2	2	3	3	3	3
CO 5	1	2	1	2	1	2	2	2	3	3	2	3	3	3	3

UNIT-I Communication Skills:

Introduction, nature and importance of communication; Process of communication; Types of communication: verbal and non-verbal; Barriers to communication; Intrapersonal, Interpersonal communication; Understanding Johari Window.

Vocabulary & Grammar: The concept of Word Formation - Root words, Use of prefixes and suffixes to form derivatives, Standard abbreviations. Basic Sentences.

Reading Task I.

UNIT-II Reading Skills:
The Reading process, purpose, different kinds of texts; Reading Comprehension; Techniques of comprehension – skimming, scanning, drawing inferences and conclusions. Practice in Critical Reading passages
Vocabulary and Grammar: Determiners. Use of Synonyms and Antonyms, Construction of Sentences.
Reading Task II.

UNIT-III Writing Skills II:
Paragraph Writing. – Structure and features of a paragraph; Essay writing, Cohesion and coherence. Techniques of writing précis.
Vocabulary & Grammar: Use of connectors and linkers, Tenses, Punctuation.
Reading Task III.

UNIT-IV Professional Writing Skills-1:
Letter Writing – Structure, format of a formal letter; Letter of Request and Response, Drafting Emails, Email and Mobile etiquette.
Vocabulary and Grammar: Phrasal verbs, Misplaced modifiers, Subject-verb agreement.
Reading Task IV

UNIT-V Professional Writing Skills-2:
Report writing – Importance, structure, elements & style of formal reports; Writing a formal report. Writing for Blogs.
Vocabulary and Grammar: Words often Confused, Common Errors. Avoiding Ambiguity & Redundancy.
Reading Task V.

Text Books:

1. Sanjay Kumar & Pushp Lata, "English Language and Communication Skills for Engineers", Oxford University Press,2018.
2. "Language and Life: A Skills Approach", Board of Editors, 2018th Edition, Orient Black Swan, 2018.

Suggested Readings:

1. Ashraf, M Rizvi, "Effective Technical Communication", Tata McGraw-Hill, 2006.
2. Michael Swan, "Practical English Usage", Oxford University Press, 4th Edition,2016.
1. Meenakshi Raman and Sangeetha Sharma, "Technical Communication: Principles and Practice" 3rd Edition, Oxford University Press, 2015.

22PYC09

ELECTROMAGNETIC THEORY AND QUANTUM MECHANICS LAB (ECE & EEE)

Instruction	3P Hours per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	1.5

COURSE OBJECTIVES:

This course aims to:

1. Apply the concepts of physics while doing experiments.
2. Understand the nature of the light experimentally.
3. Analyze the behavior of semiconductor materials and optoelectronic devices.

COURSE OUTCOMES:

After the completion of this course, the student will be able to:

1. Experiment with the concept of errors and find the ways to minimize the errors.
2. Demonstrate properties of light experimentally.
3. Find the applications of lasers and optical fibers in engineering applications.
4. Make use of semiconductor devices for practical applications.
5. Illustrate the working of optoelectronic devices.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	3	1	3	1	3	3	2	1	2	3	3	2
CO 2	3	2	1	2	2	2	1	2	2	1	1	3	3	3	2
CO 3	3	2	3	2	3	1	2	2	3	2	1	2	3	3	2
CO 4	3	3	2	2	2	1	2	3	2	1	1	3	3	3	2
CO 5	3	1	2	3	2	1	1	2	2	2	1	2	3	3	2

Experiments

1. Error Analysis : Estimation of errors in the determination of time period of a torsional pendulum
2. Newton's Rings : Determination of wavelength of given monochromatic source
3. Single Slit Diffraction : Determination of wavelength of given monochromatic source
4. Diffraction Grating : Determination of wavelengths of two yellow lines of light of mercury lamp
5. Malus's Law : Verification of Malus's law
6. Double Refraction : Determination of refractive indices of O-ray and E-ray of given calcite crystal
7. Polarimeter : Determination of specific rotation of glucose
8. Laser : Determination of wavelength of given semiconductor laser
9. Optical Fiber : Determination of numerical aperture and power losses of given optical fiber
10. Energy Gap : Determination of energy gap of given semiconductor
11. P-N Junction Diode : Study of V-I characteristics and calculation of resistance of given diode in forward bias and reverse bias
12. Thermistor : Determination of temperature coefficient of resistance of given thermistor
13. Hall Effect : Determination of Hall coefficient, carrier concentration and mobility of charge carriers of given semiconductor specimen
14. LED : Study of I-V characteristics of given LED
15. Solar Cell : Study of I-V characteristics of given solar cell and calculation of fill factor, efficiency and series resistance

NOTE: A minimum of TWELVE experiments should be done.

22EGC02N

ENGLISH LAB

(BE/B.Tech - Common to all Branches)

Instruction	2 P Hours per Week
Duration ofSEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Basic Knowledge of English Communication.

Course Objectives: This course will introduce the students

1. To nuances of Phonetics and give them sufficient practice in correct pronunciation through computer-aided multi-media instruction.
2. To the significance and application of word and sentence stress and intonation.
3. To sufficient practice in listening to English spoken by educated English speakers in different socio-cultural and professional settings.
4. To reading and speaking activities enabling them to critically interpret and respond to different texts and contexts, and produce speech with clarity and confidence.
5. To team work, role behaviour while developing their ability to use language appropriately, to discuss in groups and make presentations.

Course Outcomes:

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

1. Define the speech sounds in English and understand the nuances of pronunciation in English.
2. Produce speech with clarity and confidenceusing correct word and sentence stress, and intonation.
3. Achieve improved ability to listen, understand, analyse, and respond to English spoken in various settings.
4. Read, interpret, and review a variety of written texts, contexts, and perform appropriately in different situations.
5. Design effective posters collaboratively through creative decisions, give presentations, and efficiently participate in Group discussions.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	-	-	-	-	1	1	2	1	3	3	3	3
CO 2	-	-	-	-	-	1	-	1	2	2	1	3	3	3	3
CO 3	-	-	-	-	-	1	1	1	2	1	1	2	3	3	3
CO 4	1	1	1	1	1	1	2	2	3	3	1	3	3	3	3
CO 5	-	1	1	1	1	2	2	2	3	3	2	3	3	3	3

Exercises

Computer-Aided Language Learning Lab

1. **Introduction to English Phonetics**: Introduction to English Phonetics and organs of speech.
2. **Sound system of English**: Speech sounds- Vowels andConsonants- structure of syllables (Introduction to syllables) - Basic phonetictranscription practice.
3. **Word and Sentence stress**: Rules of word stress -Primary stress, Secondary stress; Sentence stress (word emphasis in sentences) -Practice.
4. **Intonation**:Types of Intonation, Practice in Articulation – MTI-Errors in pronunciation.
5. **Listening skills**: understanding Listening- Practice in Listening comprehension texts.

Interactive Communication Skills Lab

1. **JAM-** Ice Breaking, Speaking Activity**.**
2. **Role play/Public speaking –** Speaking with confidence and clarity in different contexts on various issues.
3. **GroupDiscussions -** Dynamics of a Group Discussion, Group Discussion Techniques,Non-Verbal Communication.
4. **Read and Review** - Preparation for active reading and instructing the students to cultivate effective reading habits to read select texts, review and write their responses.
5. **Poster presentation –** Theme, poster preparation, team work and presentation.

Text Books:

1. T Balasubramanian, "A Textbook of English Phonetics for Indian Students", Macmillan, 2nd Edition, 2012.
2. J Sethi et al., "A Practical Course in English Pronunciation (with CD)", Prentice Hall India, 2005.
3. Priyadarshi Patnaik, "Group Discussions and Interview Skills", Cambridge University Press Pvt. Ltd., 2nd Edition, 2015.
4. Aruna Koneru, "Professional Speaking Skills", Oxford University Press, 2018.

Suggested Reading:

1. "English Language Communication Skills – Lab Manual cum Workbook", Cengage Learning India Pvt. Ltd., 2022.
2. KN Shoba& J. Lourdes Javani Rayen."Communicative English – A workbook", Cambridge University Press, 2019.
3. Sanjay Kumar& Pushp. Lata. "Communication Skills: A Workbook. Oxford University Press", 2019.
4. Veerendra Mishra et al. "English Language Skills: A Practical Approach", Cambridge University Press, 2020.

Suggested Software:

1. K-VAN Multi-Media Language Lab
2. TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS).
3. Digital All Orell Digital Language Lab (Licensed Version).

22MEC01N

ENGINEERING GRAPHICS

Instruction	1 T + 3 D Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	2.5

Prerequisite: Nil

Course Objectives:

This course aims to:

1. Get exposure to a cad package and its utility.
2. Understand orthographic projections.
3. Visualize different solids and their sections in orthographic projection
4. Prepare the student to communicate effectively by using isometric projection.
5. Prepare the student to use the techniques, skills, and modern tools necessary for practice.

Course Outcomes:

Upon completion of this course, student will be able to:

1. Become conversant with appropriate use of CAD software for drafting and able to draw conic sections.
2. Understand orthographic projections of points and straight lines.
3. Draw the projections of planes.
4. Draw and analyze the internal details of solids through sectional views.
5. Create an isometric projections and views.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	1	2	2	-	1	2	3	1	3	2	1	2
CO 2	3	2	2	1	2	2	-	1	2	2	1	2	2	1	2
CO 3	3	3	2	1	2	2	-	1	2	2	1	2	2	1	2
CO 4	3	3	3	2	2	2	-	1	2	2	1	2	2	1	2
CO 5	3	2	2	1	2	2	-	1	2	2	1	2	2	2	2

List of Exercises:

1. Introduction to CAD package: Settings, draw, modify tools, dimensioning, documentation and practice exercises using Auto CAD software.
2. Construction of Conic Sections by General method.
3. Orthographic projection: Principles, conventions, Projection of points
4. Projection of straight lines: Simple position, inclined to one plane & inclined to both the planes (without traces and mid-point)
5. Projection of planes: Perpendicular planes
6. Projection of planes: Oblique planes
7. Projection of solids: Simple position
8. Projection of solids: Inclined to one plane
9. Sections of solids: Prism, pyramid in simple position
10. Sections of solids: Cone and Cylinder in simple position
11. Isometric projections and views
12. Conversion of isometric views to orthographic projections and vice-versa.

Text Books:

1. N.D.Bhatt, “Elementary Engineering Drawing”, Charotar Publishers, 2012.
2. K.Venugopal, “Engineering Drawing and Graphics + AutoCAD”, New Age International Pvt.Ltd, 2011.
3. Basanth Agrawal and C M Agrawal, “Engineering Drawing”, 2/e, McGraw-Hill Education (India) Pvt. Ltd.

Suggested Reading:

1. Shaw M.B and Rana B.C., “Engineering Drawing”, 2/e, Pearson, 2009.
2. K.L. Narayana and P.K. Kannaiah, “Text Book of Engineering Drawing”, Scitech Publications, 2011.

22MEC38N

DIGITAL FABRICATION WORKSHOP

Instruction	3P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Prerequisite: Nil

Course Objectives:

This course aims to:

1. Give a feel of Engineering Practices and develop holistic understanding of various Engineering materials and Manufacturing processes.
2. Develop skills of manufacturing, safety, precision, quality, intelligent effort, optimization, positive and team work attitude to get things right the first time.
3. Provide basic knowledge of steel, plastic, composite, and other materials for suitable applications.
4. Study of principle and hands on practice on techniques of fabrication, manufacturing, and allied skills.
5. Advance important, hard and pertinent soft skills, productivity, create skilled manpower which is cognizant of industrial workshop components and processes and can communicate their work in a technical, clear and effective way.

Course Outcomes:

Upon completion of this course, students will be able to

1. Understand safety measures to be followed in workshop to avoid accidents.
2. Identify various tools used in carpentry, house wiring and plumbing.
3. Make a given model by using workshop trades like carpentry, plumbing, House wiring and 3d modeling using solid works software for Additive Manufacturing.
4. Perform pre-processing operations on STL files for 3D printing, also understand reverse engineering process.
5. Conceptualize and produce simple device/mechanism of their choice.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	-	-	-	1	-	-	-	1	1	1	1
CO 2	1	-	1	-	-	-	-	-	-	-	-	1	1	2	1
CO 3	1	-	1	-	-	1	-	-	-	-	-	1	2	2	1
CO 4	1	-	1	-	-	1	-	-	-	--	-	1	2	2	1
CO 5	2	2	2	1	3	1	-	1	1	2	-	2	3	3	3

Lab Experiments

Group 1: Workshop Practice

1. To make a lap joint on the given wooden piece according to the given dimensions.
2. To make a dovetail joint on the given wooden piece according to the given dimensions.
3. (a)Wiring of one light point controlled by one single pole switch, a threepin socket controlled by a single switch

3 (b)Wiring of two light points connected in series and controlled by single pole switch. Verify the above circuit with different bulbs. Wiring of two light points connected in parallel from two single pole switches and a threepin socket.

4 Stair case wiring Wiring of one light point controlled from two different places independently using two 2way

switches.

5 To make external threads for GI pipes using die and connect the GI pipes as per the given diagram using taps, couplings, and bends.

6 To connect the GI pipes as per the given diagram using, Coupling, Unions, reducers, and bends. To connect the GI pipes as per the given diagram using shower, tap, and valves and demonstrate by giving water connection.

Group 2: Additive Manufacturing / 3D Printing

1. To Study the methods of Additive manufacturing process using a 3D printer.
2. To create a 3D CAD model of a door bracket using a modelling software.
3. To print a door bracket using an extruder type 3D printer.
4. To create a 3D CAD model using Reverse engineering.
5. Engraving, Drilling and Cutting operations on printed circuit boards using CNC PCB Mate.
6. To design an innovative component using the CAD software./print the selected innovative component by the student using a 3D printer.

Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of WorkshopTechnology", Vol. I, 2008 and Vol. II, Media promoters and publishers private limited, Mumbai, 2010.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.

Suggested Reading:

1. Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology.
2. Oliver Bothmann, 3D Printers: A Beginner's Guide, January 1, 2015.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

AICTE Model Curriculum with effect from AY 2025-26

BE (Electronics and Communication Engineering)

SEMESTER – III

S.no	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours Per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	22MTC08	Transform Theory and Complex Analysis	3	-	-	3	40	60	3
2	22ITC24N	Data Structures using C	3	-	-	3	40	60	3
3	22ECC01	Electronic Devices	3	-	-	3	40	60	3
4	22ECC02	EM Waves and Transmission Lines	3	-	-	3	40	60	3
5	22ECC03N	Network Analysis and Synthesis	3	1	-	3	40	60	4
6	22ECC04	Signals and Systems	3	-	-	3	40	60	3
PRACTICALS									
7	22ITC25N	Data Structures using C Lab	-	-	2	3	50	50	1
8	22ECC05	Electronic Devices Lab	-	-	2	3	50	50	1
9	22ECC06	Network Analysis and Synthesis Lab	-	-	2	3	50	50	1
10	22ECI01	MOOCs / Training / Internship	3-4 Weeks / 90 Hours				50	-	2
Total			**18**	**1**	**6**	**27**	**440**	**510**	**24**
Clock Hours Per Week: 25									

L: Lecture **D: Drawing** **CIE: Continuous Internal Evaluation**

T: Tutorial **P: Practical/Project Seminar/Dissertation** **SEE: Semester End Examination**

22MTC08

TRANSFORM THEORY AND COMPLEX ANALYSIS

Instruction	3 L Hours per week
Duration of Semester end Examination	3 Hours
Semester end Examination	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: The Student should be familiar about elementary Calculus and Complex variables.

Course Objectives:

This course aims to:

1. To learn the Laplace, Z- Transform concepts.
2. To solve linear and Non-Linear partial differential equations.
3. To learn concepts of analytic functions and complex integration.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Find Laplace, Inverse Laplace and solution of engineering problems.
2. Find the solution of Difference Equation.
3. Understand the methods to find solution of linear and non-linear PDE and solution of wave equation.
4. Solve the problems on analytic functions, Cauchy's theorem and Cauchy's integral formula.
5. Complex integrals by using Cauchy's Residues theorem.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	2	1	1	1	1	1	1	1	2	1	1	1
CO 2	3	3	2	2	1	1	1	1	1	1	1	2	1	1	1
CO 3	3	3	3	3	1	1	1	1	1	1	1	2	1	1	1
CO 4	3	3	2	2	1	1	1	1	1	1	1	2	1	1	1
CO 5	3	3	2	2	1	1	1	1	1	1	1	2	1	1	1

UNIT - I

Laplace Transforms: Laplace Transform of Elementary functions, Linearity property, First Shifting property, Change of scale property. Laplace Transform of Periodic functions, Transforms of derivatives, integral's, Multiplication by t and division by t. Evaluation of Integrals by Laplace Transforms. Inverse Laplace transforms of elementary functions, Inverse Laplace Transform by Method of partial fractions and Convolution theorem, Solution of Ordinary Differential Equations by Laplace Transform method.

UNIT - II

Z-Transforms: Z-transforms of standard functions, linearity property, damping rule, shifting theorems, multiplication by 'n', Initial value theorem. Inverse Z-transforms of standard functions, Inverse Z-transform by Convolution theorem and partial fractions method. Z-transform application to different equations.

UNIT - III

Partial Differential Equations: Linear Equations of First Order (Lagrange's Linear Equations), Solution of First Order Non-linear Partial Differential Equations (Standard forms) and Charpit's Method. Solutions by method of separation of variables, solution of One dimensional wave equation and its applications.

UNIT – IV

Function of Complex Variables: Limit continuity and derivative of complex function, Analytic functions ,C'R equations ,Harmonic functions , Conjugate harmonic function, Complex integration, Cauchy's theorem (without Proof), Cauchy-integral formula (without proof).

UNIT - V

Series of Complex terms: Taylor's Series, Laurent's Series, Types of Singularities, Residues, Cauchy's Residue theorem (without proof), Calculation of Residues.

Series Solution: Bessel's Equations, Recurrence relations, Expansions of $J_0, J_1, J_{\frac{1}{2}}, J_{-\frac{1}{2}}$

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.
2. Sharma J.N , "Functions of a Complex variables", Krishna Prakashan Media, 49th Edition.
3. S.C.Gupta, V.K.Kappoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 2014.

Suggested Reading:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T, "Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2008.
3. James ward Brown, Ruel V. Churchill", Complex variables an Applications", McGraw Hill Higher Education, 2013.

22ITC24

DATA STRUCTURES USING C
(Common for ECE and EEE)

Instruction	3 L Hours per week
Duration of Semester end Examination	3 Hours
Semester end Examination	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: Problem Solving and Programming, Problem Solving and Programming Laboratory.

Course Objectives:
This course aims to:
1. Discuss the basics of C Programming
2. Learn the usage of functions, arrays, pointers, and structures.
3. Familiarise with the concepts of Functions, Arrays, Pointers and Structures.
4. Introduce Stack, Queue and Linked lists data structures.
5. Explain the concepts of non-linear data structures like graphs and trees.

Course Outcomes:
After the completion of this course, the student will be able to
1. Understand the basic concepts of C Programming language.
2. Understand the usage of functions, arrays, pointers, and structures.
3. Apply the concepts of Stacks and Queues in solving the problems.
4. Demonstrate the standard operations on Linked lists.
5. Explain tree traversals and graph traversal techniques.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	1	-	-	-	-	-	-	-	-	1	3	3	1
CO 2	2	1	1	-	-	-	-	-	-	-	-	1	3	3	1
CO 3	2	2	2	-	-	-	-	-	-	-	-	1	3	3	1
CO 4	2	2	2	-	-	-	-	-	-	-	-	1	3	3	1
CO 5	2	2	2	-	-	-	-	-	-	-	-	1	3	3	1

UNIT -I
Introduction to C Language: C language elements, variable declarations and data types, operators and expressions, decision statements – If and switch statements, loop control statements – while, for, do-while statements, arrays.

UNIT -II
Functions: Types of functions, Recursion and argument passing, pointers, storage allocation, pointers to functions, expressions involving pointers, Storage classes – auto, register, static, extern, Structures, Unions, and Command line arguments.

UNIT -III
Basics: Algorithm specification, Data Abstraction, Performance Analysis
Stacks and Queues: Stack ADT, Queue ADT, Mazing Problem, Evaluation of Expressions

UNIT -IV

Lists: Singly Linked Lists, Dynamically Linked Stacks and Queues, Polynomials, Additional List Operations, Doubly Linked Lists

Hashing: Static Hashing

UNIT -V

Trees: Introduction, Binary Trees, Binary Tree Traversals, Heaps, Binary Search Trees

Graphs: Graph ADT, Elementary Graph Operations, Minimum Cost Spanning Trees.

Text Books:

1. Pradip Dey and Manas Ghosh, "Programming in C", 2nd Edition, Oxford University Press 2011.
2. Ellis Horowitz, Sartaj Sahni, Susan, "Fundamentals of Data Structures in C", Computer Science, 1993.

Suggested Reading:

1. A.K. Sharma, "Computer Fundamentals and Programming in C", University Press, 2nd Edition.
2. M.T. Somashekara, "Problem Solving Using C", 2nd Edition, PHI 2009 Pearson, 2013.
3. E. Balaguruswamy, "C and Data Structures", 4th Edition, Tata McGraw Hill.

e-Resources:

1. https://nptel.ac.in/courses/106105085.
2. https://archive.nptel.ac.in/courses/106/106/106106127.

22ECC01

ELECTRONIC DEVICES

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have the knowledge of semiconductor fundamentals.

Course Objectives:

This course aims to:

1. The concepts of semiconductor devices like PN junction diode, Transistor, and special diodes.
2. The applications of diodes and transistors.
3. The various configurations and characteristics of transistors – BJT, JFET & MOSFET.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Demonstrate the understanding of the characteristic behaviour of Diodes.
2. Apply the acquired knowledge in the analysis of various diode circuits.
3. Compare and Contrast the characteristics of BJT in various configurations.
4. Analyze the operation and characteristics of JFET and MOSFET.
5. Choose an appropriate electronic device for a specific application.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	2	1	1	1	1	1	2	1	1	1	2	3	3	1
CO 2	2	3	1	3	2	1	1	2	1	1	1	2	3	3	1
CO 3	1	2	1	1	1	1	1	2	1	1	1	2	3	3	1
CO 4	2	3	1	3	2	1	1	2	1	1	1	2	3	3	1
CO 5	1	3	1	2	2	1	1	2	1	1	1	2	3	3	1

UNIT - I

Semiconductor Diode Characteristics: The p-n junction Diode, Current equation, V-I characteristics, Diode resistance, Diode equivalent circuits, Temperature dependence, Transition capacitance, Diffusion capacitance, Diode switching times, Diode specifications, Zener diode – V-I characteristics, Zener diode as voltage regulator.

UNIT - II

Diode Applications: Diode as a circuit element: series diode configurations, parallel and series-parallel configurations, Clipping and clamping circuits, Clamping circuit theorem. Half wave, Full wave and Bridge Rectifiers - operation, ripple factor and efficiency calculations. Filters: L, C, LC and CLC filters with FWR – operation and ripple factor calculation.

UNIT - III

Bipolar Junction Transistor: Transistor: Construction and Operation, current components, Modes of operation, Early effect, BJT input and output characteristics: CB, CE, CC configuration. h-parameters, determination of h-parameters from transistor characteristics. BJT applications: BJT as an amplifier and as a switch.

UNIT - IV

Field Effect Transistor: Construction and Operation, Drain and transfer characteristics, Transconductance and drain resistance.
MOSFETs: Enhancement & Depletion mode MOSFETs, Drain and transfer characteristics. FET applications: FET as an amplifier and as a switch.

UNIT - V

Special Purpose Semi-Conductor Devices: Operation and V-I characteristics of UJT, SCR, Diac, Triac, Tunnel diode, Schottky diode, LED, Photodiode, Solar cell.

Text Books:

1. Millman and Halkias, "Electronic Devices and Circuits", 2nd Edition, McGraw Hill Publication, 2007.
2. Robert L. Boylestad, "Electronic Devices and Circuit Theory", 10th Edition, PHI, 2009.

Suggested Reading:

1. Jacob Millman, Christos Halkias, Chetan Parikh, "Integrated Electronics", 2nd Edition, McGraw Hill Publication, 2009.
2. David Bell, "Fundamentals of Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008.

e-Resources:

1. https://archive.nptel.ac.in/course.html.

22ECC02

EM WAVES AND TRANSMISSION LINES

Instruction	3 L Hours per week
Duration of Semester end Examination	3 Hours
Semester end Examination	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have prior knowledge about coordinate systems, vector calculus, Electrostatics and Steady Magnetic Fields.

Course Objectives:

This course aims to:

1. Provide the concepts of boundary conditions.
2. Understand the Maxwell's equations and conceptualize the wave propagation characteristics in different mediums.
3. Provide the concepts of transmission lines.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Comprehend the boundary conditions, time varying fields and understand Maxwell's equations in different forms.
2. Illustrate the Electromagnetic wave properties with respect to different transmission mediums and predict the behavior of reflection and refraction of the waves in different mediums.
3. Understand the concepts of transmission lines and the significance of Open and Short circuit Lines.
4. Estimate the transmission line properties, reflection, and matching concepts.
5. Conceptualizing Microwaves and analyzing the waves in the waveguides.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	3	2	2	1	3	1	1	2	1	1	2	3	3	3
CO 2	2	3	2	1	1	3	2	1	2	1	1	2	3	3	3
CO 3	2	2	1	3	1	3	1	2	3	1	1	2	3	3	3
CO 4	2	2	1	3	1	3	1	2	1	1	1	2	3	3	3
CO 5	2	2	1	2	1	3	1	1	3	1	1	2	3	3	3

UNIT - I

Time varying fields: Review of coordinate systems, Boundary conditions: Boundary conditions on Electric and Magnetic fields across a conductor interface and across two mediums. Time varying fields, Faradays Law, Modified Amperes Law, Gauss Law for Electric and Magnetic Fields, Maxwell equations: Integral form and Point form.

UNIT - II

Electromagnetic Waves: Wave equations, Uniform plane waves in lossy and lossless medium, Skin Depth, Polarization, Instantaneous and Average Poynting theorem and its applications, Reflection and Refraction of Plane Waves - Normal and Oblique Incidence for perfect Conductor and perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection.

UNIT - III

Transmission Lines - I: Types, Parameters, Transmission Line Equations, Primary and Secondary Constants, Characteristics Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line, Impedance at any point on the transmission line. RF and UHF Lines, Open and Short circuit lines and their significance, Properties of $\lambda/2$, $\lambda/4$ and $\lambda/8$ Lines.

UNIT - IV

Transmission Lines - II: Distortion and distortion less transmission line, Concept of loading of a transmission line, Campbell's formula, Reflection and VSWR, Matching- Quarter wave transformer, Single Stub matching, Smith chart and its applications.

UNIT - V

Introduction to Microwaves: Microwave frequency spectrum, Advantages and Applications of Microwaves. Rectangular Waveguides: TE and TM waves, Impossibility of TEM wave in waveguides.

Text Books:

1. Matthew N.O. Sadiku, "Elements of Electromagnetics" 6th edition, 2015, Newyork Oxford University Press.
2. E.C. Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems", 2nd edition., 2000, PHI.
3. Samuel Y. Liao, "Microwave Devices and Circuits," 3/e, Pearson Education, 2003.

Suggested Reading:

1. William H. Hayt Jr. and John A. Buck, "Engineering Electromagnetics", 8th edition, 2016, TMH
2. John D. Ryder, "Networks Lines and Fields", 2nd edition, 2015, PHI.
3. R.K. Shevgaonkar, "Electromagnetics Waves", Tata McGraw Hill India, 2005.
4. Sunil Bhooshan, "Fundamentals of Engineering Electromagnetics", 2012, Oxford University Press Publication.

e-Resources:

1. https://nptel.ac.in /courses/108106157.

22ECC03N

NETWORK ANALYSIS AND SYNTHESIS

Instruction	3 L + 1T Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Prerequisite: Knowledge on Elements of Electrical Engineering.

Course Objectives:
This course aims to:

1. Make understand the concepts of Electric Circuits, Network Theorems and the Transient Analysis.
2. Make understand the concept of steady state and applying phasor analysis to AC circuits and analyzing magnetic coupled circuits.
3. Familiarize resonant circuits, two port network parameters, concept of Passive Filters and Network Synthesis.

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

1. Recall basics of electrical circuits with Nodal and Mesh analysis.
2. Illustrate electrical theorems for AC and DC Circuits.
3. Develop time domain and frequency domain analysis for circuits.
4. Analyze the electrical network and two port network parameters for different applications i.e., magnetic coupled circuits, Filters.
5. Synthesize different network functions using Foster and Cauver form.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	2	1	1	1	1	2	3	1	3	3	2	3
CO 2	3	3	2	2	1	1	1	1	2	3	1	3	3	2	3
CO 3	3	3	2	2	1	1	1	1	2	3	1	3	3	2	3
CO 4	3	3	2	2	1	1	1	1	2	3	1	3	3	2	3
CO 5	3	3	3	2	1	1	1	1	2	3	1	3	3	2	3

UNIT - I

Network Theorems: Network reduction techniques, Super Nodal and Super Mesh Analysis, Superposition, Thevenin's and Norton's theorems, Reciprocity, Maximum Power Transfer, Compensation, Millman's, Duality and Tellegen's Theorems using dependent and independent sources.

UNIT - II

Transients: Introduction, Study of initial conditions, DC transients RL, RC circuits, RLC circuits, Formulation of integral, differential equations. Circuit analysis using Laplace Transform and inverse Laplace Transform, Pole-Zero Plots, Zero Input Response, Zero State Response.

UNIT - III

Steady State Analysis of AC Circuits: Phasor and vector representations, impedance and admittance, Average power, Apparent Power, Complex Power, Power triangle.

Coupled circuits: Concept of self, mutual inductance, co-efficient of coupling, dot convention rules and analysis of simple circuits.

UNIT - IV

Frequency Domain Analysis: Concept of complex frequency, impedance and admittance functions, Series and parallel resonance, Q-factor, selectivity, bandwidth.

Two Port Networks: Z, Y, h, g, ABCD and Inverse ABCD parameters, equivalence of two port networks. Inter connection of two port networks.

UNIT - V

Filters: Introduction to Filters and classification of Filters (Low pass, High pass) and their design aspects.

Network Synthesis: Synthesis vs. analysis, Elements of circuit synthesis, Positive Real Functions: Definition, Necessary and sufficient conditions for a function to be positive real, Testing of driving point functions for positive realness. Synthesis of Foster and Cauer forms of LC, RC and RL networks.

Text Books:

1. William H.Hayt, Jr.,Jck E. Kemmerly and Steven M.Durbin, "Engineering Circuit Analysis", 8th Edition, McGraw Hill, 2013.
2. Van Valkenberg M.E, "Network Analysis", PHI, 3rd Edition New Delhi, 2002.

Suggested Reading:

1. C. L. Wadhwai, "Network Analysis and Synthesis", 4th Edition, New Age Publications, 2016.
2. Sudhakar. A. and Shyam Mohan, S. P., "Circuits and Network", Tata McGraw Hill, New Delhi, 1994.

e-Resources:

1. https://nptel.ac.in/courses/108105159.
2. https://nptel.ac.in/courses/108102042.
3. https://nptel.ac.in/courses/117106108.

22ECC04

SIGNALS AND SYSTEMS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge of Differential and Integral Calculus.

Course Objectives:

This course aims to:

1. Know Signals and systems representation/classification and also the time and frequency domain analysis of continuous time signals with Fourier series, Fourier transforms and Laplace transforms.
2. Understand Sampling, time and frequency domain analysis of discrete time signals with DTFS, DTFT and Z-Transforms.
3. Understand concepts of convolution and correlation integrals.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Classify signals, systems and analyse the signals using Transform techniques.
2. Evaluate signal characteristics using time and frequency domain analysis.
3. Assess the system stability and causality using ROC and Pole-Zero Plot.
4. Describe the sampling process and analyse the DT Signal/systems using DTFS, DTFT and Z-Transform.
5. Apply the Convolution and correlation concepts for analysis of Signal and systems**.**

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	1	1	1	1	1	1	2	1	2	2	1	1
CO 2	3	2	1	1	1	1	1	1	1	2	1	2	2	1	1
CO 3	3	2	1	1	1	1	1	1	1	2	1	2	2	1	1
CO 4	3	2	1	1	1	1	1	1	1	2	1	2	2	1	1
CO 5	3	2	1	1	1	1	1	1	1	2	1	2	2	1	1

UNIT - I

Continuous Time Signals: Introduction to signals and systems, their representations and classification. Orthogonality of signals, Complete set of mutually orthogonal signals and Harmonic signals. Trigonometric Fourier series, Exponential Fourier series, Existence and Convergence. Symmetry conditions, Amplitude and Phase spectra. Power Spectral Density.

UNIT - II

Fourier Transforms: The direct and inverse Fourier transforms, Existence, Frequency spectrum and properties of Fourier Transforms, Fourier Transform of singularity functions and periodic signals. Energy Spectral Density.

UNIT - III

Laplace transforms: The Bilateral and unilateral Laplace transforms. Region of convergence and its properties. Properties of Laplace transform, Inverse Laplace transform, Laplace transform of causal periodic signals.

LTI System: Impulse response, System transfer function, Stability and Causality.

UNIT - IV

Discrete Time Signals: Sampling of continuous time signals. Sampling Theorem, DTS representation. Discrete Time Fourier Series, Discrete Time Fourier Transform and properties.

Z–Transform: The Direct Z-Transform, Region of convergence and its properties. S–Plane and Z–Plane correspondence, Z–Transform properties. Inverse Z–Transform.

Discrete LTI system: Impulse response and System transfer function. Stability and Causality.

UNIT - V

Convolution: Continuous convolution, Graphical interpretation and its properties. Discrete convolution and its properties.

Correlation: Continuous Cross correlation, Auto correlation and properties. Discrete Cross correlation, Auto correlation and properties.

Text Books:

1. B. P. Lathi, "Signals, Systems and Communications", BS Publications, 3rd Edition, 2008.
2. Simon Haykin, "Signals and Systems", Wiley India, 5th Edition, 2009.
3. Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawad, "Signals and Systems", PHI 2nd Edition, 2015.

Suggested Reading:

1. M. J. Robert, "Fundamentals of signals and systems", McGraw Hill, 2008.
2. A. Rajeswari, "Signals and Systems", Wiley India Pvt. Ltd, Publications 2021.

e-Resources:

1. https://nptel.ac.in/courses/108104100.
2. https://nptel.ac.in/courses/117101055.
3. https://nptel.ac.in/courses/117106108.
4. https://nptel.ac.in/courses/117104074.

22ITC25N

DATA STRUCTURES USING C LAB
(Common for ECE and EEE)

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisites: Programming and Problem Solving, Programming Laboratory.

Course Objectives:
The objectives of this course are to:
1. Acquaint with the IDLE and execution process of C Programs.
2. Learn the concepts of decision structures and Iteration structures in C.
3. Introduce Functions, Arrays, Pointers and Structures.
4. Explore linear data structures such as Stack, Queue and Linked lists.
5. Explain C programs to implement Trees and Graphs

Course Outcomes:
After completion of the course, students will be able to:
1. Understand the execution of programs written in C language.
2. Illustrate decision and iterative structures.
3. Demonstrate the concepts of functions, arrays, structures and pointers.
4. Implement basic operations on linked lists, stacks, queues
5. Construct Trees, graphs and implement traversals.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	1	-	-	-	-	-	-	-	-	1	3	3	1
CO 2	2	2	1	-	-	-	-	-	-	-	-	1	3	3	1
CO 3	2	2	2	-	-	-	-	-	-	-	-	1	3	3	1
CO 4	2	2	2	-	-	-	-	-	-	-	-	1	3	3	1
CO 5	2	2	2	-	-	-	-	-	-	-	-	1	3	3	1

List of Experiments
1. Using if and Switch Constructs Programs.
2. Demonstration of Looping Statements Problems.
3. Demonstration of Iterative and recursive Functions.
4. Demonstration of Structures and Union Programs.
5. Demonstration of Pointers and Arrays Programs.
6. Implementation of Stacks, Queues and standard operations.
7. Implementation of Single Linked Lists and standard operations
8. Implementation of Double Linked Lists and standard operations.
9. Construct a Binary Search Tree and implement tree traversals
10. Represent Graph and implement DFS and BFS traversals.

Text Books:
1. Pradip Dey and Manas Ghosh, "Programming in C", 2nd Edition, Oxford University Press 2011.
2. Ellis Horowitz, Sartaj Sahni, Susan, "Fundamentals of Data Structures in C", Computer Science, 1993.

Suggested Reading:

1. M.T. Somashekara, "Problem Solving Using C", 2nd Edition, PHI 2009 Pearson, 2013.
2. A.K. Sharma, "Computer Fundamentals and Programming in C", University Press, 2nd Edition.
3. E. Bala Guruswamy, "C and Data Structures", 4th Edition, Tata Mc Graw Hill.

e-Resources:

1. https://nptel.ac.in/courses/106105085.
2. https://archive.nptel.ac.in/courses/106/106/106106127.

22ECC05

ELECTRONIC DEVICES LAB

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Students should have the knowledge of semiconductor fundamentals.

Course Objectives:

This course aims to:

1. The V-I characteristics of diodes and special semiconductor devices.
2. The design and performance evaluation of various diodes as rectifiers.
3. The characteristics of transistor in various configurations.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Demonstrate the characteristic behaviour of PN junction diode and Zener diode.
2. Design various non-linear wave shaping circuits using diodes for a given specification.
3. Analyse the performance of rectifiers with and without filters.
4. Examine the characteristics of BJT and FET in various configurations.
5. Compare the characteristics of special purpose semiconductor diodes.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	1	1	2	1	1	2	2	2	2	2	3	3	2
CO 2	2	2	1	1	2	1	1	2	2	2	2	2	3	3	2
CO 3	2	2	1	1	2	1	1	2	2	2	2	2	3	3	2
CO 4	2	2	1	1	2	1	1	2	2	2	2	2	3	3	2
CO 5	2	2	1	1	2	1	1	2	2	2	2	2	3	3	2

List of Experiments:

1. V-I Characteristics of Silicon and Germanium diodes and measurement of static and dynamic resistances.
2. Zener diode reverses characteristics and its application as voltage regulator.
3. Simple series clippers, parallel clippers and biased clipping circuits.
4. Clamping Circuits.
5. Performance evaluation of half wave rectifier without filters and with C & π section filters.
6. Performance evaluation of full wave rectifiers without filters and with C & π section filters.
7. BJT characteristics in Common Base configuration and measurement of h-parameters.
8. BJT characteristics in Common Emitter configuration and measurement of h-parameters.
9. BJT characteristics in Common Collector configuration and measurement of h-parameters.
10. Drain and Transfer characteristics of JFET in CS configuration and measurement of Transconductance and Drain resistance.
11. Emitter characteristics of UJT.
12. Characteristics of SCR.
13. Characteristics of Tunnel diode.
14. **Structured Enquiry:** Design a switching circuit using BJT and JFET and analyse its operation.
15. **Open ended Enquiry:** Design a LED running lights circuit for vehicles to avoid accidents in fog / rain condition.

Virtual lab Experiments (https://be-iitkgp.vlabs.ac.in/List%20of%20experiments.html**):**

1. Rectifiers without and with filters.
2. BJT characteristics in Common Base configuration and measurement of h-parameters.

3. BJT characteristics in Common Emitter configuration and measurement of h-parameters.

Note:

1. Wherever possible, Analysis and design of circuits shall be carried out using simulation tools.
2. A minimum of 12 experiments should be performed.

Suggested Reading:

1. Robert Diffenderfer, “Electronic Devices Systems and Applications”, Cengage Learning India Private Limited, 2010.
2. Paul B. Zbar, Albert P. Malvino, Michael A. Miller, “Basic Electronics, A Text - Lab Manual”, 7th Edition, TMH 2001.
3. Mahesh Jain, “Practical semiconductors data manual No.3”, BPB Publications, 1981.
4. Bharath Electronics Ltd., “Semiconductors data manual”, IEC Publication 134, 1969.

22ECC06

NETWORK ANALYSIS AND SYNTHESIS LAB

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Knowledge of basic Electrical components and Circuits.

Course Objectives:

This course aims to:

1. Understand the basic Concepts of Electrical Circuits, equipment and verify Network theorems.
2. Analyze Resonant circuits, Attenuators and passive filters.
3. Synthesize different network functions using Foster and Cauer forms.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Identify and measure the passive and active components using electronic equipment and apply Network theorems to AC and DC Circuits.
2. Determine and analyze two port network parameters.
3. Design and verification of attenuator and filters.
4. Simulation of different networks and circuits using the simulation software.
5. Synthesize different network functions using Foster and Cauer forms.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO 2	3	3	3	2	2	2	1	1	1	2	1	2	1	3	2
CO 3	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1
CO 4	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1
CO 5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

List of Experiments:

1. Study of RLC components, Bread board, Regulated power supply, Function generator, CRO Measurement of R, L, C components using color code, multimeter and LCR - Q Meter.
2. Practice of Soldering and de -soldering for simple circuits on single and Multi-Layer PCBs.
3. Verification of Superposition theorem and Tellegen's theorem.
4. Verification of Maximum power transfer theorem. Verification of Reciprocity theorem.
5. Verification of Compensation theorem and Millman's theorem.
6. Verification of Transient Response in RC, RLCircuits.
7. Design and Verification of Series Resonance.
8. Determination of two-port network parameters (Z, Y, h, T).
9. Design and Verification of Constant-K low-pass filter.
10. Synthesization of network function using Foster and Cauer form.
11. **Structured Enquiry:** Design and Verification of Parallel Resonance.
12. **Open ended Enquiry:** Design and Verification of Constant-K High-pass filter.
13. **Virtual lab experiment:** Verification of Reciprocity Theorem – https://asnm-iitkgp.vlabs.ac.in/exp/verification-reciprocity-theorem/simulation.html

Note: Experiments are to be simulated by using simulation software.

Suggested Reading:

1. Thomas Petruzzellis, "Build Your Own Electronics Workshop", McGraw-Hill Companies, Inc., 2005.
2. A.M. Zungeru, J.M. Chuma, M. Mangwala, L.K. Ketshabetswe, "Handbook of Laboratory Experiments in Electronics and Communication Engineering", Vol. 2, 1st Edition, Notion press, 2017.

22ECI01

MOOCs / Training / Internship

Instruction / Demonstration / Training	3-4 Weeks / 90 Hours
Duration of Semester End Presentation	-
Semester End Evaluation	-
Continuous Internal Evaluation	50 Marks
Credits	2

Prerequisite: Knowledge of Basic Sciences and Engineering Science.

Course Objectives:

This course aims to:

1. Exposing the students to the industrial environment.
2. Create awareness with the current industrial technological developments relevant to program domain.
3. Provide opportunity to understand the social, economic and administrative considerations in organizations.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand Engineer's responsibilities and ethics.
2. Use various materials, processes, products and quality control.
3. Provide innovative solutions to solve real world problems.
4. Acquire knowledge in technical reports writing and presentation.
5. Apply technical knowledge to real world industrial/rural situations.

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Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	3	3	1	3	1	3	3	1	1	3
CO 2	1	1	1	3	3	1	2	1	1	1	1	1	3	3	1
CO 3	2	3	3	3	3	2	3	1	1	1	1	1	3	3	1
CO 4	1	1	1	1	1	3	1	1	3	3	1	1	1	1	3
CO 5	1	3	3	3	3	2	3	1	1	1	1	1	3	3	3

For implementation procedures and letter formats, Annexures I and III of Internship document may be referred.

Evaluation of Internship: The Industrial training / Internship of the students will be evaluated in three stages:

a) Evaluation by the Industry (in the scale of 1 to 10 where 1-Unsatisfactory; 10-Excellent).
b) Evaluation by faculty Mentor on the basis of site visit(s) or periodic communication (15 marks).
c) Evaluation through seminar presentation / Viva-Voce at the Institute by the constituted committee (25 marks).

Evaluation through Seminar presentation / Viva-Voce at the institute: Students shall give a seminar before an Expert Committee constituted by college (Director, HoD/Senior faculty, mentor and faculty expert from the same department) based on his/her training/internship carried out.

The evaluation will be based on the following criteria:

- Quality of content presented.
- Proper planning for presentation.
- Effectiveness of presentation.
- Depth of knowledge and skills.
- Attendance record, daily diary, departmental reports shall be analyzed along with the Internship report.

Monitoring / Surprise Visits: During the internship program, the faculty mentor makes a surprise visit to the internship site, to check the student's presence physically. If the student is found to be absent without prior intimation to the concerned industry, entire training / internship may be canceled. Students should inform through email to the faculty mentor as well as the industry supervisor at least one day prior to avail leave.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

AICTE Model Curriculum with effect from AY 2025-26

BE (Electronics and Communication Engineering)

SEMESTER – IV

S.no	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	22ECC07	Analog Circuits	3	-	-	3	40	60	3
2	22ECC08	Antennas and Wave Propagation	3	-	-	3	40	60	3
3	22ECC09	Control Systems	3	-	-	3	40	60	3
4	22ECC10	Digital System Design	3	-	-	3	40	60	3
5	22ECC11	Probability Theory and Stochastic Process	3	-	-	3	40	60	3
6	22EEM01	Universal Human Values-II: Understanding Harmony	-	1	-	-	50	-	1
7	22EGM01	Indian Constitution and Fundamental Principles	2	-	-	2	-	50	Non-Credit
PRACTICALS									
8	22ECC12	Analog Circuits Lab	-	-	2	3	50	50	1
9	22ECC13	Digital System Design Lab	-	-	2	3	50	50	1
10	22ECC14	Modelling and Simulation Lab	-	-	2	3	50	50	1
11	22EGC03	Employability Skills	-	-	2	3	50	50	1
12	22ECU01	Up-skill Certification Course-I	-				25	-	0.5
Total			**17**	**1**	**8**	**29**	**475**	**550**	**20.5**
Clock Hours Per Week: 26									

L: Lecture **D: Drawing** **CIE: Continuous Internal Evaluation**

T: Tutorial **P: Practical/Project Seminar/Dissertation** **SEE: Semester End Examination**

22ECC07

ANALOG CIRCUITS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Student should have knowledge of Electronic Devices.

Course Objectives:

This course aims to:

1. The various biasing circuits for BJT and FET.
2. The analysis of BJT & FET in various configurations using small signal equivalent models.
3. The concepts of multistage, feedback amplifiers, and power amplifier.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Apply the knowledge of BJT behavior in the design of various biasing and amplifier circuits.
2. Relate the knowledge of FET characteristics in the design of various biasing and amplifier circuits.
3. Apply high and low frequency models of transistor in the analysis of single stage and multistage amplifiers.
4. Analyze negative feedback amplifier circuits and compare them.
5. Compare and Contrast different types of Oscillators and Power amplifiers.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	3	1	1	1	1	1	1	1	1	3	2	1
CO 2	3	3	3	2	1	1	1	1	1	1	1	1	3	2	1
CO 3	3	3	3	3	1	1	1	1	1	1	1	1	3	2	1
CO 4	3	3	3	2	1	1	1	1	1	1	1	1	3	2	1
CO 5	3	2	1	2	1	1	1	1	1	1	1	1	3	2	1

UNIT - I

BJT Biasing: Operating point, Bias stability, stability factors, BJT biasing techniques: Fixed Bias, Collector-Base bias, Emitter Bias, Voltage-Divider bias, Thermal runaway.

BJT Amplifiers: CB, CE and CC amplifiers: Analysis using h-parameters ((approximate and exact analysis), Comparison of the three amplifier configurations, Millers Theorem – application circuit, Frequency response of BJT amplifiers.

UNIT - II

JFET biasing: Fixed biasing, Self-bias and Voltage-divider bias configurations, FET biasing for zero current drift.

JFET Amplifiers: CS, CD and CG amplifiers: Analysis using small-signal model, Comparison of three amplifier configurations, Frequency response of FET Amplifiers.

UNIT - III

Multistage amplifiers: Overview of Coupling schemes - RC coupling, Transformer coupling and Direct coupling; Analysis of CE-CE, CE-CB, CC-CC Darlington pair, Multi-stage frequency effects.

Transistor at high frequencies: Hybrid π CE transistor model, Hybrid π Conductances and Capacitances, CE short circuit current gain.

UNIT – IV

Negative Feed Back Amplifiers: The feedback concept, General characteristics of negative feedback amplifiers, Effect of negative feedback on input and output impedances, Method of analysis of feedback amplifiers, Analysis of practical feedback circuits - Voltage series, voltage shunt, current series and current shunt feedback amplifiers.

UNIT - V

Oscillators: Positive feedback and conditions for sinusoidal oscillations, RC Phase Shift Oscillator, LC oscillators – Hartley and Colpitts Oscillators, Crystal oscillator.

Large Signal Amplifiers: Classes of operation, Harmonic distortion, Class A resistive coupled and transformer coupled amplifiers, Class-B Push-pull and complementary symmetry amplifiers, Class AB operation, Power dissipation and efficiency calculations. Heat sinks. Introduction to Tuned Amplifiers

Text Books:

1. Jacob Millman, Christos Halkias, Chetan Parikh, "Integrated Electronics – Analog and Digital Circuits and Systems", 2nd Edition, McGraw Hill Publication, 2010.
2. Robert L. Boylestad, "Electronic Devices and Circuit Theory", 10th Edition, PHI, 2009.

Suggested Reading:

1. David Bell, "Fundamentals of Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008.
2. Millman and Halkias, "Electronic Devices and Circuits" 2nd Edition, McGraw Hill Publication, 2007.
3. Donald Schilling, Charles Belove, Tuvia Apelewicz Raymond Saccardi, "Electronic Circuits: Discrete and Integrated", TMH, 3rd Edition, 2012.

e-Resources:

1. https://nptel.ac.in/courses/108101094.

22ECC08

ANTENNAS AND WAVE PROPAGATION

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have prior knowledge about Electromagnetic waves.

Course Objectives:

This course aims to:

1. Provide the basic principles of an antenna and its parameters for characterizing its performance.
2. Understand the fundamental concepts of various types of antennas and arrays for customizing the radiation pattern.
3. Understand the propagation behaviour of the radio waves.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the basic parameters of an antenna.
2. Understand the radiation properties of antenna and analyze different type of wire antennas.
3. Analyze the linear arrays for uniform and non-uniform distribution.
4. Learn the concept of different types of planar antenna.
5. Study the behaviour of radio waves in various mode of wave propagation.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	3	3	1	1	2	3	1	3	1	1	2	3	3	3
CO 2	2	3	2	2	3	1	1	1	3	3	1	3	3	3	3
CO 3	3	3	2	2	3	1	2	1	3	3	3	3	3	3	3
CO 4	3	3	2	2	3	1	2	1	3	3	3	3	3	3	3
CO 5	3	3	2	2	3	1	2	1	3	3	3	3	3	3	3

UNIT - I

Antenna Basics: Principles of radiation, Retarded potential, Isotropic, Directional and Omni-directional radiators. Basic Antenna Parameters: Radiation patterns, radiation intensity, region separation, gain and directivity, Antenna polarization, Effective aperture and efficiency, Friis Transmission equation, Point sources and current distribution.

UNIT - II

Antenna Analysis: Analysis of Infinitesimal dipole, Half wave dipole, Loop antenna, Calculation of radiation resistance and directivity.

UNIT - III

Antenna Arrays: Uniform and Non-Uniform Arrays: Concept of Antenna Array, N-Element Uniform array, Two element array of Infinitesimal dipoles. Broadside and End fire arrays, Calculation of Directivity. Qualitative treatment of Non-Uniform array: Binomial and Tschebyscheff distribution and Qualitative treatment of Phased antenna array.

UNIT - IV

Microstrip Antennas: Radiation mechanism, different types, advantages and disadvantages. Design of rectangular Microstrip antenna. Reflectors: Paraboloidal Reflectors, Qualitative treatment of Smart Antennas.

Antenna Measurements: Measurement of Radiation Pattern and Gain.

UNIT - V

Wave Propagation: Frequency Spectrum, Ground wave propagation, Space and Surface waves, Tropospheric refraction and reflection, Duct propagation. Sky wave propagation: Critical frequency, Maximum Usable Frequency (MUF), Ionospheric Delay and Skip distance, Line of sight propagation.

Text Books:

1. Constantine A. Balanis, "Antenna Theory: Analysis and Design", 4th Edition, John Wiley, 2016.
2. Edward C. Jordan and Kenneth G. Balmain, "Electromagnetic Waves and Radiating Systems", 2nd Edition, PHI, 2001.

Suggested Reading:

1. John D. Krauss, Ronald J. Marhefka and Ahmad S. Khan, "Antennas and Wave Propagation", 4th Edition, TMH, 2010.
2. Dennis Roody and John Coolen, "Electronic Communications", 4th Edition, Prentice Hall, 2008.
3. I.J.Bhal and P.Bhartia, "Micro-strip antennas", Artech house, 1980.

e-Resources:

1. https://archive.nptel.ac.in/courses/117/107/117107035.

22ECC09

CONTROL SYSTEMS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: The student is expected to have knowledge of Laplace transform and electrical and electronic circuits.

Course Objectives:

This course aims to:

1. Introduce various control systems (Open and closed loop) and their equivalent mathematical models using block diagrams, signal flow graphs and state space techniques.
2. Analyze the time and frequency response of control system to access the transient response and steady state response.
3. Study different types of stability concepts in control systems and Design various controllers and compensators to improve the system dynamic performance.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Distinguish the closed-loop control systems from open-loop control systems and develop mathematical models in time domain (differential equations, state equations) and S-domain (Transfer function using Laplace transform).
2. Evaluation of transfer function from block diagram and signal flow graph by using block diagram reduction techniques and Mason gain formula, respectively.
3. Investigate the stability of control system via Routh-Hurwitz criteria, Root-locus method and Nyquist Plot.
4. Utilize standard test signals to analyze the time response of first and second-order control systems and frequency response analysis of the control system.
5. Design and develop various controllers and compensators to control the steady state error, stability and transient response.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	1	1	1	1	1	1	1	1	1	1	3	2	2
CO 2	3	3	1	2	1	1	1	1	1	1	1	1	3	2	2
CO 3	3	3	3	3	2	1	1	1	1	1	1	1	3	2	2
CO 4	3	3	2	3	2	1	1	1	1	1	1	1	3	2	2
CO 5	3	3	3	2	1	1	1	1	1	1	1	1	3	2	2

UNIT - I

Control System Fundamentals: Classification of control systems, Open and Closed Loop control systems, Block diagram reduction and signal flow graphs, Mathematical modelling of a Mechanical system and conversion into Electrical system.

UNIT - II

Time Response Analysis: Transfer function and Impulse Response, Types of Inputs, Transient Response of first and second Order System with different inputs, Time domain Specifications. Types of Systems, Static error coefficients, Error series, PD, PI and PID controllers.

UNIT - III

Root Locus: Routh-Hurwitz criteria for stability, Root Locus Techniques, Analysis of typical systems using Root Locus Techniques, Effect of location of roots on system response.

UNIT - IV

Frequency Response Analysis: Frequency domain specifications, Bode plot, Principle of Argument, Nyquist plot and stability criterion, Gain and Phase Margins from the Bode and Nyquist diagrams, Lead and Lag compensators.

UNIT - V

State Space Analysis: Concept of State, State Variable, State vector and State space. State space representations of linear time invariant systems, State transition matrix, Solution of state equation, Controllability, Observability and Design of control systems using state variable feedback.

Text Books:

1. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International Publishers, 5th Edition 2012.
2. Benjamin C. Kuo, "Automatic Control Systems", 7th Edition, PHI, 2010.

Suggested Reading:

1. K. Ogata, "Modern Control Engineering", EEE, 5th Edition, PHI, 2003.
2. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", 11th Edition Pearson, 2008.
3. Gopal Madan, "Digital control engineering" 1st Edition, New age publishers, 2008.

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc20_ee90.

22ECC10

DIGITAL SYSTEM DESIGN

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge of Electronic device concepts.

Course Objectives:

This course aims to:

1. Learn various techniques for logic minimization.
2. Comprehend the concepts of various combinational circuits and sequential circuits.
3. Learn the Language fundamentals of Verilog HDL and also able to simulate and synthesize various digital modules.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the basic concepts related to digital system design.
2. Design the combinational and sequential circuits.
3. Analyze the behavior of the digital system design.
4. Develop the digital system using various Verilog HDL modeling.
5. Apply the design concepts of digital system using Verilog HDL.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	3	2	1	1	1	1	1	1	1	3	2	2
CO 2	3	2	2	3	2	1	1	1	1	1	1	1	3	3	2
CO 3	3	3	3	3	2	1	1	1	1	1	1	2	3	2	2
CO 4	3	3	3	3	2	2	1	2	2	1	1	2	3	2	3
CO 5	3	3	3	3	2	2	1	2	2	1	1	2	3	2	2

UNIT - I

Logic Simplification and Combinational Logic Design: Number system representation and conversion, Binary Arithmetic, Complements, Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Introduction to Logic Gates, Ex-OR, Ex-NOR operations, Minimization of Switching Functions: Karnaugh map method, Quine –McCluskey Tabular Minimization Method, Logic function realization: AND-OR, OR-AND and NAND/NOR realizations.

UNIT - II

Introduction to Combinational Design: Binary Adders and Subtractor, Code converters: Binary to Gray, Gray to Binary, BCD to excess3, BCD to Seven Segment display. Decoders, Encoders, Priority Encoders, Multiplexers, De-multiplexers, Comparators, Implementations of Logic Functions using Decoders and Multiplexers.

UNIT - III

Sequential Logic Design: Latches, Flipflops, Difference between latch and flipflop, types of flipflops like S-R, D, T, JK and Master-Slave JK Flip Flop, Flip flop conversions, setup and hold times, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts.

UNIT – IV

Introduction to HDLs: VLSI Design flow, Basic Concepts of Verilog HDL, Data Types, System Tasks and Compiler Directives. Gate Level Modelling: Gate Types and Gate Delays. Dataflow Modelling: Continuous Assignment and Delays. Design of Stimulus Block.

UNIT - V

Behavioral Modelling: Structured Procedures, Procedural Assignments, Timing control, Conditional statements, Sequential and Parallel Blocks. Switch level Modelling, Introduction to tasks and functions, Useful modelling Techniques, Procedural continuous assignments, Overriding parameters, Conditional compilation and execution, Introduction to Logic Synthesis. Concept of Programming using FPGA.

Text Books:

1. Morris Mano M. and Michael D.Ciletti, "Digital Design, With an Introduction to Verilog HDL", 5th Edition, Pearson 2013.
2. Samir Palnitkar, "Verilog HDL, A guide to Digital design and synthesis", 2nd Edition, Pearson Education, 2008.

Suggested Reading:

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th Edition, 2009.
2. Thomas L. Floyd, "Digital Fundamentals", Pearson, 11th Edition, 2015.

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc24_cs61.
2. https://onlinecourses.nptel.ac.in/noc24_ee17.
3. https://onlinecourses.nptel.ac.in/noc24_cs10.

22ECC11

PROBABILITY THEORY AND STOCHASTIC PROCESS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: A prior knowledge of probability.

Course Objectives:
This course aims to:

1. Apply the knowledge of probability, random variables and random processes gained in this course to several complex engineering problems.
2. Model a random variable/process into a mathematical model. Compute probability distributions and estimate statistical / time variations.
3. Learn the basic concepts of noise, characterize the noise and estimate the response of a linear system to a random process such as noise.

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

1. Understand fundamentals of Probability and the concept of random variables.
2. Characterize random distributions.
3. Determine the Spectral and temporal characteristics of Random Signals.
4. Analyze the Noise in Communication systems.
5. Estimate the auto-correlation and power spectral density of linear system response.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	2	1	1	1	1	1	2	1	1	1	2	3	3	1
CO 2	2	3	1	3	2	1	1	2	1	1	1	2	3	3	1
CO 3	1	2	1	1	1	1	1	2	1	1	1	2	3	3	1
CO 4	2	3	1	3	2	1	1	2	1	1	1	2	3	3	1
CO 5	1	3	1	2	2	1	1	2	1	1	1	2	3	3	1

UNIT - I

Probability and Random Variables: Review of Probability, Joint and Conditional Probability, Total Probability, Bayes' Theorem, Independent Events, Concept of Random Variables, Continuous Distributions: Uniform, Exponential, Gaussian and Rayleigh Distributions. Discrete Distributions: Binomial and Poison Distributions. Conditional and Joint Distributions and Density Functions.

UNIT - II

Operations on Single Random Variables: Expectation, Moments about Origin and Central Moments, Chebychev's Inequality and Markov's Inequality. Functions that give Moments: Characteristic Function, Moment Generating Function, Central Limit Theorem (proof not expected).

Operations on Multiple Random Variables: Expected Value of a Function of Random Variables, Joint Moments about the Origin, Joint Central Moments, Jointly Gaussian Random Variables and Properties.

UNIT - III

Stochastic Processes – Temporal Characteristics: The Random Process Concept, Classification of Processes. Stationarity and Independence: Distribution and Density Functions, Wide-Sense Stationarity, Strict-Sense Stationarity, Time Averages and Ergodicity. Autocorrelation Function and its Properties, Cross-Correlation Function and its Properties, Covariance Function, Gaussian Random Process.

Stochastic Processes – Spectral Characteristics: Power Density Spectrum and its Properties, Relationship between Power Spectrum and Autocorrelation Function, Cross-Power Density Spectrum and its Properties. Relationship between Cross-Power Spectrum and Cross-Correlation Function.

UNIT -IV

Noise: Thermal Noise, White Noise and Colored Noise, AWGN, Noise Temperature, Noise in Two-Port Network: Noise Figure, Equivalent Noise Temperature and Noise Bandwidth. Noise Figure and Equivalent Noise Temperature for Cascaded Systems.

UNIT - V

Linear System with Random Inputs: Random Signal Response of Linear Systems: System Response, Convolution, Mean and Mean Squared Value of System Response, Auto Correlation of Response and Cross Correlation functions of Input and Output. Power Density Spectrum of Response, Cross-Power Density Spectrums of Input and Output.

Text Books:

1. Peyton Z.Peebles JR., "Probability Random Variables and Random Signal Principles", Tata McGraw Hill, Edition, 4/e, 2002.
2. Herbert Taub, Donald Schilling and Goutam Saha, "Principles of Communication", Tata McGraw Hill, 4th Edition, 2017.
3. Athanasios Papolis and S.Unnikrishna Pillai, "Probability, Random Variables and Stochastic Processes", McGraw Hill, Inc., 4th Edition, 2006.

Suggested Reading:

1. Henry Stark and John W Woods, "Probability & Random Process with Application to Signal Processing", Pearson Education, 3rd Edition, 2014.
2. Simon Haykin, "Communication Systems" John Wiley & Sons, Inc. 5th Edition, 2009.
3. B.P.Lathi, "Signals, Systems & Communications", B.S.Publications, 2003.

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc24_ma97.
2. https://ocw.mit.edu/courses/18-440-probability-and-random-variables-spring-2014.

22EEM01

UNIVERSAL HUMAN VALUES-II: UNDERSTANDING HARMONY

(BE / B.Tech – Common to all Branches)

Instruction	1 T Hours per Week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	1

Introduction

This course discusses the role of human values in one's family, in society and in nature. During the Induction Program, students would get an initial exposure to human values through Universal Human Values–I. This exposure is to be augmented by this compulsory full semester foundation course.

Prerequisite: Universal Human Values–I Student Induction Program.

Course Objectives:

This course aims to:

1. Understand the concept of universal human values
2. Cultivate empathy and respect for diversity
3. Inspire the social responsibility and global citizenship

Course Outcomes

Upon completion of this course, students will be able to:

1. Become familiar about themselves, and their surroundings (family, society, nature).
2. develop empathy and respect for diversity by gaining an appreciation for different cultures, perspectives and identities
3. Exhibit responsible and ethical behavior by adhering to principles of integrity, honesty, compassion, and justice.
4. Recognize their role as global citizens.
5. Exhibit a sense of social responsibility.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1
CO 2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO 3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
CO 4	1	1	1	3	2	1	1	2	1	1	1	1	2	2	2
CO 5	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2

Module -1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

- Purpose and motivation for the course, recapitulation from Universal Human Values-I
- Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and
- Experiential Validation- as the process for self-exploration.
- Natural acceptance of human values.
- Definitiveness of Ethical Human Conduct.
- Continuous Happiness and Prosperity- A look at basic Human Aspirations.
- Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.

- Understanding Happiness and Prosperity correctly- A critical appraisal of the current Scenario.
- Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

Module- 2: 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.
- Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

Module-3: 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 meaning of Trust; Difference between intention and competence.
- Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.
- Understanding the harmony in society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co -existence as comprehensive Human Goals.
- Strategy for transition from the present state to Universal Human Order:
  a. At the level of individual: as socially and ecologically responsible engineers, technologists, and managers.
  b. At the level of society: as mutually enriching institutions and organizations.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss scenarios. Elicit examples from students' lives.

Module -4: Understanding Harmony in Nature and Existence - Whole existence as Coexistence.

- Understanding the harmony in Nature.
- Interconnectedness and mutual fulfilment among the four orders of nature - recyclability and self-regulation in nature.
- Understanding Existence as Co-existence of mutually interacting units in all - pervasive space.
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.
- Holistic perception of harmony at all levels of existence.
- Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
- Case studies of typical holistic technologies, management models and production systems.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc. Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

Mode of Conduct (L-T-P-C 0-1-0-0)

- While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.
- In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection, and self- exploration.
- Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentors, in a group sitting.
- **Tutorials (experiments or practical) are important for this course**. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignments and/or activities are included.
- The practice sessions would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to the development of commitment, namely behaving and working based on basic human values.
- **It is advised to share the experience of the Faculty to the class in a capsule form.**
- **Involve more in evaluating the student by different activities with proper RUBRCCS**

Assessment:

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self- assessment, peer assessment etc. will be used in evaluation.

Example:

Module-1:	10 M
Module -2:	10 M
Module- 3:	10 M
Module-4:	10 M
Attendance & Attitude:	10 M

The overall pass percentage is 50%. In case the student fails, he/she must repeat the course.

Textbooks

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics" 2nd Revised Edition, Excel Books, New Delhi, 2022.
2. R R Gaur, R Asthana, G P Bagaria "Teacher's Manual for A Foundation Course in Human Values and Professional Ethics", nd Revised Edition, Excel Books, New Delhi, 2022.

Reference Books

1. A Nagaraj, Jeevan Vidya: Ek Parichaya, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. A.N. Tripathi, Human Values, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. Mohandas Karamchand Gandhi, The Story of My Experiments with Truth.

e-Resources:

1. https://nptel.ac.in/courses/109104068.

22EGM01

INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES

(BE / B.Tech – Common to all Branches)

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	No Credits

Prerequisite: Basic awareness of Indian Constitution and Government.

Course Objectives

The course will introduce the students to:

1. Understand the history of framing of the Indian Constitution.
2. Awareness on Fundamental Rights, Duties and Directive Principles of State Policy.
3. Explore the organization of Union Government, and functions of President and Prime Minister.
4. Gain an insight into the inter-functionality of Union Legislature and Judiciary
5. Educate on the local governance and problems in development of rural and urban areas.

Course Outcomes

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

1. Understand the history of framing of the Indian Constitution and its features.
2. Assess the realization of Fundamental Rights and Directive Principles of State Policy.
3. Analyze the challenges to federal system and position of the President and the Prime Minister in the Union Government.
4. Underline the role of the Legislature and the Judiciary in Union Government and their mutual relations.
5. Evolve the development of the local governments in India and assess the role of Collector in district administration.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	1	-	-	1	1	1	1	-	-	-	-	-	-
CO 2	-	-	2	-	-	3	2	2	1	-	-	-	-	-	-
CO 3	-	-	1	-	-	1	1	-	-	-	-	-	-	-	-
CO 4	-	-	1	-	-	1	1	-	-	-	-	-	-	-	-
CO 5	-	-	2	-	-	3	2	1	1	-	-	-	-	-	-

Unit-I

Constitutional History and Framing of Indian Constitution

East India Company rule (1757-1857): Social, Economic, Political and Administrative impact of Company rule in India. British Rule (1858-1947): Indian National Movement, Government of India Acts 1909, 1919 and 1935, and Indian Independence Act 1947. Framing of the Indian Constitution: Constituent Assembly, Preamble and Salient Features.

Unit-II

Fundamental Rights, Duties and Directive Principles of State Policy

The Fundamental Rights**:** Features and significance of Rights. Fundamental Duties: Importance and the legal status of Duties. Directive Principles of State Policy: Socialist, Gandhian and Liberal-intellectual principles, importance and relevance.

Unit-III

Union Government and its Administration

Federalism: Division of legislative and financial powers between the Union and the State. Union Executive: Role and position of President, Prime Minister and Council of Ministers. Emergency Provisions: National Emergency, Constitutional Emergency and Financial Emergency.

Unit-IV

Union Legislature and Judiciary

Union Legislature: Parliament of India-Composition and functions of Parliament, and Parliamentary Committees. Union Judiciary: Supreme Court of India-Composition and Functions.

Unit-V

Local Self Governments

Rural Local Governments: Zilla Parishad- CEO and functions of Zilla Parishad, Mandal Parishad- Role of Elected and Officials, Gram Panchayat- Sarpanch, Secretary and Gram Sabha. Urban Local Governments: Structure and functions of Municipalities and Municipal Corporations. District Collector: Powers and functions of Collector.

Text Books:

1. Sastry Ravindra, (Ed), "Indian Government & Politics", Telugu Akademy, 2nd edition, 2018.
2. "Indian Constitution at Work", NCERT, First edition 2006, Reprinted in 2022.

Suggested Reading:

1. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, "Framing of Indian Constitution", 1st Edition, 2015.
3. Granville Austin, "The Indian Constitution: The Cornerstone of a Nation", OUP, 2nd Edition, 1999.
4. M.V. Pylee, "India's Constitution", S. Chand Publishing, 16th Edition, 2017.
5. Rajeev Bhargava (ed), "Politics and Ethics of the Indian Constitution", OUP, 2008.

e-Resources:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

22ECC12

ANALOG CIRCUITS LAB

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Knowledge on Electronic Devices Lab and Electronic Workshop and Networks Lab.

Course objectives:

This course aims to familiarize:

1. Design and analysis of Biasing circuits and Single stage amplifiers.
2. The frequency response of Multistage and Feedback amplifiers.
3. The generation of sinusoidal signals using Oscillators.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Design various BJT and FET biasing circuits to identify the appropriate circuit for faithful amplification.
2. Experiment with single stage and multistage BJT/FET amplifiers to compare the Gain and Bandwidth.
3. Compare and contrast different types of feedback topologies.
4. Develop and test various oscillator circuits.
5. Evaluate the performance of large signal amplifiers.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	3	2	2	1	1	1	2	1	1	1	3	2	1
CO 2	2	1	3	2	2	1	1	1	2	1	1	1	3	2	1
CO 3	2	1	3	2	2	1	1	1	2	1	1	1	3	2	1
CO 4	2	1	3	2	2	1	1	1	2	1	1	1	3	2	1
CO 5	2	1	3	2	2	1	1	1	2	1	1	1	3	2	1

List of Experiments:

1. Design of BJT and FET Biasing Circuits for given specifications.
2. Common Emitter BJT amplifier and study of its frequency response.
3. Common Source FET amplifier and study of its frequency response.
4. Frequency response of Two RC - Coupled CS FET amplifier
5. Voltage series feedback amplifier.
6. Voltage shunt feedback amplifier.
7. Current series feedback amplifier.
8. RC Phase Shift Oscillator.
9. Hartley Oscillator.
10. Colpitts Oscillator.
11. Class-A power amplifier.
12. Class-B power amplifier.
13. **Structured enquiry:** Design a circuit that converts a given D.C Voltage to Frequency using BJTs and verify its operation.
14. **Open ended Enquiry:** Design and implement a classroom sound monitoring system using BJTs and a 0.5W speaker.
15. **Virtual lab experiment:** Study of CE Amplifier (https://be-iitkgp.vlabs.ac.in/exp/ce-amplifier/)

Note: Wherever possible, Analysis and design of circuits should be carried out using SPICE tools.

Suggested Reading:

1. Robert Diffenderfer, “Electronic Devices: Systems and Applications”, Cengage Learning India Private Limited, 2010.
2. Paul B. Zbar, Albert P. Malvino, Michael A. Miller, “Basic Electronics, A Text - Lab Manual”, 7th Edition, TMH 2001.

22ECC13

DIGITAL SYSTEM DESIGN LAB

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Digital concepts and C language concepts.

Course Objectives:

This course aims to:

1. Simulate and synthesize combinational logic circuits.
2. Simulate and synthesize sequential logic circuits.
3. Learn and implement procedure for any digital system design.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Design a Digital circuit using Verilog HDL.
2. Understand various abstraction levels of a digital design.
3. Verify the functionality of a design using Test bench.
4. Simulate and synthesize combinational logic circuits.
5. Simulate and synthesize sequential logic circuits.

Course Articulation Matrix

PO /PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	2	3	1	1	1	3	2	1	1	2	3	3
CO 2	3	2	2	2	3	1	1	1	3	2	1	1	2	3	3
CO 3	3	3	2	2	3	2	2	1	3	2	2	2	2	3	3
CO 4	3	3	2	3	3	2	2	2	3	2	2	2	3	3	3
CO 5	3	3	2	3	3	2	2	2	3	2	2	2	3	3	3

List of Experiments:

Write a Verilog HDL code to Simulate and synthesize the following in Gate level, Data flow and Behavioral Modeling styles.

1. Logic Gates.
2. Binary Adders.
3. Binary Subtractors.
4. Multiplexers and De-multiplexers.
5. Encoders, Decoders and Comparator.
6. Implementation of logic function using Multiplexers and Decoders.
7. Arithmetic and Logic Unit.
8. Flip-Flops:SR,D,T,JK.
9. Implementation of SSI Circuits using FPGA.
10. **Structured Enquiry:** Design of a counter for the given specifications.
11. **Open ended Enquiry:** Design of a simple Digital System for real time applications.
12. **Virtual Lab Experiments: V**erify the truth table of RS, JK, T and D flip-flops using NAND & NOR gates**.** https://de-iitr.vlabs.ac.in/exp/truth-tables-flip-flops/simulation.html

Note: A minimum of 10 experiments should be performed.

Suggested Reading:

1. Samir Palnitkar, "Verilog HDL, A guide to Digital design and synthesis", 2nd Edition, Pearson Education, 2008.

22ECC14

MODELLING AND SIMULATION LAB

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Knowledge of Signals and Systems, Control Systems.

Course Objectives:

This course aims to:

1. To understand the simulation of generation of Various (Continuous/Discrete) signals.
2. To study various arithmetic operations on signals and various transforms applied for signals.
3. To understand the characteristics of control system and its characteristics.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Simulate the given waveform using standard test signals and sequences in MATLAB.
2. Analyze the effect of various transformations applied on signals in MATLAB.
3. Understand the second order system characteristics in LabView.
4. Simulate the Bode plot and Nyquist plot of the system and analysis its performance characteristics in LabView.
5. Understand the fundamentals of electronic circuits using Multisim simulation.

Course Articulation Matrix

PO /PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	1	3	1	1	1	1	1	1	1	3	2	1
CO 2	3	3	2	1	3	1	1	1	1	1	1	1	3	2	1
CO 3	3	3	2	1	3	1	1	1	1	1	1	1	3	2	1
CO 4	3	3	2	1	3	1	1	1	1	1	1	1	3	2	1
CO 5	3	3	1	1	3	1	1	1	1	1	1	1	3	2	1

List of Experiments:

PART-A

Signal analysis using MATLAB software

1. Basic Operations on Matrices.
2. Generation of various signals and sequences: Unit Impulse, Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc and Random signals.
3. a) Operations on signals and sequences: Addition, Multiplication, Scaling, Shifting, Folding.
   b) Computation of Energy and Average Power.
4. Linear Convolution, Auto Correlation and Cross Correlation of Sequences.
5. Find the Fourier Transform of a given signal and plotting its magnitude and phase Spectrums.
6. Generation of Gaussian noise, Computation of its mean, Mean Square Value, Skew, PSD and PDF.

PART-B

Modelling of system and its characteristics using Lab VIEW and Multisim

1. a) Representation of the transfer function in LabVIEW.
   b) Conversion of transfer function to state space representation of the system.
2. Plot unit step response of a standard second order system and also finds the characteristics of second order system using LabVIEW.
3. Plot bode plot of given transfer function and also determine the gain and phase margins using LabVIEW.
4. Plot Nyquist plot for given transfer function and to discuss closed loop stability using LabVIEW.
5. Design and develop Low pass and High pass Filter using Multisim.
6. Simulate and study Integrator and Differentiator using Multisim.

Note: Minimum of five experiments in PART-A and five experiments in PART-B

Suggested Reading:

1. B. P. Lathi, "Signals, Systems and Communications", BS Publications, 3rd Edition, 2008.
2. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International Publishers, 5/e, 2012.
3. Jeffrey Travis and Jim Kring, "Lab VIEW for Everyone: Graphical Programming Made Easy and Fun", 3rd Edition, Prentice Hall, 2007.
4. Multisim User Manual – National Instruments, 2009.

22EGC03

EMPLOYABILITY SKILLS

(BE / BTech - Common to all Branches)

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	01

Prerequisite: Basic Knowledge of Soft skills in the professional setting.

Course Objectives:

To help the students:

1. Learn the art of communication, participate in group discussions and case studies with confidence and to make effective presentations.
2. With- resume packaging, preparing them to face interviews.
3. Build an impressive personality through effective time management, leadership qualities, self-confidence and assertiveness.
4. Understand professional etiquette and to make them learn academic ethics and value system.
5. To be competent in verbal aptitude.

Course Outcomes:

By the end of the course**,** the students will be able to:

1. Become effective communicators, participate in group discussions with confidence and be able to make presentations in a professional context.
2. Write resumes, prepare and face interviews confidently.
3. Be assertive and set short term and long term goals, learn to manage time effectively and deal with stress.
4. Make the transition smoothly from campus to work, use media with etiquette and understand the academic ethics.
5. Enrich their vocabulary, frame accurate sentences and comprehend passages confidently.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	1	-	-	-	1	-	2	3	3	1	3	1	1	1
CO 2	-	-	-	-	-	-	-	1	-	2	-	1	-	1	1
CO 3	-	-	-	-	-	1	-	1	2	1	1	3	1	1	1
CO 4	-	1	1	-	-	1	-	2	3	3	1	3	1	1	1
CO 5	-	-	-	-	-	-	-	1	2	2	1	3	-	-	1

UNIT-I

Verbal Aptitude: Error Detection, Articles, Prepositions, Tenses, Concord and Transformation of Sentences - Jumbled Words / Sentences - Vocabulary, Synonyms, Antonyms, One Word Substitutes, Idioms and Phrases, Word / Sentence / Text Completion- Reading Comprehension.

UNIT-II

Group Discussion & Presentation Skills: Dynamics of Group Discussion - Case Studies - Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Accuracy, Coherence.
Elements of Effective Presentation – Structure of a Presentation – Presentation tools – Body language - Preparing an Effective PPT.

UNIT-III

Behavioural Skills: Personal strength analysis-Effective Time Management- Goal Setting- Stress management.
Corporate Culture – Grooming and etiquette-Statement of Purpose (SOP).

UNIT-IV

Mini Project: Research-Hypothesis-Developing a Questionnaire-Data Collection-Analysis-General and Technical Report - Writing an Abstract –Technical Report Writing-Plagiarism-Project Seminar.

UNIT-V

Interview Skills: Cover Letter and Résumé writing – Structure and Presentation, Planning, Defining the Career Objective, Projecting ones Strengths and Skill-sets – Interviews: Concept and Process, Pre-Interview Planning, Opening Strategies, Answering Strategies, Mock Interviews.

Text Books:

1. Leena Sen, "Communication Skills", Prentice-Hall of India, 2005.
2. Gulati and Sarvesh, "Corporate Soft Skills", New Delhi: Rupa and Co., 2006.
3. Edgar Thorpe and Showick Thorpe, "Objective English", 2nd edition, Pearson Education, 2007.
4. Ramesh, Gopalswamy, and Mahadevan Ramesh, "The ACE of Soft Skills", New Delhi: Pearson, 2010.

Suggested Reading:

1. Van Emden, Joan, and Lucinda Becker, "Presentation Skills for Students", New York: Palgrave Macmillan, 2004.
2. R.S. Aggarwal, "A Modern Approach to Verbal & Non-Verbal Reasoning", 2018.
3. Covey and Stephen R, "The Habits of Highly Effective People", New York: Free Press, 1989.
4. Shalini Verma, "Body Language - Your Success Mantra", S Chand, 2006.

22ECU01

Up-skill Certification Course - I

Instruction	-
Duration of SEE	-
SEE	-
CIE	25 Marks
Credits	0.5

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

AICTE Model Curriculum with effect from AY 2026-27

BE (Electronics and Communication Engineering)

SEMESTER – V

S.no	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	22ECC15	Analog and Digital Communication	3	-	-	3	40	60	3
2	22ECC16	Computer Architecture and Microprocessors	3	-	-	3	40	60	3
3	22ECC17	Digital Signal Processing	3	-	-	3	40	60	3
4	22ECC18	Linear and Digital Integrated Circuits	3	-	-	3	40	60	3
5		Professional Elective-I	3	-	-	3	40	60	3
6		Professional Elective-II	3	-	-	3	40	60	3
7		Open Elective-I	3	-	-	3	40	60	3
PRACTICALS									
8	22ECC19	Analog and Digital Communication Lab	-	-	2	3	50	50	1
9	22ECC20	Digital Signal Processing Lab	-	-	2	3	50	50	1
10	22ECC21	Linear and Digital Integrated Circuits Lab	-	-	2	3	50	50	1
11	22ECI02	Industrial / Rural Internship	3-4 Weeks / 90 Hours				50	-	2
Total			**21**	**-**	**6**	**30**	**480**	**570**	**26**
Clock Hours Per Week: 27									

L: Lecture **D: Drawing** **CIE: Continuous Internal Evaluation**

T: Tutorial **P: Practical/Project Seminar/Dissertation** **SEE: Semester End Examination**

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

AICTE Model Curriculum with effect from AY 2026-27

BE (Electronics and Communication Engineering)

SEMESTER – V

S. no	List of Courses in Professional Elective-I		List of Courses in Professional Elective-II	
	Course code	Title of the Course	Course code	Title of the Course
1	22ECE01	VLSI Technology	22ECE07	CMOS Analog and Digital IC Design
2	22ECE02	Fiber Optic Communication	22ECE08	Mathematical Modelling of Communication Systems
3	22ECE03	Signal Detection Techniques	22ECE09	Biomedical Instrumentation and Signal Processing
4	22ECE04	Embedded C Programming	22ECE10	Sensing Techniques and Sensor Systems
5	22ECE05	Software Defined Radio	22ECE11	MEMS
6	22ECE06	Artificial Intelligence for ECE	22ECE12	Cloud Computing and Applications

S. no	List of Courses in Open Elective-I	
	Course code	Title of the Course
1	22EGO01	Technical Writing Skills
2	22EGO03	Indian Traditional Knowledge
3	22CEO02	Disaster Risk Reduction and Management
4	22MEO06	Principles of Entrepreneurship and Startups
5	22CSO01	Introduction to Web Technologies
6	22ITO01	Object Oriented Programming Using JAVA

22ECC15

ANALOG AND DIGITAL COMMUNICATION

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge on fundamentals of signals and systems and probability theory is required.

Course Objectives:
This course aims to:

1. Make understand the concepts of modulation, continuous wave modulations and their performances.
2. Make understand the concept of information theory and application of source coding schemes.
3. Familiarize several digital carrier modulation schemes and evaluate their performances.

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

1. Analyze different amplitude modulation schemes and assess their performance.
2. Evaluate various angle modulation schemes.
3. Understand the concept of pulse analog and digital modulation schemes and compare their performance.
4. Interpret the concept of information theory and apply source coding schemes.
5. Investigate different digital modulation schemes and compute the bit error performance.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	2	1	1	1	1	2	3	1	3	3	2	3
CO 2	3	3	3	2	1	1	1	1	2	3	1	3	3	2	3
CO 3	3	3	3	2	1	1	1	1	2	3	1	3	3	2	3
CO 4	3	3	2	2	1	1	1	1	2	3	1	3	3	2	3
CO 5	3	3	3	2	1	1	1	1	2	3	1	3	3	2	3

UNIT-I

Amplitude modulation: Need for modulation, Amplitude Modulation - Time and frequency domain description, single tone modulation, power relations in AM, Generation of AM waves - Switching modulator, Detection of AM Waves - Envelope detector, DSB-SC modulation - time and frequency domain description, Generation of DSB-SC Waves - Balanced Modulators, Coherent detection of DSB-SC, COSTAS Loop, SSB modulation - time and frequency domain description. Principle of Vestigial side band modulation. AM Transmitter. AM Receiver- Super heterodyne receiver, image frequency rejection and its ratio, receiver characteristics. Figure of merit calculation of AM.

UNIT-II

Angle modulation: Basic concepts of Phase Modulation, Frequency Modulation: Single tone frequency modulation, Spectrum Analysis of Sinusoidal FM Wave using Bessel functions, NBFM, WBFM, Power and Transmission bandwidth of FM, Indirect Generation of FM - Armstrong Method, Detection of FM Signal: Phase locked loop, Concept of Pre-emphasis and de-emphasis.

UNIT-III

Pulse Modulation:

Types of Pulse analog modulation- PAM, PWM and PPM (Qualitative treatment only).

Pulse Digital Modulation:

PCM Generation and Reconstruction, Estimation of Quantization Noise, Non-Uniform Quantization and Companding, DPCM, DM and Adaptive DM, Noise in PCM and DM.

UNIT-IV

Information Theory: Uncertainty, Information and Entropy, Source coding: Source coding theorem, Shannon – Fano algorithm and Huffman coding. Discrete memory-less channels: Types of channels, cascaded channels, mutual information, Channel capacity, Information rate and Information capacity. Introduction to error control coding.

UNIT-V

Digital Modulation Techniques: Digital Carrier Modulation Schemes: Optimum receiver for Binary Digital Modulation Schemes, Binary ASK, PSK, DPSK, FSK signaling schemes and their BERs. Comparison of Digital Modulation Schemes. Introduction to M-ary Signaling Schemes: QPSK.

Text Books:

1. Simon Haykin, "Communication Systems",2nd Edition, WileyIndia,2011.
2. R.P. Singh, S.D. Sapre, "Communication Systems", 2/e, Tata McGraw Hill Education, 2008.
3. Sam Shanmugham K., "Digital and Analog Communication Systems", Wiley, 2012.

Suggested reading:

1. Herbert Taub, Donald L. Shilling and GoutamSaha, "Principles of Communication Systems", 3rd Edition, TMH, 2008.
2. P.Ramakrishna Rao, "Digital Communication", 2nd Edition TMH, 2003.

e-Resources:

1. https://nptel.ac.in/courses/117105143.
2. https://nptel.ac.in/courses/108101113.

22ECC16

COMPUTER ARCHITECTURE AND MICROPROCESSORS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic knowledge on digital system design.

Course Objectives:

This course aims to:

1. Study and understand the principles of computer system.
2. Understand the design of computer system.
3. Explore the architecture and instruction set of the microprocessors.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand how computer works.
2. Apply fixed and floating-point arithmetic algorithms.
3. Compare various memories, memory access techniques.
4. Assess the performance of computers.
5. Analyze architecture and instruction set of microprocessors.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	1	2	1	1	1	1	1	1	1	2	2	1
CO 2	1	2	2	1	2	1	1	1	1	1	1	1	2	3	1
CO 3	2	2	3	2	2	1	1	1	1	1	1	1	3	2	2
CO 4	2	1	2	2	3	1	1	1	1	1	1	2	3	2	3
CO 5	1	1	1	1	2	1	1	1	1	1	1	1	2	2	1

UNIT-I

Data representation and Computer Arithmetic: Basic structure of computers, Functional units, Fixed point representation of numbers, Digital arithmetic algorithms for Addition, Subtraction, Multiplication using Booth's algorithm and Division using restoring and non-restoring algorithms, Floating point representation with IEEE standards.

UNIT-II

Basic Computer Organization and Design: Instruction codes, Stored program organization, Computer registers and computer instructions, Timing and control, hardwired and micro programmed control unit, Instruction cycle, Program interrupt, Interrupt cycle, Micro programmed Control organization, Address sequencing, Micro instruction format.

UNIT-III

Central Processing Unit: General register organization, Stack organization, Instruction formats, Addressing modes, Data transfer and manipulation, Program control, CISC and RISC: features and comparison, Instruction Pipeline.

Input-Output Organization: Peripheral devices, I/O interface: I/O Bus and interface modules, isolated versus memory mapped I/O Modes of Transfer: Programmed I/O, DMA and Interrupt initiated I/O. Priority interrupt: Daisy chaining, Parallel Priority interrupt.

UNIT-IV

Memory Organization: Memory hierarchy, Primary memory, Auxiliary memory, Associative memory, Cache memory, mapping functions: direct, associate and set associate, Virtual memory: address mapping using pages, Memory management.

UNIT-V

8086 Microprocessor: Evolution of microprocessors, 8086 Microprocessor**:** Internal architecture, flag register, Signal description under minimum and maximum mode of operation, register organization, Addressing modes. Overview of Instruction set. Introduction to the advanced microprocessors (x86): Salient features, real and protected modes. Evolution of Pentium Processors.

Text Books:

1. Morris Mano. M., "Computer System Architecture", 3/e, Pearson Education, 2005.
2. Hayes J.P, "Computer Architecture and Organization", 3/e, Mcgraw Hill, 2012.
3. Barry B. Brey, "The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro, Pentium II, III, IV", 8/e Pearson Education, 2006.

Suggested Reading:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization" 5/e McGrawHill, 2011.
2. Ray A.K. and Bhurchandi, K.M., "Advanced Microprocessor and peripherals", 2/e TMH 2007.
3. Douglas V Hall, SSSP Rao, "Microprocessors and Its Interfacing" (SIE), 3/e, Tata McGraw-Hill Education Pvt. Ltd, 2012.

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs61/preview.

22ECC17

DIGITAL SIGNAL PROCESSING

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Concepts of Signals, Systems and analog filter design.

Course Objectives: This course aims to:

1. Know Discrete-time signals in the frequency domain using DFT and FFT.
2. Design digital IIR and FIR filters for the given specifications.
3. Introduce the basics of Multi-rate digital signal processing, Digital signal processor and its applications.

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

1. Apply the concept of DFT and FFT for signal processing applications.
2. Implementation of IIR filters for the given specifications.
3. Design FIR filters for the given specifications.
4. Interpret the concepts of Multi-rate digital signal processing and its applications.
5. Understand the architecture features of TMS320C67XX processor.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	2	3	2	-	-	3	2	-	3	3	3	3
CO 2	3	3	3	2	3	2	-	-	3	2	-	3	3	3	3
CO 3	3	3	3	2	3	2	-	-	3	2	-	3	3	3	3
CO 4	3	3	3	2	3	2	-	-	3	2	-	3	3	3	3
CO 5	3	3	3	2	3	2	-	-	3	2	-	3	3	3	3

UNIT-I

Discrete Fourier Transform: Introduction, Discrete Fourier Transform (DFT), Properties of DFT, Efficient computation of DFT-Fast Fourier Transform (FFT) algorithms: Radix-2 FFT algorithms – Decimation in Time, Decimation in Frequency algorithms, In-place computation, Bit reversal algorithm, Linear filtering using FFT algorithm.

UNIT-II

IIR Filter Design: Butterworth and Chebyshev approximation, IIR digital filter design techniques- Impulse Invariant transformation, Bilinear transform techniques, Digital Butterworth and Chebyshev filters, Spectral transformation techniques. Comparison between FIR and IIR filters, Realization of IIR filters-Direct form-I and II.

UNIT-III

FIR Filter Design: Linear phase FIR filters –Introduction, types, magnitude and phase responses of linear phase FIR filters, Windowing technique for design of FIR filters – Rectangular, Bartlet, Hamming, Blackman and Kaiser Windows, frequency sampling technique, Realization of FIR filters-Direct form, linear phase filter.

UNIT- IV

Finite word length effects: Quantization Errors Round-off and Truncation Errors, Limit cycles, Overflow Oscillations, Coefficient Quantization Error.

Multirate Digital Signal Processing: Introduction -Decimation by a Factor-D, Interpolation by a Factor-I, Sampling Rate Conversion by a Rational Factor-I/D, Nobel identities, design of multistage decimator.

UNIT-V

DSP Processors: Introduction, Difference between DSP and General Purpose Processor architectures, need for DSP processors. TMS320C67XX DSP processor: architecture, functional units, pipelining, registers, linear and circular addressing modes.

Text Books:

1. John G. Proakis & Dimtris G. Manolakis, "Digital Signal Processing Principles, Algorithms and Application", PHI, 4/e, 2012.
2. Sanjit K Mitra, "Digital Signal Processing, A computer based approach", TMH, 3/e, 2011.
3. Rulph Chassaing, "Digital Signal Processing and Applications with the C6713 and C6416 DSK", John wiley & sons, 2005.

Suggested Reading:

1. K. Deergha Rao & MNS swamy, "Digital Signal Processing: Theory and Practice", Springer, 2018.
2. Avtar Singh & S. Srinivasan, "Digital Signal Processing Implementation using DSP microprocessors", Thomson Brooks, 2/e, 2004.

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc24_ee16.

22ECC18

LINEAR AND DIGITAL INTEGRATED CIRCUITS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge about Analog electronic circuits.

Course Objectives: This course aims to:

1. Impart the concepts of Op-Amp, 555 Timers, IC regulator, data converter and its characteristics.
2. Illustrate the linear and nonlinear applications of operational amplifier.
3. Design combinational and sequential circuits with IC, memories and PLD.

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

1. Understand the basic construction, characteristics and parameters of Op-Amp.
2. Analyze the linear and nonlinear applications of Op-Amp.
3. Explain the concepts of IC555 timer, IC723 regulator, memories and PLD.
4. Classify and describe the characteristics of different logic families.
5. Design logic functions of Combinational and Sequential circuits with ICs.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	3	2	1	1	1	1	1	1	1	2	2	1	1
CO2	2	3	3	3	2	2	1	1	1	1	1	3	3	3	2
CO3	2	2	2	2	2	1	1	1	1	1	1	2	2	1	1
CO4	1	1	2	2	2	1	1	1	1	1	1	2	2	1	1
CO5	2	2	3	3	2	2	1	1	1	1	1	3	3	3	1

UNIT – I

Operational Amplifier: Op-Amp block diagram, ideal Op-Amp Characteristics, Inverting and Non-inverting amplifiers with ideal and non-ideal Op-amps, Voltage Follower, Op-Amp parameters- Input offset voltage, Output offset voltage, input offset and bias currents, Slew rate, CMRR and PSRR.

UNIT – II

Op-Amp Applications: Summing Amplifier, Difference Amplifier, ideal and practical Integrator and differentiator. Sample and hold circuit, Comparator, Schmitt Trigger with and without reference voltage, Triangular waveform generator.

UNIT – III

555 Timer: Functional diagram. Modes of operation: Monostable, Astable multivibrators.

Voltage Regulator: IC7805, Analysis and design of voltage regulator using IC 723.

Data Converters: Specifications, DAC - Weighted Resistor, R-2R Ladder, ADC - Comparator, Successive Approximation and Dual Slope.

UNIT – IV

Logic Families: Digital IC characteristics, TTL logic family, TTL series and TTL output configurations: open collector, Totem pole, Tri state logic. MOS logic family, CMOS logic family and its series characteristics, CMOS transmission gate, CMOS open drain and high impedance outputs. Comparison of TTL and CMOS logic families.

UNIT – V

Combinational and Sequential Circuits: Design of logic functions/circuits - Decoder, Multiplexer, Adder- Serial adder, parallel adder and BCD adder, counters - asynchronous counter (IC7493) and synchronous counter (IC74163).

Semiconductor Memories: Memory Terminology, ROM, RAM types, Architectures, operation, Expanding word size and capacity, Introduction to PLD's- PAL and PLA, Programming with PLDs, Introduction to CPLD&FPGA and its architectures.

Text Books:

1. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 4/e, PHI, 2015.
2. Ronald J. Tocci, Neal S. Widmer & Gregory L. Moss, "Digital Systems: Principles and Applications", PHI, 12/e, 2016.

Suggested Reading:

1. K.R. Botkar, "Integrated Circuits", 10/e, Khanna Publishers, 2010.
2. Roy Chowdhury D, Jain S.B, "Linear Integrated Circuits",4/e, New Age International Publishers, 2018.
3. Jain R.P., "Modern Digital Electronics", 4/e, TMH, 2011.
4. Charles H Roth and Larry L Kinney, "Fundamentals of Logic Design" 7th edition, Cengage Publication, 2014.
5. David A. Bell, 'Operational Amplifier and Linear ICs', third edition, Oxford university press, 2013.

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc24_ee147.
2. https://onlinecourses.nptel.ac.in/noc24_ee140.

22ECE01

VLSI TECHNOLOGY

(Professional Elective-I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: A prior knowledge of Semiconductor Properties.

Course Objectives:

This course aims to:

1. Understand the procedure for preparing silicon wafer and its cleaning.
2. Know the various fabrications steps involved.
3. Learn the concepts of packaging and testing of ICs.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Describe the various processing steps (including base materials, layers, clean room) involved in the IC fabrication.
2. Illustrate the crystal growth, wafer processing and cleaning methods.
3. Analyze the oxidation and lithography processes with its parameters.
4. Explain the doping and etching methods used in IC fabrication.
5. Outline the deposition, packaging and testing concepts applied for VLSI circuits.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO 2	3	2	2	1	1	1	1	1	1	1	1	1	2	1	1
CO 3	3	3	2	2	1	1	1	1	1	1	1	1	3	2	2
CO 4	3	3	2	1	1	1	1	1	1	1	1	1	3	1	2
CO 5	3	1	2	1	1	1	1	1	1	1	1	1	2	1	2

UNIT-I

Introduction: Integrated Circuits Review of history of VLSI technology progress, Silicon as the Base Material and its advantages, various Layers of ICs: Substrate, Active Layer, Oxide/Nitride Layers, Metal/Poly Silicon Layers. Functions of each of the Layers. Introduction to clean room technology.

UNIT-II

Silicon Wafer Preparation: Electronic Grade Silicon, CZ and FZ Methods of Single Crystal Growth, Silicon Shaping, Mechanical Operations, Chemical Operations.

Wafer-Cleaning Technology: Introduction, basic concepts of wafer cleaning, Wet-cleaning technology, Dry-cleaning technology.

UNIT-III

Oxide Growth: Structure of SiO2, Growth Mechanism and Dynamics, Oxide Growth by Thermal method.

Lithography: Steps involved in Photolithography, photo resists and their characteristics, optical exposure systems contact and projection systems, steppers, X-ray Electron Beam Lithography.

UNIT-IV

Etching: Chemical, Electro Chemical Plasma (Dry Etching) Reactive Plasma Etching.

Ion Implantation: Range and Penetration Depth, Damage and Annealing Ion Implantation machine.

Diffusion: Constant and Infinite Source Diffusions, Diffusion Profiles and Diffusion Systems.

UNIT-V

Dielectric and Polysilicon Film Deposition Techniques: Chemical Vapour Deposition (CVD) and associated methods like LPCVD and PECVD. PVD thermal evaporation a sputtering.

Packaging and Metallization: die and Bonding and Packaging.

Text Books:

1. J. D. Plummer, M .D. Deal and P. B. Griffin, "The Silicon VLSI Technology Fundamentals, Practice and modeling", Pearson Education 2009.
2. S.M. Sze, "VLSI Technology", McGraw hill International Editions, 2017.

Suggested Reading:

1. CY Chang and S.M. SZe , "VLSI Technology", Tata McGraw-Hill Companies Inc. with effect from the academic year 2016-2017.
2. Stephen A, "The Science and Engineering of Microelectronic Fabrication", Campbell Oxford 2001.

e-Resources:

1. https://archive.nptel.ac.in/courses/117/106/117106093.

22ECE02

FIBER OPTIC COMMUNICATION

(Professional Elective-I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Fundamentals of Electromagnetics and Communication are required.

Course Objectives:

This course aims to:

1. Understand the properties of optical fiber that affect the performance of a communication link and types of fiber materials with their properties and the losses occur in fibers and the principles of single and multi-mode optical fibers and their characteristics.
2. Know the working of semiconductor lasers, and differentiate between direct modulation and external electro-optic modulation.
3. Analyze the operation of LEDs, Laser diodes, and PIN photo detectors (spectral properties, bandwidth, and circuits) and apply in optical systems.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Select necessary components required in modern optical communications systems.
2. Analyze various distortions in optical fibers.
3. Distinguish the various Optical sources and Optical detectors.
4. Examine the Power Launching and Coupling and fiber optical receiver.
5. Determine the performance of Optical Communication link.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	2	1	2	3	2	2	2	1	1	1	3	3	2
CO 2	3	3	3	3	2	3	2	2	1	1	1	1	3	3	2
CO 3	2	3	3	3	2	3	3	2	1	1	1	1	3	3	2
CO 4	3	2	3	2	2	3	3	2	1	1	1	1	3	3	2
CO 5	2	2	3	3	2	3	3	2	1	1	1	1	3	3	2

UNIT–I

Overview of Optical Fiber Communication: The general system, advantages of optical fiber communications. Optical fiber wave guides- Acceptance angle, Numerical Aperture, Skew rays, Cylindrical fibers: Modes, V-number, Mode coupling, Step Index fibers, Graded Index fibers, Single mode fibers: Cut off wavelength, Mode Field Diameter, Effective Refractive Index.

UNIT–II

Signal Distortion in Optical Fibers: Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses, Information capacity determination, Types of Dispersion: Material dispersion, Wave-guide dispersion. Intermodal dispersion, Pulse broadening in Graded index fiber.

Optical Fiber Connectors: Connector types, Single mode fiber connectors, Connector return loss, Fiber Splicing: Splicing techniques, Splicing single mode fibers, Fiber alignment and joint loss: Multimode fiber joints, Single mode fiber joints (Qualitative treatment only).

UNIT–III

Optical Sources: LEDs, Structures, Materials, Quantum efficiency, Power Modulation. Injection Laser Diodes: Modes, Threshold conditions, External quantum efficiency, Laser diode rate equations, Resonant frequencies, Optical detectors: Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors.

UNIT–IV

Source to Fiber Power Launching: Power coupling, Power launching, Fundamental receiver operation, error sources, Receiver configuration, Digital receiver performance, Probability of Error, Quantum limit.

UNIT–V

Optical System Design: Point-to- point links, Component choice and considerations, Link power budget, Rise time budget with examples, WDM and its applications.

Text Books:

1. Gerd Keiser, "Optical Fiber Communications", McGraw-Hill International edition, 5th Edition, 2017.
2. John M. Senior, "Optical Fiber Communications", PHI, 3rd Edition, 2009.
3. D.K. Mynbaev, S.C. Gupta and Lowell L. Scheiner, "Fiber Optic Communications", Pearson Education, 2005.

Suggested Reading:

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

e-Resources:

1. https://nptel.ac.in/courses/117101054.

22ECE03

SIGNAL DETECTION TECHNIQUES

(Professional Elective-I)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Concepts of random variables and random processes.

Course Objectives:

This course aims to:

1. Study the importance of discrete random processes in the communications.
2. Understand random signal modelling and statistical decisions.
3. Acquire the knowledge about various detection techniques.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Apply and analyse discrete random process concepts in communications.
2. Understand binary hypothesis techniques.
3. Analyse the various statistical decision techniques.
4. Demonstrate the various binary detection techniques and M-ary detection.
5. Evaluate various CFAR detectors.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	1	1	3	1	1	2	2	1	3	3	1	2
CO 2	3	3	2	1	1	3	1	1	2	2	1	3	3	1	2
CO 3	3	3	2	1	1	3	1	1	2	2	1	3	3	1	2
CO 4	3	3	2	1	1	3	1	1	2	2	1	3	3	1	2
CO 5	3	3	2	1	1	3	1	1	2	2	1	3	3	1	2

UNIT-I

Discrete-Time Random Processes: Introduction, Definitions, Auto Regressive (AR) Processes, Moving Average (MA) Processes, Auto Regressive Moving Average (ARMA) Processes.

UNIT-II

Statistical Decision Theory: Introduction, Bayes' Criterion - Binary Hypothesis Testing and M-ary Hypothesis Testing, Minimax Criterion, Neyman-Pearson Criterion.

UNIT-III

The General Gaussian Problem: Introduction, Binary Detection, Same Covariance - Diagonal Covariance Matrix and Non-Diagonal Covariance Matrix, Same Mean - Uncorrelated Signal Components and Equal Variances, Uncorrelated Signal Components and Unequal Variances.

UNIT-IV

Detection: Introduction, Binary Detection, Simple Binary Detection, General Binary Detection, M-ary Detection, Correlation Receiver, Matched Filter Receiver.

UNIT-V

Adaptive Thresholding CFAR Detection: Introduction, Principles of Adaptive CFAR Detection, Target Models, Review of Some CFAR Detectors.

Text Books:

1. Mourad Barkat, "Signal Detection and Estimation", Artech House, 2nd Edition, 2005.
2. D.G. Manolakis, V.K. Ingle and S.M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.

Suggested Reading:

1. Papoulis and S.U. Pillai, "Probability, Random Variables and Stochastic Processes", 4th Edition, McGraw Hill, 2002.
2. Payton. Z. Peebles Jr., "Probability Random Variables and Random Signal Principles", TMH, 4th Edition, 2003.
3. Fundamentals of Statistical Signal Processing", Volume II: Detection Theory: 2, by Steven M. Kay, Prentice Hall Signal Processing Series 1998 for the course "Signal Detection Techniques.

e-Resources:

1. https://nptel.ac.in/courses/117103018.

22ECE04

EMBEDDED C PROGRAMMING

(Professional Elective-I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Programming in 'C' Language.

Course Objectives:

This course aims to:

1. Describe the features and architecture of Embedded Development Boards.
2. Interfacing of various sensors along with display systems to Embedded Development Boards through Embedded 'C'.
3. Develop various applications using Embedded C Programming.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the concepts, features, and architecture of the Embedded Development Boards.
2. Analyze the various functions used in Embedded C Programming.
3. Interface the various sensors along with display systems to Embedded Development Boards.
4. Apply the concepts of IoT to Embedded Development Board.
5. Demonstrate and designs of various emerging field applications with Embedded C Programming.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	-	-	-	-	-	-	-	-	-	2	2	-
CO 2	1	2	2	1	2	-	-	-	-	-	-	-	2	3	-
CO 3	2	2	3	2	2	-	-	-	-	-	-	-	3	2	2
CO 4	2	1	2	2	3	-	-	-	-	-	-	2	3	2	3
CO 5	1	1	1	-	-	-	-	-	-	-	-	1	2	2	1

UNIT-I

Introduction to Embedded development boards: Importance of Embedded Development Boards for current trends and needs**,** Origin of Arduino, familiarizing with Arduino family, Pin configuration and Architecture of Arduino UNO, power connections, digital and analog ports, Arduino clones and variants, Installation of Arduino IDE, uploading the program.

UNIT-II

Embedded C Programming Concepts: Data types: variables and constants, Operators, Control Statements, Arrays and Functions. Programming with Embedded C for I/O Functions: Pins Configured as input, Pins Configured as output, pin Mode function, digital Write, digital Read functions, analog Read, analog Write functions, time delay functions.

.**UNIT-III**

Interfacing with Displays and Sensors: Working with Serial Monitor, LED interfacing, LCD interfacing, fixed one-line static message display, Running message display, Interfacing of Temperature sensor, humidity sensor, IR sensor, Gas detection sensor, PIR Sensor, Ultrasonic Sensor and DC motor.

UNIT-IV

Introduction to NodeMCU and IoT Concepts: Features and Pin configuration of NodeMCU, Programming with NodeMCU using Arduino IDE. Communicating with web servers: HTTP, HTML, Arduino uno and NodeMCU as a web server, Web controllers, calling of web services using ThingSpeak.

UNIT-V

Debugging Techniques and Applications: Testing the Arduino board, problems with IDE, debugging techniques, Case studies or Application of Embedded Development Boards in the field of agriculture, medical, security, home appliances, automotive systems, and consumer electronics.

Text Books:

1. Simon Monk, "Programming Arduino: Getting Started with Sketches", McGraw-Hill Education, Second Edition, 2016.
2. Massimo Banzi, "Getting Started with Arduino: The Open Source", Shroff Publishers & Distributors Pvt Ltd, 2014.

Suggested Reading:

1. Margolis, "Arduino Cookbook", Shroff/O'Reilly Publication, 2nd Edition 2012.
2. Michael J. Pont, "Embedded C", 2nd Edition, Pearson Education, 2008.

e-Resources:

1. https://nptel.ac.in/courses/106105166.

22ECE05

SOFTWARE DEFINED RADIO

(Professional Elective-I)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: The students should have knowledge of analog and digital communications.

Course Objectives:

This course aims to:

1. Make the students understand the differences between Super-heterodyne Radio, Software Defined Radio, and Cognitive Radio.
2. Give the Knowledge to students about FPGA-based architectures and processors with low power consumption.
3. Understand the single node Cognitive radio techniques and basics of Co-operative Spectrum sensing and the applications of CR.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand and compare the Super-heterodyne receiver, SDR and CR.
2. Analyze the basic architecture of SDR.
3. Determine the process or based on the application.
4. Evaluate and choose the various spectrum sensing methods based on application.
5. Choose the USRP and WARP boards based on the facilities required for an SDR application.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	1	1	2	3	2	1	1	1	1	1	3	3	2
CO 2	2	1	1	1	1	1	1	1	1	1	1	1	3	2	3
CO 3	2	1	1	1	1	1	1	1	1	1	1	1	3	2	2
CO 4	2	2	1	1	1	1	1	1	1	1	1	1	3	3	3
CO 5	2	1	1	1	1	1	2	1	1	1	1	1	3	3	3

UNIT-I

Introduction to SDR: What is Software-Defined Radio, The Requirement for Software-Defined Radio, Legacy Systems, The Benefits of Multi stranded Terminals, Economies of Scale, Global Roaming, Service Upgrading, Adaptive Modulation and Coding, Operational Requirements, Key Requirements, Reconfiguration Mechanisms, Handset Model, New Base-Station and Network, Architectures, Separation of Digital and RF, Tower-Top Mounting, BTS Hoteling, Smart Antenna Systems, Smart Antenna System Architectures, Power Consumption Issues, Calibration Issues, Projects and Sources of Information on Software Defined Radio.

UNIT-II

RF System Design: Introduction, world frequency band plans, Noise, and channel Capacity, link budget, free space loss, practical loss models, detailed system link budget, 3G RF performance requirements, multicarrier power amplifiers, signal processing capacity trade-off, Design flow.

UNIT-III

Basic Architecture of a Software Defined Radio, Software Defined Radio Architectures, Ideal Software Defined Radio Architecture, Required Hardware Specifications, Digital Aspects of a Software Defined Radio, Digital Hardware, Alternative Digital Processing Options for BTS Applications, Alternative Digital Processing Options for Handset Applications, Current Technology Limitations, A/D Signal to-Noise Ratio and Power Consumption, Derivation of Minimum Power Consumption, Power Consumption Examples.

UNIT-IV

Signal Processing Devices and Architectures General Purpose Processors, Digital Signal Processors, Field Programmable Gate Arrays, Specialized Processing Units, Tilera Tile Processor, Application-Specific Integrated Circuits, Hybrid Solutions, Choosing a DSP Solution, Comparison of all processors.

UNIT-V

Introduction to Cognitive Radio: Techniques and Signal Processing History and background, Communication policy and Spectrum Management, Cognitive radio cycle, Cognitive radio architecture, SDR architecture for cognitive radio, Spectrum sensing Single node sensing: energy detection. Introduction and challenges of Co-operative spectrum sensing. Concepts of 5G and 6G technologies.

Textbooks:

1. Eugene Grayver, “Implementing Software Defined Radio”, Springer, New York Heidelberg Dordrecht London, ISBN 978-1-4419-9332-8 (eBook) 2013.
2. BruceA.Fette, “CognitiveRadioTechnology”, Elsevier, ISBN10:0-7506-7952-2, 2/e, 2006.
3. PaulBurns, “Software-Definedradiofor3G”, Artechhouse Publishers, Inc, ©2003.

Suggested Reading:

1. Peter B.Kenington, “RFandBasebandTechniquesforSoftwareDefinedRadio”, ArtechHousePublishers, Inc ©2005.
2. Hüseyin Arslan, “Cognitive Radio, Software Defined Radio and Adaptive Wireless Systems”, Springer, ISBN 978- 1-4020-5541-6 HB, 2007.

e-Resources:

1. https://archive.nptel.ac.in/content/syllabus_pdf/108107107.pdf

22ECE06

ARTIFICIAL INTELLIGENCE FOR ECE

(Professional Elective-I)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge of probability, Linear Algebra, Data Structure and programming.

Course Objectives:

This course aims to:

1. Exposure to the foundation of Artificial Intelligence.
2. Familiarize the applications of Artificial Intelligence in Industry.
3. Inculcate the concepts of Neural Networks and Pattern Recognition.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the basics of AI and intelligent agents.
2. Apply Expert Systems to solve real time problems.
3. Understand knowledge representation methods.
4. Build algorithms using neural network techniques for various applications.
5. Solve the various classification problems like object recognition.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	1	1	1	1	1	1	1	1	1	1	3	1	1
CO 2	3	3	3	2	2	3	2	1	2	1	1	2	3	1	1
CO 3	3	3	1	3	1	1	1	1	1	1	1	1	3	1	1
CO 4	3	3	3	2	2	1	1	1	1	1	1	1	3	1	1
CO 5	3	3	3	3	1	3	2	1	2	1	1	1	3	2	1

UNIT-I

Introduction to AI and Intelligent Agents: Concept of AI, current status of AI, Agents, Good Behavior: Environment, problem formulation. The structure of agents. Basic concepts of Search Algorithms: Uninformed depth first search, breadth first search, uniform cost search, depth limited search, iterative deepening search and informed search techniques like greedy best first search and A* algorithm, concepts of admissibility.

UNIT-II

Knowledge representation: Bayesian network representation, Construction and inference. Hidden Markov Model. Approaches to knowledge representation, knowledge representation using the semantic network, extended semantic networks for Knowledge representation, knowledge representation using frames.

UNIT-III

Neural Networks: What is a neural network, the human brain, models of a neuron, neural networks as a directed graph, feedback and network architectures. Learning processes and learning tasks.

UNIT IV

Machine Learning (ML): Introduction to ML, types of learning, applications of ML.

Supervised learning: Linear regression, polynomial regression, classification methods– KNN classifier, decision trees, naïve bayes, supports vector machines.

Unsupervised Learning: Clustering – K-means clustering, dimensionality reduction – PCA (principal component analysis), ensemble learning – boosting & bagging approaches.

UNIT-V

Applications and tools of Artificial Intelligence: Pre-processing, feature extraction for signal and time series data.

Machine learning in Image processing: Fundamentals of image processing, feature mapping case study on image classification using artificial neural networks.

Artificial Intelligence in Speech Processing: Process of speech production a block diagram approach, Classification of speech sounds, speech recognition using HMM.

Text Books:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence—A Modern Approach”, 3rd Edition, Prentice-Hall Series, 2010.
2. Christopher M. Bishop, Clareddon, “Neural networks for pattern Recognition”, Oxford, 1995.
3. Simon Haykin, “Neural networks and learning Machines”, 3rd Edition, Pearson- Prentice Hall, 2009.
4. M. Narsimhamurty and V. Susheela Devi, “Pattern Recognition- An Algorithmic Approach", Springer Universities Press, 2011.
5. B. Yegnanarayana, “Artificial Neural Networks”, PHI, 2005.

Suggested Books:

1. Elaine Rich, Kevin Knight and Shivashankar B Nair, “Artificial Intelligence”, Tata McGraw Hill Education Pvt. Ltd., 2010.
2. Flasiński, Marius, “Introduction to Artificial Intelligence”, Springer International Publisher, 2016.

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs56/preview.
2. https://onlinecourses.nptel.ac.in/noc23_cs18/preview.

22ECE07

CMOS ANALOG AND DIGITAL IC DESIGN

(Professional Elective-II)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Analog and Digital Design concepts.

Course Objectives: This course aims to

1. Educate about the different Models of MOSFET, so that it can be used in analytical analysis and modelling of the circuits.
2. Demonstrate the construction, analysis and design of basic circuits of Analog IC Design.
3. Demonstrate the construction, analysis and design of basic circuits of Digital IC Design.

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

1. Understand the concepts of MOS Device and model.
2. Choose appropriate amplifier or current mirror circuit for a given application or specification.
3. Design various types of amplifiers, Op-Amps as per the required specifications.
4. Design and analyse any combinational circuits for a given application.
5. Design and analyse sequential circuits for any given application.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	1	1	1	1	1	1	1	1	1	1	3	1	1
CO 2	2	3	3	2	1	1	1	1	1	1	1	1	3	1	1
CO 3	2	3	3	3	1	1	1	1	1	1	1	1	3	1	1
CO 4	2	3	3	3	1	1	1	1	1	1	1	1	3	1	1
CO 5	2	3	3	3	1	1	1	1	1	1	1	1	3	1	1

UNIT–I: MOS Modelling

Basic MOS Device Physics: MOS structure, MOS I/V Characteristics: Threshold Voltage, Derivation of Drain current, Second Order Effects, MOS Device Layout, MOS Device Capacitances, MOS Low Frequencies Small Signal Models, Long Channel vs Short Channel.

UNIT–II: Single Stage Amplifiers & Current mirrors

Single Stage Amplifiers: Basic Concepts, Common Source Stage: with Resistive Load, Current Source Load, diode Load with Source Degeneration, Source Follower, Common Gate Stage, Cascode Stage, Folded Cascode. Basic Current Mirrors, Cascode Current Mirrors Frequency Response of Single Stage CS Amplifiers, Miller Effect.

UNIT–III: **Differential Amplifiers & Op-Amp**

Differential Amplifiers: Single Ended vs Differential Amplifiers, Basic Differential Pair, Analysis of Basic Differential Pair, Operational Amplifiers: One Stage Op-Amp, Two Stage Op-Amp, Frequency Compensation of Two Stage Op-Amp, Common Mode Feed-Back, Input Range Limitations, Slew Rate, PSRR.

UNIT–IV: Combinational Logic

Inverter: Static CMOS Inverter, Static CMOS Design, Logic Effort, Rationed Logic, Pass Transistor Logic, Dynamic Logic Speed and Power Dissipation in Dynamic Logic, CMOS Transmission Gate Logic.

UNIT–V: Sequential Logic

Static Latches and Registers, MUX Based Latches, Static SR Flip-Flops, Master-Slave Edge Triggered Register, Dynamic Latches, and Registers.

Text Books:

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill. 2002.
2. J P Rabaey, A P Chandrakasan, B Nikolic, "Digital Integrated circuits: A design perspective", Prentice Hall electronics and VLSI series, 2nd edition 2003.

Suggested Reading:

1. David Johns, Ken Martin, "Analog Integrated Circuit Design", John Wiley & sons. 2004.
2. Jacob Baker.R.et.al., "CMOS Circuit Design", IEEE Press, Prentice Hall, India, 2000.
3. Paul. R. Gray & Robert G. Major, "Analysis and Design of Analog Integrated Circuits", John Wiley & sons. 2004.
4. Kang, S. and Leblebici, Y., "CMOS Digital Integrated Circuits, Analysis and Design", TMH, 3rdEdition 2003.

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc24_ee111/preview.

22ECE08

MATHEMATICAL MODELLING OF COMMUNICATION SYSTEMS

(Professional Elective-II)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: The student should have knowledge of probability theory and programming.

Course Objectives:

This course aims to:

1. To introduce the importance of Monte Carlo methods for analyzing the behavior of communication systems.
2. To inspire students to model and analyze stochastic systems in their surroundings, empowering them to apply these principles to practical challenges in Communication engineering and related fields.
3. To develop a comprehensive understanding of stochastic modeling and communication systems.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Gain a solid understanding of MATLAB Learn key programming constructs.
2. Explore Linear Algebra and Signal Processing Fundamentals.
3. Develop a comprehensive understanding of probability and stochastic processes.
4. Design and Develop Stochastic Models and Data Compression Techniques.
5. Modeling of Communications and Wireless Technologies.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	3	3	1	1	1	1	1	2	2	3	2	2
CO 2	3	3	3	3	3	1	1	1	1	1	2	2	3	3	3
CO 3	3	3	3	3	3	3	1	1	1	1	2	2	3	3	3
CO 4	3	3	3	3	3	3	1	1	1	1	2	3	3	3	3
CO 5	3	3	3	3	3	3	1	1	1	1	2	3	3	3	3

UNIT-I

Fundamentals: Introduction, Basics of MATLAB, Data Types, Floating Point Numbers, Scripts and Flow of Control, The For Loop, Arrays, Indexing, Some Results from Linear Algebra, Matrix Multiplication, Eigenvalues and Eigenvectors, Complex Numbers, Hermitian Matrices, Signals, Convolution.

UNIT-II

Probability Theory: Probability, Bayes Theorem, Random Variables, Clinical Trials, Random Numbers, Random Distributions, Histograms, Functions of Random Variables, Generating Random Distributions, Laws of Large numbers, Random Processes, Properties of Random Processes, Power Spectra, Signals and Noise.

UNIT-III

Stochastic Modeling: Stochastic Models, The AR-1 Process, Yule Walker Equations, Markov Chains, Analog to Digital Conversion, K Means, Correlation, Predictive Coding, Image Compression, Transform Domain Compression, Multi Resolution Coding.

UNIT-IV

Communication Theory: Introduction to Communications, Low Pass and Band-pass Signals, Signal Spaces, PAM, Detection, Effects of AWGN, ML Detection, The Union Bound, Symbol Error Rates, Choosing Constellations.

UNIT-V

Wireless Communication: Orthogonal Signaling, Non-Coherent Detection, DPSK, Introduction to Wireless Communications, Propagation and Fading, Introduction to MIMO and OFDM.

Text Books:

1. Rudra Pratap. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers. Oxford University Press, Inc., USA, 2009.
2. Sheldon M. Ross, Introduction to Probability Models, (Twelfth Edition), Academic Press, 2019.
3. Proakis, J.G., Salehi, M., Bauch, G., Contemporary Communication Systems Using MATLAB, Third edition, Cengage Learning, 2012.

Suggested Reading:

1. Cho, Yong Soo, et al. MIMO-OFDM wireless communications with MATLAB. John Wiley & Sons, 2010.
2. Haykin, Simon S, Adaptive Filter Theory, Fifth Edition, Pearson, 2014.

e-Resources:

1. https://nptel.ac.in/courses/108103191.

22ECE09

BIOMEDICAL INSTRUMENTATION AND SIGNAL PROCESSING

(Professional Elective-II)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: The student should have basic knowledge of Signals and Systems.

Course Objectives:

1. To understand the physiological systems present in the human body.
2. To understand the application of electronic systems used in modern health care.
3. To acquire, process and analyse Bio medical signals.

Course Outcomes:

At the end of the course students will be able to

1. Know the functionality of the human body.
2. Know the practical limitations of electronic gadgets used for human systems.
3. Measure various physiological parameters.
4. Know the functionality of Bio medical recorders.
5. Learn the concepts of Brain- computer interface.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	2	1	1	1	1	2	3	1	3	3	2	3
CO 2	3	3	2	2	1	1	1	1	2	3	1	3	3	2	3
CO 3	3	3	2	2	1	1	1	1	2	3	1	3	3	2	3
CO 4	3	3	2	2	1	1	1	1	2	3	1	3	3	2	3
CO 5	3	3	3	2	1	1	1	1	2	3	1	3	3	2	3

UNIT-I

Introduction to Biomedical Signals

Action Potential and Its Generation, Origin and Waveform Characteristics of Basic Biomedical Signals Like: Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Phonocardiogram (PCG), Electro Neuro Gram (ENG), Event-Related Potentials (ERPS), Electro Gastro Gram (EGG), Objectives of Biomedical Signal Analysis, Difficulties in Biomedical Signal Analysis, Computer-Aided Diagnosis.

UNIT–II

Basic Transducer Principles: Transducer principles, active and passive transducers, their bio medical applications.

Electrodes: Electrode theory, bio potential electrodes, bio chemical transducers. Cardiovascular System: The heart and cardiovascular system, the heart, blood pressure, blood flow, heart sounds, ECG, Measurement of blood pressure, blood flow, cardiac output, and heart sounds and PCG. Patient care and monitoring systems: Elements of Intensive care systems, patient monitoring systems, other instruments, organization of the hospital for patient care monitoring, pace makers, defibrillators.

UNIT-III

Bio Medical Amplifiers: Basic requirements, differential amplifier, carrier amplifier, chopper amplifier, phase sensitive detector. EEG: Signal sources, EEG recording, applications of EEG. EMG: Surface and needle electrodes, EMG, measurement of conduction velocity, ERG, EOG. Respiration: mechanism, spirometer, and pneumotachograph.

Bio telemetry: Introduction, physiological parameters adaptable to biotelemetry, components of telemetry system, implantable units, applications of telemetry in patient care. Computer in Biomedical instrumentation: digital computer, microprocessor, interfacing computer with other medical equipment, biomedical computer applications, Introduction to CAT scanner. X-Ray: X-ray unit, radiation therapy, Introduction to MRI and nuclear imaging.

UNIT – IV

Filtering for Removal of artifacts: Statistical Preliminaries, Time domain filtering (Synchronized Averaging, Moving Average), Time domain filtering (Moving Average Filter to Integration, Derivative-based operator), Frequency Domain Filtering (Notch Filter), Optimal Filtering: The Weiner Filter, Adaptive Filtering Selecting Appropriate Filter.

UNIT – V

Event Detection: Example events (viz. P, QRS and T wave in ECG), Derivative based Approaches for QRS Detection Pan Tompkins Algorithm for QRS Detection, Dicrotic Notch Detection Correlation Analysis of EEG .

Waveform Analysis : Signal, Morphological Analysis of ECG, Correlation coefficient, The Minimum phase correspondent, Signal length, Envelop Extraction, Amplitude demodulation, The Envelogram, Analysis of activity, Root Mean Square value, Zero-crossing rate, Turns Count, Form factor, Periodogram, Averaged Periodogram.

Text Books:

1. Leslie Cromwell, Fred J Weibell and Erich A Pfeiffer, Biomedical Instrumentation and Measurements, PHI, 2nd edition, 2003.
2. C Raja Rao and SK Guha, "Principles of Medical Electronics and Biomedical Instrumentation", Universities press, 2013.
3. D C Reddy "Biomedical Signal Processing: Principles and Techniques", Tata McGraw-Hill Publishing Co. Ltd, 2005.

Suggested Reading:

1. J G Webster "Medical Instrumentation: Application & Design", John Wiley & Sons Inc., 2001.
2. C Raja Rao, S K Guha "Principles of Medical Electronics and Biomedical Instrumentation", Universities Press, 2001.

e-Resources:

1. https://onlinecourses.swayam2.ac.in/nou24_bt07/preview.

22ECE10

SENSING TECHNIQUES AND SENSOR SYSTEMS

(Professional Elective-II)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Fundamental concepts of electronics.

Course Objectives:

This course aims to:

1. To expose the students to many varieties of transducers, measuring instruments, their Operating principles and construction.
2. Identify the details of instrumentation and devices intended for a particular application.
3. To provide an idea of strengths and weaknesses of the various types of sensors.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the fundamental and applications of several different types of sensors.
2. Evaluate and perform accurate measurements for any engineering system with clear idea of the potential errors.
3. Describe the working principles of various sensors.
4. Select an appropriate sensor for given application.
5. Understand various sensor materials and technologies used in designing sensors.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	1	1	1	2	2	1	1	1	1	2	3	1	1
CO 2	3	3	2	1	1	1	1	1	1	1	1	2	3	2	1
CO 3	3	3	2	1	1	2	2	1	1	1	1	2	3	1	1
CO 4	3	3	2	1	1	1	2	1	1	1	1	2	3	1	1
CO 5	3	3	2	1	1	2	1	1	1	1	1	2	3	2	2

UNIT-I

Introduction: Difference between sensor and transducer - Primary measuring elements - selection and characteristics: Range; resolution, Sensitivity, error, repeatability, linearity and accuracy, impedance, backlash, Response time, Dead band, Error - Absolute error, Relative error Limiting errors, Propagation of errors, Errors in measurement-gross, systematic and random errors, Loading effect, Statistical analysis of measurement data and probable error.

UNIT-II

Sensors: Definition, classification of sensors.

Proximity Sensors: Principle, Inductive and Capacitive proximity sensors and its applications.

Velocity, motion, force sensors: Tachogenerator, Optical encoders, Strain Gauge as force Sensor.

Fluid pressure: Tactile sensors, **Flow Sensors**: Ultrasonic and laser, **Level Sensors:** Ultrasonic and Capacitive.

Light sensors: Photo Diodes and Applications of Photo Diodes.

UNIT-III

Transducers: Definition, classification of Transducers.

Mechanical Transducers: Displacement-to-Pressure, Seismic Displacement Transducers.

Passive Electrical Transducers: LVDT, Resistor Moisture Transducer.

Active Electrical Transducers: Hall Effect Transducer, Piezoelectric transducer.

UNIT - IV

Micro Sensors: Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors.

UNIT - V

Applications: Microphone and its types, Temperature measurement-Thermistor, Thermometer - resistance wire thermometers, semiconductor thermometers and thermocouples, proximity sensor, Hygrometer.

Text Books:

1. D. Patranabis, "Sensors and Transducers", Prentice Hall India Pvt., 2nd Ed, 2021.
2. Clarence W. De Silva, "Sensors and Actuators Engineering System Instrumentation", Taylor & Francis Ltd, 2nd Ed, 2015.

Suggested Reading:

1. Jacob Fraden, "Hand Book of Modern Sensors: Physics, Designs and Application" 4Ed, Springer, 2010.
2. Jonathan Wolpaw and Elizabeth Winter Wolpaw, "Brain-Computer Interfaces: Principles and Practice", Oxford University Press, 2012.
3. D. V. S. Murty, "Transducers and Instrumentation", Prentice Hall India Pvt., Limited, 2008.

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc24_ee83/preview.

22ECE11

MEMS

(Professional Elective-II)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Fundamentals of Semiconductors & Physics.

Course Objectives: This course aims to:

1. Integrate the knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
2. Explore the various possible materials and rudiments of Micro fabrication techniques.
3. Identify and understand the mechanism of various sensors and actuators.

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

1. Understand the fundamental concepts of MEMS and Microsystems.
2. Classify and discuss various possible materials for MEMS based devices.
3. Illustrate various process steps involved in fabrication of MEMS devices.
4. Understand various abstraction levels of a Microsystems Design.
5. Apply knowledge to design micro sensors and micro actuators.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	2	3	2	1	1	3	2	1	3	3	3	3
CO 2	3	3	3	2	3	2	1	1	3	2	1	3	3	3	3
CO 3	3	3	3	2	3	2	1	1	3	2	1	3	3	3	3
CO 4	3	3	3	2	3	2	1	1	3	2	1	3	3	3	3
CO 5	3	3	3	2	3	2	1	1	3	2	1	3	3	3	3

UNIT-I

MEMS and Microsystem: Introduction to MEMS, Microsystems and Microelectronics, Multidisciplinary Nature of MEMS, Miniaturization and its Benefits, MEMS Design Considerations, Advantages of MEMS Technology, Applications of MEMS.

UNIT-II

Materials for MEMS: Introduction, Substrates & Wafers, Active Substrate Materials, Silicon as a Substrate Material, Silicon Compounds, Piezoelectric Crystals, Polymers, Packaging Materials.

UNIT-III

Microfabrication: Introduction, Fabrication Process – Wafer Processing, Photolithography, Ion Implantation, Oxidation, Chemical Vapor Deposition (CVD), Physical Vapor Deposition, Deposition By Epitaxy, Etching, Manufacturing Process - Bulk Micromachining, Surface Micromachining and LIGA Process, Packaging Technology, System Level Packaging, Single and Multichip Packaging. Microsystem Packaging, Interfacings in Microsystem Packaging.

UNIT-IV

Microsystems Design: Introduction**,** Design Considerations, Process design, Mechanical Design, Mechanical Design using Finite Element method, Design of a Silicon die for a micro pressure sensor.

UNIT-V

MEMS Based Sensors and Actuators: Introduction, Working Principles of Microsystem - Micro Sensors, Micro Actuators, MEMS with Micro Sensors: Pressure Sensors, Temperature Sensors, Humidity Sensors, Accelerometers, Gyroscopes, Biomedical Sensors, Chemical Sensors, MEMS with Micro Actuators: Microgrippers, Micropumps.

Text Books:

1. Tai-Ran Hsu, MEMS and Microsystems: Design, Manufacture, and Nanoscale Engineering, 2nd Edition, John Wiley & Sons, Inc., Hoboken, New Jersey, 2008.
2. Gabriel M Rebeiz, RF MEMS - Theory Design and Technology, John Wiley, 2004.
3. Microsystem Design by Stephen D. Senturia, Springer International, Edition, 2010.

Suggested Reading:

1. Marc Madou, Fundamentals of Micro Fabrication CRC Press.
2. Mohamed Gad-el-Hak, The MEMS Handbook, CRC Press.
3. Julian W.Gardner, Vijay K.Varadan, Osama O. Awadel Karim, “Micro sensors MEMS and Smart Devices”, John Wiley & Sons Ltd., 2001.

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc24_ee139/preview.

22ECE12

CLOUD COMPUTING AND APPLICATIONS

(Professional Elective-II)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Fundamental concepts of computer networking.

Course Objectives: This course aims to:

1. To impart the fundamentals and essentials of Cloud Computing.
2. Describes the cloud architecture, layers and models.
3. Introduce the concepts of resource management and security in cloud.

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

1. Understand the basic concepts of cloud computing.
2. Describe the cloud computing.
3. Explain and characterize various cloud service models and cloud deployment models.
4. Investigate the resources available and /Interpret the security and privacy issues related to cloud computing environments.
5. Apply the concepts of cloud computing in real world scenario.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	3	1	1	1	1	1	1	1	1	1	2	1	1	1
CO 2	3	2	1	2	1	1	1	1	1	1	1	1	1	1	1
CO 3	3	2	1	1	1	1	1	1	1	1	1	1	1	1	1
CO 4	3	3	1	2	1	1	1	1	1	1	1	1	1	1	1
CO 5	2	3	1	1	1	1	1	1	1	1	1	2	1	1	1

UNIT-I

Introduction to Cloud: Introduction to Cloud Computing, Origins of Cloud computing, Fundamentals of cloud computing - Definition of Cloud, Basic Concepts, Goals, Benefits, Risks and Challenges, RAS (Reliability, Availability and Serviceability) Cloud components, Essential characteristics Comparing cloud providers with traditional IT service providers.

UNIT-II

Cloud Insights: Roots of cloud computing. Virtualization in Cloud Computing, Cloud scenarios – Benefits: scalability, simplicity, vendors, security, Service Level Agreement.

UNIT-III

Cloud Platform Architecture: Basic Cloud Architecture, Monolithic and Microservice Architecture, Cloud Computing and Service Models - SaaS, PaaS, IaaS – features, benefits, challenges and risks in cloud adoption. Cloud deployment models - Public, Private, Community and Hybrid clouds.

UNIT-IV

Resource Management and Security in Cloud: Resources in cloud computing, Resource Management, Green Computing, Resource Scheduling. Inter Cloud Resource Management – HaaS, LaaS and NaaS. Resource Provisioning Methods: Types. Cloud Security Overview: Firewall, DoS Attack, Data Security, Application Security, Virtual Machine Security.

UNIT-V

Cloud Computing Applications: Case Studies: Google App Engine (GAE) – Traffic Management, Traffic Splitting, Compute Engine Vs APP Engine, Scaling – Types, Amazon Web Services (AWS), Google Cloud Platform (GCP) and Azure. Cloud Software Environments – Eucalyptus – Open Nebula – Open Stack.

Text Books:

1. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigm", 1st Edition, John Wiley and Sons, 2011.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. Jaden Locus "cloud Computing For Beginners With Examples " year of publication 2019Michael Miller – Que, "Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online", 2008.

Suggested Reading:

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing", Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach", Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)", OReilly, 2009.
4. Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper, "Cloud computing for dummies", Wiley Publishing, Inc, 2010.

e-Resources:

1. https://nptel.ac.in/courses/106105167.

22EGO01

TECHNICAL WRITING SKILLS

(Open Elective – I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Language proficiency and the ability to simplify complex technical concepts for a diverse audience.

Course Objectives:

The course will introduce the students to:

1. Process of communication and channels of communication in general writing and technical writing in particular.
2. Learn Technical Writing including sentence structure and be able to understand and use technology specific words.
3. Write business letters and technical articles.
4. Write technical reports and technical proposals.
5. Learn to write agenda, record minutes of a meeting, draft memos. Understand how to make technical presentations.

Course Outcomes:

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

1. Communicate effectively, without barriers and understand aspects of technical communication.
2. Differentiate between general writing and technical writing and write error free sentences using technology specific words.
3. Apply techniques of writing in business correspondence and in writing articles.
4. Draft technical reports and technical proposals.
5. Prepare agenda and minutes of a meeting and demonstrate effective technical presentation skills.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	2	1	1	-	1	1	2	3	3	2	3	1	1	1
CO 2	-	1	-	1	-	-	-	1	2	2	1	2	1	1	1
CO 3	-	2	-	2	-	1	1	1	2	3	2	2	1	1	1
CO 4	2	2	1	3	-	2	2	1	3	3	2	2	1	2	2
CO 5	1	1	1	1	-	1	1	1	3	3	2	2	1	1	2

Unit - I

Communication – Nature and process.

Channels of Communication – Downward, upward and horizontal communication. Barriers to communication.

Technical Communication – Definition, oral and written communication. Importance and need for Technical communication. Nature of Technical Communication. Aspects and forms of Technical communication. Technical communication Skills – Listening, Speaking, Reading & Writing.

Unit II

Technical Writing – Techniques of writing. Selection of words and phrases in technical writing. Differences between technical writing and general writing. Abstract and specific words. Sentence structure and requisites of sentence construction. Paragraph length and structure.

Unit III

Business correspondence – Sales letters, letters of Quotation, Claim and Adjustment letters.

Technical Articles: Nature and significance, types. Journal articles and Conference papers, elements of technical articles.

Unit IV

Technical Reports: Types, significance, structure, style and writing of reports. Routine reports, Project reports.

Technical Proposals: Definition, types, characteristics, structure and significance.

Unit V

Mechanics of Meetings: Preparation of agenda, participation, chairing and writing minutes of a meeting. Memorandum. Seminars, workshops and conferences.

Technical Presentations: Defining purpose, audience and locale, organizing content, preparing an outline, use of Audio Visual Aids, nuances of delivery, importance of body language and voice dynamics.

Textbooks:

1. Meenakshi Raman & Sangeeta Sharma, "Technical Communications-Principles and Practice", Oxford University Press, Second Edition, 2012.
2. M Ashraf Rizvi, "Effective Technical Communication", Tata McGraw Hill Education Pvt Ltd, 2012.

Suggested Reading:

1. Kavita Tyagi & Padma Misra, "Basic Technical Communication", PHI Learning Pvt Ltd, 2012.
2. R.C Sharma & Krishna Mohan, "Business Correspondence and Report Writing", Tata McGraw Hill, 2003

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc18_mg13/preview.
2. https://www.technical-writing-training-and-certification.com.
3. https://academy.whatfix.com/technical-writing-skills.

22EGO03

INDIAN TRADITIONAL KNOWLEDGE

(Open Elective – I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge of Indian Culture.

Course Objectives:

This course aims to:

1. To get a knowledge in Indian Culture.
2. To know Indian Languages and Literature and the fine arts in India
3. To explore the Science and Scientists of Medieval and Modern India.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand philosophy of Indian culture.
2. Distinguish the Indian languages and literature.
3. Learn the philosophy of ancient, medieval, and modern India.
4. Acquire the information about the fine arts in India.
5. Know the contribution of scientists of different eras.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	2	1	1	2	3	3	2	2	1	2	1	1	1
CO 2	1	1	2	1	1	2	3	3	2	2	1	2	2	1	2
CO 3	1	1	2	1	1	2	3	3	2	2	1	2	1	1	1
CO 4	1	1	2	1	1	2	3	3	2	2	1	2	1	1	2
CO 5	1	3	2	1	1	2	3	3	2	2	2	3	2	2	2

UNIT I

Culture and Civilization: Culture, Civilization and heritage, general characteristics of culture, importance of culture in human life, Cultural diversity, Aesthetics, Women seers, Indus culture, Indian Cuisine, Martial arts.

UNIT II

Education System: Education in ancient, medieval and modern India, aims of education, subjects, Languages, Science and Scientists of ancient. Medieval and modern India. Concepts of Sciences in Indian Knowledge Systems.

UNIT III

Linguistic Wealth: Indian languages and Literature: The role of Sanskrit, Morphology and brevity of Sanskrit, Concepts of NLP in IKS. Paleography, Fundamentals of Vedic Mathematics, Significance of scriptures to current society, Indian semantics and lexicography, Darshanas.

UNIT IV

Art, Technology & Engineering: Sculpture, Painting and Handicrafts, Indian Music, Dance Drama and Theatre, introduction to Mayamatam, Iron and Steel technology, Use of metals in medicinal preparations.

UNIT-V

Science and Logic: Heliocentric system, Sulbasutras, Katapayadi, Engineering in Vedas, Adaptability of Sanskrit in Computer languages, Related commands Hindu calendar, 6 Pramanas in Indian logic, Scientific method applied to therapeutics, Fallacies, Tarka- Induction and deduction, Ayurvedic biology, Definition of health.

Text Books:

1. B. Madhavan, Nagendra Pavana, Vinayak Rajat Bhat, "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning, June 2022.
2. Kapil Kapoor, "Text and Interpretation: The Indian Tradition", D K Print World Ltd., 2005.
3. Samskrita Bharati, "Science in Sanskrit",2017.
4. Satya Prakash, "Founders of sciences in Ancient India", Govindram Hasanand, 1986.

Suggested Reading:

1. Brajendranath Seal**, "**The Positive Sciences of the Ancient Hindus", Motilal Banarasidass, 2016.
2. Kancha Ilaiah, "Turning the Pot, Tilling the Land: Dignity of Labour in Our Times", Navayana, 2019.
3. Balram Singh and others, "Science & Technology in Ancient Indian Texts", D.K. Print World Ltd, 1st edition, 2012.
4. Smt. Kalpama Paranjepe, "Ancient Indian insight and Modern Science"**,** Bhandarkar Oriental Research Institute, 1996.
5. Pradeep Parihar, "Vedic World and Ancient Science", World House Book Publishing, 2021.

22CEO02

DISASTER RISK REDUCTION AND MANAGEMENT

(Open Elective – I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Outcomes:

Upon completion of this course, the student will be able to,

1. Explain the fundamental concepts of disaster management.
2. Demonstrate the principles and practices of disaster risk reduction management.
3. Identify stress and its management during disaster.
4. Outline institutional frame work at different levels of administration.
5. Evaluate disaster management study including data search, analysis and presentation as a case study.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	-	-	-	-	2	3	-	-	-	-	1	-	-	-
CO 2	2	-	-	-	-	2	3	-	-	-	-	1	-	-	-
CO 3	2	-	-	-	-	2	3	-	-	-	-	1	-	-	-
CO 4	2	-	-	-	2	2	3	-	-	-	-	1	-	-	-
CO 5	2	-	-	-	-	2	3	-	-	-	-	1	-	-	-

UNIT I

Fundamental concepts in disaster management: Hazard and disaster-concepts, vulnerability and risk, Hazardand disaster type – Natural, Water- related, pandemic and Human induced hazards disasters. Causes and Impactsof disasters – Impacts on natural eco systems: physical, psychological and social impact. Disaster and financial resilience. Disaster vulnerability profile of India –Specific to geographical regions and states (as per regional significance).

UNIT II

Disaster Management Cycle: Rescue, Relief, Rehabilitation, Prevention, Mitigation and Preparedness. Disaster risk reduction (DRR). Community based DRR, institutions concerned with safety, disaster mitigation and construction techniques as per Indian standards and Early warning systems.

UNIT III

Disaster Impacts Management: Trauma and stress management, First aid and emergency procedures Awareness generation strategies for the community on safe practices in disaster (as per regional significance).

UNIT IV

Institutional framework of disaster management in India: NDMA-SDMA, NDRF, civic volunteers, and NIDM. Phases of disaster/risk management and post-disaster responses. Compensation and insurance Applications of remote sensing & GIS in disaster management. Components of disaster management. Preparedness of rescue and relief, mitigation, rehabilitation & reconstruction. Institutional frame work of disaster management in India.

UNIT V

Capacity building for disaster/damage mitigation: Structural and Nonstructural measures forcapacity building for disaster/damage mitigation. Disaster risk reduction strategies and national disaster management guidelines. Disaster management Act -2005. Regional issues as per regional requirement/university can take minimum two topics as per high powered committee.

Text Books:

1. Singh, R. (2017), "Disaster management Guidelines for Earth quakes, Landslides, Avalanches andTsunami". Horizon Press publications.
2. Taimpo (2016), "Disaster management and preparedness". CRC Press Publications

Suggested Reading:

1. Nidhi, G.D. (2014), "Disaster management preparedness" .CBS Publications Pvt. Ltd.
2. Gupta, A.K.,Nair, S.S., Shiraz, A. and Dey, S. (2013), "Flood Disaster Risk Management-CBS Publications Pvt Ltd.
3. Singh, R. (2016), "Disaster management Guidelines for Natural Disasters" Oxford University Press Pvt. Ltd

e-Resources:

1. https://nptel.ac.in/courses/124107010.
2. https://onlinecourses.swayam2.ac.in/cec19_hs20/preview.

22MEO06

PRINCIPLES OF ENTREPRENEURSHIP AND STARTUPS

(Open Elective – I)

Instruction	3L	Hours per week
Duration of SEE	3	Hours
SEE	60	Marks
CIE	40	Marks
Credits	3	

Prerequisite: Nil

Course Objectives:

This course aims to:

1. Impart basic concepts and procedure of idea generation.
2. Familiarize the nature of industry and related opportunities and challenges.
3. Familiarize with elements of business plan and its procedure.
4. Learn the project management and its techniques.
5. Know the behavioral issues and time management.

Course Outcomes:

Upon completion of this course, the students will be able to:

1. Understand the concept and essence of entrepreneurship.
2. Identify business opportunities and nature of enterprise.
3. Analyze the feasibility of new business plan.
4. Apply project management techniques like PERT and CPM for effective planning and execution of projects.
5. Use behavioral, leadership and time management aspects in entrepreneurial journey.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	1	1	1	2	2	2	1	1	1	1	-	-	3
CO 2	1	1	1	1	1	2	2	2	2	2	3	1	-	-	3
CO 3	1	1	1	2	2	2	2	2	2	2	3	1	-	-	3
CO 4	2	1	1	2	2	2	2	2	1	2	3	1	-	-	3
CO 5	1	-	1	1	1	-	2	2	1	1	1	1	-	-	3

UNIT - I

Entrepreneurship: Definition, Characteristics of an Entrepreneur, Functions of Entrepreneurs, Entrepreneur vs. Intrapreneur, First Generation Entrepreneur, Women Entrepreneurship, Ideas and their Sources, Conception and Evaluation of Ideas.

Behavioral Aspects of Entrepreneurs: Personality: Determinants, Attributes and Models, Leadership: Concepts and Models, Values and Attitudes, Motivation Aspects.

UNIT - II

Indian Industrial Environment: Competence, Opportunities and Challenges, Entrepreneurship and Economic Growth, Small Scale Industry in India, objectives, Linkage among Small, Medium and Heavy Industries, Types of Enterprises, Corporate Social Responsibility.

UNIT - III

Business Plan: Introduction, Elements of Business Plan and its salient features, Business Model Canvas, Technical Analysis, Profitability and Financial Analysis, Marketing Analysis, Feasibility Studies, Executive Summary.

UNIT - IV

Project Management: During construction phase, project organization, project planning and control using CPM, PERT techniques, human aspects of project management.

Time Management: Approaches of Time Management, their strengths and weaknesses. Time Management Matrix, Urgency Addiction.

UNIT - V

Startup: Definition, Startup Ecosystem, Startup Incubator, Need and Importance of Startups and Incubation Centers. Sources of Finance and Incentives for Startups. Innovation, Creativity, Intellectual Property in Entrepreneurial Journey. Business firm Registration Process in INDIA.

Text Books:

1. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, 1997.
2. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", Tata Mcgraw- Hill Publishing Company Ltd, 1995.
3. S.S. Khanka, "Entrepreneurial Development", S. Chand & Co. Pvt. Ltd., New Delhi, 2015.

Suggested Reading:

1. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship", 5th edition, Tata Mc Graw Hill Publishing Company. Ltd., 2005.
2. Stephen R. Covey and A. Roger Merrill, "First Things First", Simon and Schuster Publication, 1994.

22CSO01

INTRODUCTION TO WEB TECHNOLOGIES

(Open Elective – I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge on a programming language.

Course Objectives:
This course aims to:
1. Acquire knowledge on HTML, Java Script and XML to develop client side web applications.
2. Learn developing web applications using Django.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Understand the technologies required for developing web application.
2. Identify and choose HTML tags, CSS and java scripts to develop well-structured and easily maintained web pages.
3. Design and Develop interactive and innovative web pages using various platforms/technologies like HTML, CSS, XML, JAVASCRIPT.
4. Create and deploy web applications in web server by using Django concepts.
5. Evaluate different web applications to implement optimal solutions for real time problems

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	3	2	2	1	1	1	1	2	3	1	3	2	2	2
CO 2	2	3	2	2	1	1	1	1	2	3	1	3	2	2	2
CO 3	2	3	2	2	1	1	1	1	2	3	1	3	2	2	2
CO 4	2	3	2	2	1	1	1	1	2	3	1	3	2	2	3
CO 5	2	3	3	2	1	1	1	1	2	3	1	3	2	2	3

UNIT - I
Web Basics: WWW Browsers, Web Servers, URL, MIME, HTTPS.
Introduction HTML5: basic tags, Images, Tables, Lists, Forms, Layout, Graphics, span and div tags. Grid, Cascading Style Sheets.

UNIT – II
The Basics of Java script: Primitive operations and Expressions, Arrays, Functions, Pattern Matching Using Regular Expressions, Document Object Model, Element Access in JavaScript, Events and Event Handling, Handling Events from Body, Button, Text Box and Password Elements.
Dynamic Documents with Java Script: Positioning Elements, Moving Elements, float and clear.

UNIT - III
XML: Introduction, uses of XML, the Syntax of XML, XML Document Structure, Namespaces, XML schemas, displaying Raw XML Documents, displaying XML documents with CSS, JSON, XML vs JSON.

UNIT - IV

Django: Introduction, Models, Templates, supported data bases, URL configuration. Templates, Modifying and Improving the Templates, Creating a Form.

UNIT - V

Applications: Introduction to Ajax, Node.js and.
Bootstrap: Introduction to Bootstrap, bootstrap grid, bootstrap components.
Web Application Frameworks: React JS, JQuery.

Text Books:

1. HTML5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery), Dreamtech, 2017.
2. Adrian Holovaty and Jacob Kaplan-Moss" The Definitive Guide to Django Web Development Done Right", après-2009
3. P. J. Deitel - Deitel, H. M. Deitel - Deitel, "Internet & World Wide Web How To Program", 5th Edition, Prentice Hall, 2007.
4. Miguel Grinberg , "Flask Web Development", First edition-2014.

Suggested Reading:

1. Web Technologies, Uttam K Roy, Oxford University Press
2. Chris Bates, "Web Programming, building internet applications", 2nd edition, John Wiley & Sons, 2010.
3. JavaScript for Modern Web Development: Building a Web Application Using HTML, CSS, and JavaScript, by Alok Ranjan, Abhilasha Sinha, Ranjit Battwad, BPB, 2020.

e-Resources:

1. https://www.w3.org/standards/webdesign
2. https://www.w3schools.com/angular
3. https://www.w3schools.com/jquery/default.asp
4. https://www.tutorialspoint.com/flask/index.htm
5. https://www.tutorialspoint.com/web2py/index.htm
6. https://www.tutorialspoint.com/fuelphp/index.htm

22ITO01

OBJECT ORIENTED PROGRAMMING USING JAVA

(Open Elective – I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aims to:

1. To familiarize with fundamentals of object-oriented programming paradigm.
2. To impart the knowledge of string handling, interfaces, packages and inner classes.
3. To acquaint with Exception handling mechanisms and Multithreading.
4. To gain knowledge on collection framework, stream classes.
5. To familiarize web application environment using Servlets and JSP.

Course Outcomes:

Upon completing this course, students will be able to:

1. To understand fundamentals of object-oriented programming paradigm.
2. To apply knowledge of string handling, interfaces, packages and inner classes.
3. To implement Exception handling mechanisms and Multithreading.
4. To demonstrate knowledge on collection framework, stream classes.
5. To develop web applications using Servlets and JSP.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	2	1	-	-	-	-	-	-	1	-	-	1	1	1
CO 2	-	2	1	1	-	-	-	-	-	-	-	-	1	2	1
CO 3	-	1	1	1	-	-	-	-	-	-	3	-	1	2	1
CO 4	1	2	1	1	-	-	-	-	-	-	3	1	1	1	2
CO 5	1	2	1	2	3	-	-	1	3	-	3	1	1	1	3

UNIT-I

OOP concepts: Data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism, classes and objects, Procedural and object oriented programming paradigms.

Introduction to Java: Java's Magic: The Byte code, The Java Buzzwords, Simple Java Programs, Java Primitive Types, Arrays: How to create and define arrays, Basic Operators, Control statements.

Introducing Classes: Declaring objects, methods, Constructors, this keyword, Method Overloading and Constructor Overloading, Objects as parameters, Returning objects, Use of static and final keywords.

UNIT-II

Inheritance: super and subclasses, Member access rules ,super keyword**,** Method overriding, Dynamic method dispatch , Abstract classes, using final with inheritance , Introduction to Object class.

Packages: Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages.

Interfaces: Defining and implementing interfaces, Nested Interfaces. **Strings Handling:** String & StringBuffer classes, StringTokenizer class and Wrapper classes and conversion between Objects and primitives.

Inner classes in Java: Types of inner classes, Creating static / non-static inner classes, Local and anonymous inner classes.

UNIT-III

Exception Handling in Java: what are Exceptions? Exception types**,** Usage of try, catch, throw, throws and finally clauses, writing your own exception classes. **Multi-threading in Java:** The java Thread Model, How to create threads, Thread class in java, Thread priorities, Thread synchronization.

Generics: What are Generics? Generic classes, bounded types, Generic methods and interfaces.

UNIT-IV

Collections Framework: Overview of Collection Framework, Commonly used Collection classes – Array List, Linked List, Hash Set, LinkedHashSet, Tree Set, Collection Interfaces –Collection, List, Set, Sorted Set, Accessing a collection via an Iteration, Storing user-defined classes in collections, Map Interfaces and

Classes, Using a comparator. Legacy classes – Vector, Hash table, The Enumeration interface.

Input/Output : How to read user input (from keyboard) using scanner class,Stream classes, InputStream, OutputStream, FileInputStream, FileOutputStream, Reader and Writer, FileReader, FileWriter classes. File class.

UNIT-V

Java Servlets: Overview of Java Servlet API, Servlet Implementation, Servlet Configuration, Servlet Exceptions, Servlet Life cycle, Request and Response methods, Approaches to Session tracking, Servlet Context, Servlet Collaboration.

JSP Basics: Introduction to JSP, Directives, Scripting Elements, Standard Actions.

Databases: Connect servlet to MySQL, Connect JSP to MySQL.

Text Books:

1. Herbert Schildt, "Java: The Complete Reference", 8th Edition, Tata McGraw Hill Publications, 2011.
2. Kathy Sierra, Bryan Basham, Bert Bates, ―Head First Servlets and JSP‖, 2nd Edition, O'Reilly Media, Inc, 2008.

Suggested Reading:

1. E Balagurusamy "Programming with JAVA", 6th Edition, Tata McGraw-Hill Publishing company Ltd,2019.
2. Sachin Malhotra & Saurabh Choudhary, "Programming in Java", 2nd Edition, Oxford University Press, 2014.
3. C. Thomas Wu, "An introduction to Object-oriented programming with Java", 4th Edition, Tata McGraw-Hill Publishing company Ltd., 2010. 4. Kathy Sierra, Bert Bates, "Head First Java: A Brain-Friendly Guide"2nd Edition, O'Reilly,2005

e-Resources:

1. https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html.
2. http://nptel.ac.in/courses/106106147/
3. https://ocw.mit.edu/courses/electrical-engineering-and-computerscience/6-092- introduction-to-programming-in-java-january-iap-2010/lecture-notes/

22ECC19

ANALOG AND DIGITAL COMMUNICATION LAB

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Knowledge on fundamentals of signals and systems and probability theory is required.

Course Objectives:
This course aims to:
1. Conduct experiments on various continuous wave modulations.
2. Generate and detect various pulse analog and pulse digital modulation schemes.
3. Carry out experiments on various digital carrier modulation techniques..

Course Outcomes:
Upon completion of this course, students will be able to:
1. Demonstrate the generation and detection of various analog and digital modulated signals.
2. Illustrate the sampling concept and interpret the generation and detection of various pulse analog and digital modulated signals.
3. Obtain and analyze frequency response of Pre-Emphasis and De-Emphasis circuits.
4. Assess different line coding techniques.
5. Evaluate various digital carrier modulation techniques experimentally.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	3	2	3	3	1	1	2	1	2	3	3	1
CO 2	3	3	3	3	2	3	2	1	1	2	1	2	3	3	2
CO 3	3	3	3	3	2	3	3	2	1	2	1	3	3	3	2
CO 4	3	3	3	3	1	3	3	2	1	2	1	3	3	3	2
CO 5	3	3	3	3	1	3	3	2	1	2	1	3	3	3	2

List of Experiments:
1. AM signals generation and detection.
2. Generation of DSB-SC using Balanced modulator.
3. FM generation and detection.
4. Sampling of continuous time signal and its Reconstruction (PAM).
5. PWM Modulation and Demodulation.
6. PPM Modulation and Demodulation.
7. Data formats / Line coding techniques.
8. PCM generation and detection.
9. Linear Delta Modulation and demodulation.
10. Adaptive Delta Modulation and demodulation
11. ASK generation and detection.
12. FSK generation and detection.
13. BPSK generation and detection.
14. QPSK generation and detection.

15. **Structured Enquiry:**
    - Design Armstrong FM transmitter for the given specifications.
    - Design and develop an N-bit PCM encoder for the specified input signals.
16. **Open-ended Enquiry:**
    - Simulate various analog, pulse analog, pulse digital and digital carrier modulation schemes and assess their performance.
    - Design different Line coding schemes using logic Gates.

Wherever possible some experiments may be simulated using simulations software.

Suggested reading:

1. A.M. Zungeru, J.M. Chuma, M. Mangwala, L.K. Ketshabetswe, "Handbook of Laboratory Experiments in Electronics and Communication Engineering", Vol. 2, 1st Edition, Notion press, 2017.

22ECC20

DIGITAL SIGNAL PROCESSING LAB

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: The knowledge of basics of signals, systems, linear algebra and calculus is required.

Course Objectives:

This course aims to:

1. Simulation of DFT, FFT, Digital filters and multirate concepts using MATLAB.
2. Understand spectral analysis of noisy signals using MATLAB.
3. Implementation of digital filters on DSP Processor.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Illustrate linear convolution and correlation using MATLAB.
2. Design the digital filters using MATLAB.
3. Examine the performance of multirate techniques using MATLAB.
4. Experiment with decimator and interpolator on DSP processor.
5. Implement the digital filters on DSP processor.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	1	2	2	1	1	1	1	2	1	1	3	1	1
CO 2	2	3	2	2	2	1	1	1	1	2	1	1	3	2	2
CO 3	2	2	1	2	2	1	1	1	1	2	1	1	3	2	1
CO 4	2	2	1	2	2	1	1	1	1	2	1	1	3	2	1
CO 5	2	3	2	2	2	1	1	1	1	2	1	1	3	3	2

List of Experiments

(A) Experiments on signal processing using MATLAB.

1. Basics of Matrix Operations.
2. Generation of Analog and Discrete signals.
3. Linear Convolution, Circular Convolution and Correlation of sequences.
4. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) of a sequence.
5. FIR filter Design using different windows
6. IIR filter Design: Butter worth, Chebyshev type 1 and 2: LPF, HPF, BPF & BSF.
7. Spectral Analysis of noisy signal using Welch's method
8. Interpolation and Decimation.
9. Multistage filter Designing.
10. Design of Filter using Filter designer tool using MATLAB
    a. Design FIR filter for the specification of structured enquiry. Generate Matlab code/ HDL code / Embedded C code for DSP processor to validate the result.
    b. Design IIR filter for the specification of structured enquiry. Generate Matlab code/ HDL code / Embedded C code for DSP processor to validate the result.
11. Write a program for speech enhancement using spectral subtraction algorithm.
12. Design a filter to remove salt & pepper noise in digital images.

(B) Experiments on DSK and CCS

1. Study of procedure to work in real – time.
2. Generation of Sinusoidal signal.
3. Solutions of difference equations.
4. Linear Convolution.
5. Implementation of FIR filter.
6. Implementation of second order IIR filters.
7. Decimation and Interpolation.
8. Dual Tone Multi Frequency (DTMF).

Structured enquiry: Design the best IIR band pass filter to meet the given specifications:

Pass band cut off frequencies: [500 600] Hz
Stop band cut off frequencies: [525 675] Hz
Pass band ripple: ≤ 2dB
Stop band attenuation: ≥ 60dB

Open-ended enquiry: Design a three stage multirate filter to meet the given specifications:
Pass band cut off frequency: 450 Hz
Stop band cut off frequency: 500 Hz
Pass band ripple: ≤ 3dB
Stop band attenuation: ≥ 40dB
Sampling frequency: 40 KHz
Compare with single stage filter.

Note:

1. A minimum of 10 experiments is mandatory.
2. For Part "A", MATLAB with different toolboxes like Signal Processing, Signal Processing block set, and SIMULINK/ MATHEMATICA/ any popular software can be used.

Suggested Reading:

1. Vinay K. Ingle and John G. Proakis, "Digital Signal Processing using MATLAB", 4/e, Cengage learning, 2011.
2. B. Venkataramani and M. Bhaskar, "Digital Signal Processor architecture, programming and application", 6/e, TMH, 2006.

22ECC21

LINEAR AND DIGITAL INTEGRATED CIRCUITS LAB

Instruction	2 P Hours per Week
Duration of SEE	3Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Knowledge of Analog electronic circuits.

Course Objectives:

This course aims to:

1. Know and verify the concepts of 741 Op-Amp, IC555 timer, IC723 and data converters.
2. Know the various characteristics of TTL and CMOS gates and implement the circuits with Digital ICs.
3. Contrast the differences between linear and digital ICs.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Analyze the configurations, parameters of IC741.
2. Demonstrate the circuits of Op-Amp for various applications.
3. Design the circuits using IC555 timer, IC723 and data converters.
4. Determine the characteristics of TTL and CMOS gates.
5. Develop various combinational circuits and sequential circuits using digital ICs.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	3	1	1	1	1	1	2	2	1	2	2	2	1
CO 2	2	3	3	3	1	1	1	1	2	2	1	2	3	3	1
CO 3	2	3	3	3	1	1	1	1	2	2	1	2	3	3	1
CO 4	2	2	2	1	1	1	1	1	2	2	1	2	2	2	1
CO 5	2	3	3	3	1	1	1	1	2	2	1	2	3	3	1

Lab Experiments

Part-A: Linear IC Experiments

1. Implement Voltage Follower, Inverting and Non-Inverting Amplifiers using Op-Amp.
2. Measurement of Op-Amp parameters.
3. Implement Arithmetic Circuits using Op-Amp.
4. Implement Waveform generation using Op-Amp.
5. Implement Astable and Monostable multivibrators using IC555Timer.
6. Implement Low and High Voltage Regulators using IC723.
7. Implement D to A Converter using R-2R ladder.
8. Implement A to D Converter.

Part-B: Digital IC Experiments

1. Measurement of various characteristic parameters of TTL and CMOS gates.
2. Implement Logic function using Decoders.
3. Implement Logic function using Multiplexers.

4. Implement Binary adder and subtractor, BCD adder using ICs.
5. Design of Synchronous, Asynchronous up/down counters.
6. Implement Shift registers and ring counter using ICs.
7. Implement the Interfacing counters with 7-segment LED display units.

Structured enquiry: Implement a Security Monitoring System (Use only nonprogrammable ICs.)

Open ended enquiry: Design a Digital Clock structure to display minutes and seconds. (Use only non-programmable ICs.)

Suggested Reading:

1. National Semiconductor Corporation, “Linear applications”, Data book, 1986.
2. National Semiconductor Corporation, “Logic data book-Vol-II”, 1984.

22ECI02

INDUSTRIAL / RURAL INTERNSHIP

Instruction/Demonstration/Training	3-4 Weeks / 90 Hours
Duration of SEE	-
SEE	-
CIE	50 Marks
Credits	2

Prerequisite: Knowledge of Basic Sciences and Engineering Sciences / Knowledge about rural environment.

Course Objectives:

This course aims to:

1. Exposing the students to the industrial environment/ rural environment.
2. Create awareness with the current industrial technological developments relevant to program domain.
3. Provide opportunity to understand the social, economic and administrative considerations in organizations/rural areas.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand Engineer's responsibilities and ethics.
2. Use various materials, processes, products and quality control.
3. Provide innovative solutions to solve real world problems.
4. Acquire knowledge in technical reports writing and presentation.
5. Apply technical knowledge to real world industrial/rural situations.

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Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	3	3	1	3	1	3	3	1	1	3
CO 2	1	1	1	3	3	1	2	1	1	1	1	1	3	3	1
CO 3	2	3	3	3	3	2	3	1	1	1	1	1	3	3	1
CO 4	1	1	1	1	1	3	1	1	3	3	1	1	1	1	3
CO 5	1	3	3	3	3	2	3	1	1	1	1	1	3	3	3

For implementation procedures and letter formats, annexures I and III of Internship document may be referred.

Evaluation of Internship: The internship of the students will be evaluated in three stages:

d) Evaluation by the Industry/Academic Supervisor (in the scale of 1 to 10 where 1-Unsatisfactory; 10-Excellent).
e) Evaluation by faculty Mentor on the basis of site visit(s) or periodic communication (15 marks).
f) Evaluation through seminar presentation/Viva-Voce at the Institute by the constituted committee (25 marks).

Evaluation through Seminar presentation / Viva-Voce at the institute: Students shall give a seminar before an E*xpert Committee* constituted by college (Director, HoD / Senior faculty, mentor and faculty expert from the same department) based on his/her internship carried out.

The evaluation will be based on the following criteria:

- Quality of content presented.
- Proper planning for presentation.
- Effectiveness of presentation.
- Depth of knowledge and skills.
- Attendance record, daily diary, departmental reports shall be analyzed along with the internship Report

Monitoring/ Surprise Visits: During the internship, the faculty mentor makes a surprise visit to the industry, to check the student's presence physically. If the student is found to be absent without prior intimation to the concerned industry, entire internship may be canceled. Students should inform through email to the faculty mentor as well as the industry supervisor at least one day prior to avail leave.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

AICTE Model Curriculum with effect from AY 2026-27

BE (Electronics and Communication Engineering)

SEMESTER – VI

S.no	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	22ECC22	Microcontrollers	3	-	-	3	40	60	3
2	22ECC23	Microwave Engineering and Mobile Communication	3	-	-	3	40	60	3
3	22ECC24	VLSI Design	3	-	-	3	40	60	3
4		Professional Elective-III	3	-	-	3	40	60	3
5		Professional Elective-IV	3	-	-	3	40	60	3
6		Open Elective-II	3	-	-	3	40	60	3
PRACTICALS									
7	22ECC25	Microcontrollers Lab	-	-	2	3	50	50	1
8	22ECC26	Microwave Engineering and Mobile Communication Lab	-	-	2	3	50	50	1
9	22ECC27	Electronic Design and Automation Lab	-	-	2	3	50	50	1
10	22ECC28	Mini Project	-	-	2	-	50	-	1
11	22ECU02	Up-skill Certification Course- II	-				25	-	0.5
Total			**18**	**-**	**8**	**27**	**465**	**510**	**22.5**
Clock Hours Per Week: 26									

L: Lecture **D: Drawing** **CIE: Continuous Internal Evaluation**

T: Tutorial **P: Practical/Project Seminar/Dissertation** **SEE: Semester End Examination**

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

AICTE Model Curriculum with effect from AY 2026-27

BE (Electronics and Communication Engineering)

SEMESTER – VI

S. no	List of Courses in Professional Elective-III		List of Courses in Professional Elective-IV	
	Course code	Title of the Course	Course code	Title of the Course
1	22ECE13	CMOS Data Converters	22ECE19	CPLD and FPGA Architectures
2	22ECE14	Coding Theory and Techniques	22ECE20	Radar and Satellite Communication
3	22ECE15	Adaptive Signal Processing	22ECE21	Image and Video Processing
4	22ECE16	Real Time Operating Systems	22ECE22	Embedded Systems
5	22ECE17	Smart Antennas	22ECE23	Green Communication
6	22ECE18	Cryptography and BlockChain Technology	22ECE24	Data Analytics for Signal Processing

S. no	List of Courses in Open Elective-II	
	Course code	Title of the Course
1	22BTO01	Biology for Engineers
2	22MEO01	Principles of Design Thinking
3	22MTO01	Fundamentals of Quantum Computing
4	22CSO02	Introduction to Database Management Systems
5	22CIO04	Fundamentals of AR and VR
6	22ADO03	Free and Open - Source Softwares

22ECC22

MICROCONTROLLERS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge of Computer Architecture and Microprocessors.

Course Objectives:

This course aims to:

1. Understand architecture features of the microcontrollers
2. Learn the programming of the microcontrollers
3. Understand the interfacing of various modules with microcontrollers.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the architectures of different microcontrollers to enable to design applications using them.
2. Develop code both in assembly and in high level language for various applications of microcontrollers.
3. Analyze and develop applications by using on-chip peripherals of different microcontrollers.
4. Interface various I/O Modules with 8051 microcontrollers.
5. Apply theoretical learning to practical real time problems for automation.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	3	1	3	3	-	-	-	-	-	-	3	3	2
CO 2	3	3	3	2	3	3	-	-	-	-	-	-	3	3	2
CO 3	3	3	3	2	3	3	-	-	-	-	-	-	3	3	2
CO 4	2	2	3	2	3	2	-	-	-	-	-	-	3	3	2
CO 5	3	3	3	2	3	3	-	-	-	-	-	3	3	2	2

UNIT-I

8051 Microcontroller: Introduction to Microcontroller, Overview of 8051 family, Internal Architecture of 8051, PSW, Pin description, I/O Ports, Memory organization and expansion. Addressing modes and Bit addressable features.

8051 Instruction set: Data transfer, Arithmetic, Logical, Program branching and bit manipulation instructions.

UNIT-II

8051 Programming: Introduction to 8051 programming development tools, basic programming using instruction set, Introduction to 8051 C Programming, 8051 I/O Port Programming, 8051 Timer Programming in Assembly and C, 8051 Serial port Programming in Assembly and C, 8051 Interrupt Programming in Assembly and C.

UNIT-III

8051 Interfacing: Interfacing LED, Switches, Relay and Buzzer, Interfacing Analog to Digital Converter, Sensor Interfacing, Interfacing Digital to Analog Converter, LCD and Keyboard interfacing, Interfacing DC Motor and Stepper Motor – Direction and Speed Control.

UNIT-IV

ARM: Introduction to RISC Processors, ARM Design Philosophy, ARM Processor families, Architecture- Revisions, Registers, Program status register, Pipeline, Introduction to Exceptions.

ARM Instruction set: Data processing instructions, Branch instructions, Load-Store instructions, Software interrupt instruction, Program Status Register instructions, Loading constants, and Conditional executions. Introduction to THUMB instructions, Differences between Thumb and ARM modes - Register usage.

UNIT-V

ARM 7 Microcontroller (LPC2148)**:** Salient features of LPC 2148, Architectural Overview.

LPC2148 Peripherals: Description of General-purpose input/output (GPIO) ports, Pin control Block - Features, GPIO Programming, Operation of PLL, On-chip ADC and DAC. Brief overview on I2C, SPI and Embedded application using communication protocols.

Text Books:

1. Mazidi M.A, Mazidi JG & Rolin D. Mckinlay, “The 8051 Microcontroller & Embedded Systems using Assembly and C”, 2/e, Pearson Education, 2007.
2. Andrew N. Sloss, Domonic Symes, Chris Wright, “ARM System Developers Guide Designing and Optimizing system software”, 1/e, Elsever, 2004.

Suggested Reading:

1. Ayala K.J, “The 8051 Microcontroller Architecture, Programming and Applications”, Penram International, 2007.
2. Steve Furber, “ARM System on Chip Architecture”, 2/e, Pearson education, 2000.
3. Philips semiconductors, “ARM 7 (LPC 214x) user manual”, 2005.
4. Lyla B. Das, "Architecture, Programming and Interfacing of Low-power Processors-ARM 7, Cortex-M", CENGAGE, 2017.

e-Resources:

1. https://archive.nptel.ac.in/courses/108/105/108105102.
2. https://archive.nptel.ac.in/courses/106/105/106105193.

22ECC23

MICROWAVE ENGINEERING AND MOBILE COMMUNICATION

Instruction	3L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: A course on EM theory and Communications are required.

Course Objectives:

This course aims to:

1. To understand the waveguide concepts and microwave sources.
2. To familiarize the concepts related to cellular communication and its capacity.
3. To expose different Mobile communication standards.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the concepts of waveguide and microwave sources.
2. Relate the cellular concepts like frequency reuse, hand off, coverage and capacity.
3. Analyze the mobile radio propagation with large scale and small scale fading.
4. Select the suitable diversity and equalization technique to combat the multipath fading effects.
5. Compare the mobile radio networks and standards.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	2	2	1	2	1	1	1	1	1	3	2	2
CO 2	3	2	3	3	2	1	1	1	1	1	1	1	3	2	2
CO 3	2	2	2	2	3	1	2	1	1	1	1	1	3	2	2
CO 4	2	2	2	3	2	2	1	1	1	2	1	2	3	2	2
CO 5	1	1	2	3	2	2	1	1	1	1	1	1	3	2	2

Unit-I

Microwave Cavities: Concepts of circular wave guides, Rectangular and circular cavity resonators, wave impedance.

Microwave Circuits and Components: Concept of microwave hybrid circuit, Introduction to scattering parameters. Properties and S-parameters of reciprocal components – E and H Plane Tees, Magic Tee, Directional Coupler.

Non Reciprocal Components: Ferrites – Composition and Faraday Rotation; Ferrite Components – Isolators, Gyrators and Circulators. S- Parameters of Isolator and Circulator.

Unit-II

Microwave Tubes: Limitations of Conventional Tubes at Microwave Frequencies. Principles of Gunn Diode.

O-type tubes: Two cavity klystron, velocity modulation process, bunching process. Output power and efficiency. Reflex Klystron operation, Power out and efficiency.

M-type tubes: Magnetron, π mode of operation, pushing and pulling effect.

TWT: Slow wave structure, principle and operation of TWT (Qualitative treatment only).

UNIT–III

Cellular Concepts: Frequency reuse, Channel Assignment strategies, Hand off strategies. Interference and System capacity, improving coverage and capacity in cellular systems. FDMA, TDMA, CDMA, OFDM, SDMA, Comparison of Multiple Access Techniques.

UNIT–IV

Mobile Radio Propagation: Large Scale Fading - Free space propagation model, Three basic propagation mechanisms, Reflection, Ground Reflection(Two-Ray)Model, Diffraction, Scattering, Practical link budget using path loss models. Small Scale Fading : Multipath Propagation, Types of small scale fading, Parameters of Mobile Multipath channels, Fading effects due to multipath time delay Spread and Doppler spread.

UNIT–V

Diversity Techniques and Equalization: Diversity – Types of diversity – Diversity combining techniques: Selection, Feedback, Maximal Ratio Combining and Equal Gain Combining – Rake receiver. Equalization and types.

Mobile Radio standards: 2G GSM system overview: GSM system architecture, Frame structure for GSM, 2.5G – GPRS and EDGE- features, need for 3G and 4G technologies, Introduction to 3G and 4G LTE, E-UMTS RAN.

Text Books:

1. Theodore S. Rappaport - Wireless Communications Principles and Practice, 2nd Edition, Pearson Education, 2003.
2. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, First Edition, 2005.

Suggested Reading:

1. W.C.Y. Lee - Mobile Cellular Communications, 2nd Edition, MC Graw Hill, 1995.
2. Modern Wireless Communications-Simon Haykin, Michael Moher, Pearson Education, 2005.
3. Wireless Communications and Networking, Vijay Garg, Elsevier Publications, 2007.
4. Andreas F.Molisch - Wireless Communications John Wiley, 2nd Edition, 2006.

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc24_ee82/preview.

22ECC24

VLSI DESIGN

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Prior knowledge of Verilog HDL and MOS Transistor Theory.

Course Objectives: This course aims to:

1. Study the concepts of Verilog HDL, simulation and synthesis process/concepts.
2. Learn the various characteristics of MOS transistor, process steps in IC fabrication.
3. Learn the various concepts required to obtain the digital logic layout diagrams. To know various subsystem design concepts.

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

1. Model a digital design using Advanced Verilog HDL constructs.
2. Analyze the characteristic behavior of MOSFET and discuss CMOS circuit Design Process
3. Explain various process steps involved in IC fabrication.
4. Design various NMOS and CMOS based logic circuits.
5. Discuss the concepts of subsystem designs and Testing.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	2	1	1	1	1	1	2	1	1	1	2	3	1	1
CO 2	2	3	1	3	1	1	1	2	1	1	1	2	3	2	1
CO 3	1	1	1	1	1	1	1	2	1	1	1	2	3	1	1
CO 4	1	3	1	2	1	1	1	2	1	1	1	2	3	3	1
CO 5	1	1	1	1	1	1	1	2	1	1	1	2	3	1	1

UNIT-I

Advanced Verilog HDL: Review of behavioral modelling**.** Functions and tasks. Switch level Modelling, User Define Primitives (UDP), Design of Mealy and Moore state models using Verilog, Logic Synthesis, RTL to GDS flow, Synthesis Design flow, Gate level Netlist.

UNIT–II

IC fabrication Steps: Process steps in IC fabrication. Crystal growth and wafer preparation - Czochralski process – apparatus silicon shaping, slicing and polishing- Diffusion, Ion implantation - Annealing process - Oxidation process - Lithography - Photolithography, electron beam and x-ray lithography - Chemical Vapour Deposition (CVD) - epitaxial growth-reactors-metallization and packaging.

UNIT–III

MOS and CMOS Circuits and Design Process: Introduction to MOS Technology, Basic MOS Transistor action: Enhancement and Depletion Modes. Basic electrical properties of MOS, Threshold voltage and Body Effect. Design of MOS inverters with different loads. Basic Logic Gates with CMOS: INVERTER, NAND, NOR, AOI and OAI gates. Scaling of Technology, MOS Layers, Stick diagrams, Lambda based Design rules and Layout diagrams.

UNIT–IV

Designing of CMOS Circuits: Sub system design Principles, Dynamic logic, BiCMOS inverer, pass transistors, Latch-up in CMOS Circuits, Domino logic, Transmission gate logic circuits, Multiplexer and D flip flop using Transmission gates. Design of complex circuits using AOI and OAI.

UNIT–V

Sub systems Design and Testing:

Memories: 1T, 3T Dynamic RAM Cell, 6T Static RAM Cell. NOR and NAND based ROM Memory Design. Introduction to CPLD and FPGA.

Testing: Introduction to Testing, Fault models (stuck - at 1 and stuck - at 0). Path sensitization and D-Algorithm, Controllability, Observability. Introduction to SoC and ASIC design.

Text Books:

1. Samir Palnitkar,"Verilog HDL:A guide to Digital design and synthesis", 2/e, Pearson Education, 2008.
2. Kamran Eshraghian, Douglas A. Pucknell, Sholeh Eshraghian, "Essentials of VLSI circuits and systems", PHI, 2011.
3. Neil HEWeste, David Harris, Ayan Banerjee, "CMOS VLSI Design–A circuit and System Perspective", 3/e, Pearson Education,2006.
4. Parag K Lal, " Fault Tolerant and Fault Testable Hardware Design " , BS Publications, 2020
5. S.M. Sze, VLSI Technology,McGraw-Hill, 2nd Edition, 1988.

Suggested Reading:

1. Michael D. Ciletti, "Advanced Digital Design with Verilog HDL", PHI, 2005.
2. John P. Uyemura, "Introduction to VLSI Circuits and systems", John Wiley & Sons, 2011.
3. Sung-Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits Analysis and Design, McGraw-Hill, 1998.

e-Resources:

1. https://nptel.ac.in/courses/108107129.

22ECE13

CMOS DATA CONVERTERS

(Professional Elective-III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: A prior knowledge of Analog IC Design and Digital System Design.

Course Objectives:

This course aims to:

1. Familiarization of OP-AMP based circuits.
2. To understand performance measures of Data converters.
3. To study different types of data converter circuits.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand Op-Amp based data converter designs.
2. Explain various performance measures of Data converters.
3. Design and analyze mixed mode circuits such as Comparator, switched capacitor and sample & hold circuits.
4. Design and analyze an A/D or D/A converter circuits.
5. Apply principles of oversampling.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	2	1	1	1	1	1	2	1	1	1	2	3	1	1
CO 2	2	3	1	3	1	1	1	2	1	1	1	2	3	2	1
CO 3	1	1	3	1	1	1	1	2	1	1	1	2	3	1	1
CO 4	1	3	3	2	1	1	1	2	1	1	1	2	3	3	1
CO 5	1	1	1	1	2	1	1	2	1	1	1	2	3	1	1

UNIT I

OP-Amp: OP-Amp as comparator, Charge injection error, switched capacitor basic operation and analysis, first order filter, switched capacitor gain circuits, Sample and hold circuit-its performance.

UNIT II

Data converter : Introduction, Ideal data converter, Quantization, Static performance, Dynamic performance, frequency domain measures.

UNIT III

Nyquist rated DAC: Decoder based converter-Resistor string converters, folded resistor string converters. Binary scaled converter- Binary weighted converter, current-mode converter. Thermometer coded converter, Resistor capacitor hybrid converter, Segmented converters.

UNIT IV

Nyquist rate ADC: Successive approximation converter, Algorithmic ADC, Flash converter, Two-step ADC, Interpolation ADC, Folding ADC, Piplied ADC,Time interleaved adc.

UNIT V

Oversampled Converter: Oversampling with and without noise shaping, system architecture of Delta- Sigma ADC, system architecture of Delta- Sigma DAC, Digital decimation filter, band pass over sampling converter.

Text Books:

1. D.A John & Ken Martin, "Analog Integrated Circuit Design". John Wiley Publications, Reprint 2011.
2. BehzadRazavi, "Design of Analog CMOS Integrated Circuits", Tata-McGraw Hill Publications, 2002.

Suggested Book:

1. Philip E. Allen & Douglas R. Holberg, "CMOS Analog Circuit Design", Oxford University Press, 2002.

e-Resources:

1. https://nptel.ac.in/courses/117106034.

22ECE14

CODING THEORY AND TECHNIQUES

(Professional Elective-III)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge of matrices and digital communication.

Course Objectives:

This course aims to:

1. Implementation of channel coding techniques in digital communications.
2. Know basic notions of error control coding and fundamentals of abstract algebra, finite fields and its extension.
3. Understand the mathematical structure and algorithms for RS and BCH codes.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Recall the theory and principles of information theory and channel Coding.
2. Design and analyze the encoding and decoding circuits for various coding techniques.
3. Apply the principles of abstract algebra, finite fields and its extension to design related codes.
4. Examine the error detection and correction capability of coding techniques for digital communication.
5. Evaluate the performance of error control codes using different decoding algorithms.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	1	1	1	1	1	1	1	1	1	1	3	1	1
CO 2	2	3	1	1	1	1	1	1	1	1	1	1	3	3	1
CO 3	2	3	1	1	1	1	1	1	1	1	1	1	3	3	1
CO 4	2	3	1	1	1	1	1	1	1	1	1	1	3	1	1
CO 5	2	3	1	1	1	1	1	1	1	1	1	1	3	1	1

UNIT-I

Linear Block Codes: Introduction, generator and parity-check matrices, encoding, Syndrome decoding, Maximum Likelihood (ML) decoding-hard decision decoding and soft decision decoding.

Binary Cyclic Codes: Description, encoding, Syndrome computation and error detection, Encoder and Syndrome generator implementations, Introduction to LDPC Codes.

UNIT-II

Galois Fields: Fields, Binary arithmetic, Basic properties of Galois Fields, polynomials over GF (2), Construction of Galois Fields GF(2^m) from GF(2), properties of extension fields, conjugates, Minimal polynomials, Factorization of (X^n+1) over a finite field.

UNIT-III

BCH Codes: Introduction, general description of BCH codes, Encoding, Decoding – Berlekamp's algorithm, a Fast Berlekamp-Massey algorithm.

UNIT-IV

RS Codes: Introduction, general description of Reed-Solomon codes, encoding, decoding of Reed- Solomon codes using Berlekamp-Massey algorithm.

UNIT V

Convolution Codes: Introduction, Encoding, State diagram, Code Tree, Code Trellis diagram, Decoding - Maximum Likelihood (ML) Viterbi decoding - soft decision and hard decision decoding. Introduction to turbo code.

Text books:

1. Shulin and Daniel J. Costello, Jr. "Error Control Coding," 2/e, Pearson, 2011.
2. L.H.Charles LEE "Error control block codes for Communication Engineers", Artech, 2000.

Suggested readings:

1. Simon Haykin, "Communication Systems", 4/e, Wiley, 2000.
2. K Sam Shanmugum, "Digital and Analog Communication Systems", Wiley, 2005.
3. K. Deergha Rao, "Channel coding techniques for wireless communication", spring, 2019.
4. Man Young Ree, "Error-Correcting Coding Theory", Mc-Graw-Hill, 1/e, 1989.
5. Ranjan Bose "Information Theory Coding and Cryptography", 3rd edition, MC-Graw Hill, 2016.
6. Todd K. Moon, "Error Correction Coding: Mathematical Methods and Algorithms", John Wiley & Sons, 2005.

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc24_ee95.

22ECE15

ADAPTIVE SIGNAL PROCESSING

(Professional Elective-III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: The student should have knowledge of Probability, Linear Algebra, and Digital Signal Processing.

Course Objectives:

This course aims to:

1. To understand the basics of the adaptive system.
2. To make familiar with gradient search algorithms and functions.
3. To introduce LMS & RLS algorithms.

Course Outcomes:

Upon completion of this course, students will be able to:

1. To understand the theory of different filters and algorithms.
2. To understand the theory of multi-rater DSP, solve numerical problems, and write algorithms.
3. To understand the theory of prediction and solution of normal equations.
4. To know applications of DSP at the block level.
5. To understand Kalman Filter theory.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	3	3	1	1	1	1	1	2	2	2	2	2
CO 2	3	3	3	3	3	1	1	1	1	1	2	2	3	3	3
CO 3	3	3	3	3	3	1	1	1	1	1	2	2	3	3	3
CO 4	3	3	3	3	3	1	1	1	1	1	2	2	3	3	3
CO 5	3	3	3	3	3	1	1	1	1	1	2	2	3	3	3

UNIT-I

Adaptive Filtering: Approaches to the development of adaptive filter theory. Introduction to filtering, smoothing and prediction. Wiener filter theory, introduction; Error performance surface; Normal equation; Principle of orthogonality; Minimum mean squared error.

UNIT-II

Gradient Descent: Gradient algorithms; Learning curves; LMS gradient algorithm; LMS stochastic gradient algorithms; convergence of LMS algorithms.

UNIT-III

Adaptive Filtering Applications: Applications of adaptive filter to adaptive noise canceling, Echo cancellation in telephone circuits and adaptive beamforming.

UNIT-IV

Adaptive Filtering Applications: Kalman Filter theory; Introduction; recursive minimum mean square estimation for scalar random variables; statement of the Kalman filtering problem: the innovations process; Estimation of state using the innovations process; Filtering examples.

UNIT-V

Kalman Filtering: Vector Kalman filter formulation. Examples. Application of Kalman filter to target tracking. Introduction to Extended Kalman Filter.

Text Books:

1. Sophocles, J. Orphanidies, "Optimum signal processing an introduction", McMillan,1985
2. Simon Haykins, "Adaptive signal processing", PHI, 1986.
3. Bernard Widrow, "Adaptive signal processing", PHI, 1986.

Suggested Reading:

1. Bozic, Svetozar Mile. Digital and Kalman filtering. Courier Dover Publications, 2018.
2. https://onlinecourses.nptel.ac.in/noc23_ee138/preview.

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc23_ee138/preview.

22ECE16

REAL TIME OPERATING SYSTEMS

(Professional Elective-III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: Prior knowledge of Computer Organization and Architecture is required.

Course Objectives:

This course aims to:

1. Learn about the fundamental need of Real Time operating systems.
2. Understand the concepts of different RTOS.
3. Study the Linux based target system design process.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the basics of operating system, its requirements and applications.
2. Identify the basic requirements, applications and issues of real time systems.
3. Analyze process management techniques of OS.
4. Use IPCs and Memory management for the development of RTOS applications..
5. Apply the VxWorks task functions for development of application.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	1	1	1	2	1	1	2	3	1	2	2	3	2
CO 2	3	3	2	2	2	2	1	1	1	3	1	2	2	2	2
CO 3	3	3	2	3	3	1	1	1	1	3	1	2	2	3	2
CO 4	3	3	3	2	3	1	1	1	1	2	2	2	2	2	2
CO 5	3	2	3	2	3	1	2	1	1	2	2	2	1	1	1

UNIT-I

Introduction: Introduction to Operating System: Computer Hardware Organization, BIOS and Boot Process, Multi-threading concepts, Processes, Threads, Scheduling

UNIT-II

Basics of Real-Time Concepts: Terminology: RTOS concepts and definitions, Differences between GPOS and RTOS, real-time design issues, examples, Hardware Considerations: logic states, CPU, memory, I/O, Architectures, RTOS building blocks, Real-Time Kernel

UNIT-III

Process Management: Concepts, scheduling, IPC, RPC, CPU Scheduling, scheduling criteria, scheduling algorithms Threads: Multi-threading models, threading issues, thread libraries, synchronization Mutex: creating, deleting, prioritizing mutex, mutex internals.

UNIT-IV

Inter-Process Communication: Messages, Buffers, mailboxes, queues, semaphores, deadlock, priority inversion, pipes.
Memory Management: Process stack management, run-time buffer size, swapping, overlays, block / page management, replacement algorithms, real-time garbage collection.

UNIT-V

Introduction to Vx Works: Salient Features, Multitasking, Task state transition, Task Control: Task Creation and Activation, Task Stack, Task Names and IDs, Task Options, Task Information, Task Deletion and Safety, Semaphore and message queues related functions.

Text Books:

1. 1. J. J Labrosse, "MicroC/OS-II: The Real –Time Kernel", Newnes, 2002. 2. Jane W. S. Liu, "Real-time systems", Prentice Hall, 2000.
2. William Stallings, "Operating Systems Internals and Design Principles," 7/e, Pearson Education, 2014

Suggested Reading:

1. W. Richard Stevens, "Advanced Programming in the UNIX® Environment", 2nd Edition, Pearson Education India, 2011. 2. Philips A. Laplante, "Real-Time System Design and Analysis", 3rd Edition, John Wley& Sons, 2004 3. Doug Abbott, "Linux for Embedded and Real-Time Applications", Newnes, 2nd Edition, 2011.
2. Wind River Systems Inc., "VxWorks Programmers Guide", 1997.
3. Rajib Mall, "Real Time Systems", Pearson Education, 2/e, 2007.

e-Resources:

1. https://nptel.ac.in/courses/106105214.
2. https://onlinecourses.nptel.ac.in/noc24_cs80/preview.

22ECE17

SMART ANTENNAS

(Professional Elective-III)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: The student must have undergone the courses on Antennas, Mobile Cellular Communications, and Digital Signal Processing.

Course Objectives:

This course aims to:

1. To learn the fundamentals of non-uniform and planar antenna arrays and MIMO antenna system.
2. To learn the different types of smart antenna configuration and their importance.
3. To compare the different types of the algorithm used for DOA estimation and beamforming.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the basic principles of Non-Uniform and Planar antenna arrays.
2. Comprehend the necessity of smart antenna and smart antenna configuration.
3. Understand the DOA estimation methods and compare different algorithms for DOA estimation.
4. Analyze various beamforming algorithms used in a smart antenna system.
5. Describe the fundamentals of the MIMO and RDA antenna systems.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	2	1	1	2	2	2	3	1	2	3	3	1
CO 2	3	2	2	1	1	2	2	2	3	3	1	2	3	3	3
CO 3	3	3	3	3	3	2	2	2	3	3	2	2	3	3	2
CO 4	3	3	3	3	3	2	2	2	3	3	2	2	3	3	2
CO 5	3	3	2	2	1	2	2	2	3	3	1	2	3	3	2

UNIT-I

Antenna Arrays:

Review of antenna Arrays – Non-Uniform Arrays, Binomial and Chebyshev distribution, Planar Arrays, Butler matrices, Qualitative Treatment of Phased Antenna Arrays.

UNIT-II

Smart Antennas:

Introduction, Space Division Multiple Access, Need for Smart Antenna systems, Advantages and Disadvantages of smart antennas. Smart Antenna Configurations: Analysis of Switched-Beam Antennas, Adaptive Antenna. Qualitative treatment of Smart Antenna Architecture.

UNIT-III

DOA Estimation:

The Array Response Vector, Received Signal Model, The Subspace-Based Data Model, Signal Auto-covariance Matrices Conventional DOA Estimation Methods: Conventional Beamforming Method and Capon's Minimum Variance Methods.

UNIT-IV

Beam Forming Techniques:

Introduction to Beam Forming, Classical Beam former. Statistically Optimum Beamforming Weight Vectors: The Maximum SNR Beam former, The Multiple Side lobe Canceller and the Maximum SINR Beam former, Qualitative Treatment of Least Mean-Square (LMS) and Recursive Least-Squares (RLS) Algorithm.

UNIT-V

MIMO and RDA:

Introduction to MIMO Antennas, Isolation, Envelope Correlation Coefficient, Total Active Reflection Coefficient. Retro directive Array Antenna (RDA): Van Atta Array and Phase Conjugating Array.

Text Books:

1. Balanis CA, Ioannides PI, "Introduction to Smart Antennas", Morgan & Claypool Publishers; 2007.
2. Gross F, "Smart antennas for wireless communications", McGraw-Hill Professional, 2005.
3. Luo Q, Gao SS, Liu W, Gu C. "Low-cost smart antennas", John Wiley & Sons; 2019.

Suggested Reading:

1. Godara LC, "Smart antennas" CRC press; 2004.

e-Resources:

1. https://nptel.ac.in/courses/117107035.

22ECE18

CRYPTOGRAPHY AND BLOCKCHAIN TECHNOLOGY

(Professional Elective-III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Data Structures and Algorithms, Introduction to Programming.

Course Objectives:

This course aims to:

1. Provide conceptual understanding of basic concepts of cryptography.
2. Describes the Blockchain technology and its applications.
3. Introduce cryptocurrency transactions using Blockchain technology.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Comprehend the key concepts of fundamental cryptography techniques which are required for Blockchain Technology.
2. Describe the key concepts and compare various models of Blockchain Technology.
3. Understand consensus mechanism in Blockchain and acquire knowledge regarding Bitcoin cryptocurrency transactions and their validation.
4. Analyze the concepts and technologies for Ethereum and Hyperledger blockchains.
5. Apply the concepts of Blockchain technology in real world scenario.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	3	1	1	1	2	1	2	1	2	1	3	3	3	3
CO 2	2	2	1	1	2	2	1	2	1	2	1	3	3	2	2
CO 3	1	1	1	1	2	3	1	2	1	2	1	3	2	2	2
CO 4	1	1	2	1	2	3	1	2	1	2	1	3	2	2	3
CO 5	1	2	2	2	2	3	3	2	1	2	3	3	3	3	3

UNIT-I

Overview of Cryptography: Introduction to Cryptography, History and development of cryptography, Cryptanalysis, Private Key Cryptography: Classical cryptosystems: shift, substitution and Vigenere ciphers; Attacks on shift, substitution and Vigenere ciphers, designing a provably secure system: One -Time pads. Introduction to DES, AES Cryptosystems.

Public Key Cryptography: RSA Algorithm, Elliptical Curve Cryptography.

UNIT-II

Introduction to client-server architecture, distributed computing and decentralized systems.

Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature. A basic Cryptocurrency and example.

Introduction to Blockchain Technology: Evolution of Blockchain and how it is changing the landscape of digitalization, Block in a Blockchain, Working principles of blockchain technology. Types of Blockchain: Public, Private and Consortium, Public Ledgers, Transactions in blockchain, Mining Mechanism, Consensus.

UNIT-III

Introduction to digital wallet and types of wallets: Paper, Desktop, mobile and Meta mask/Browser based wallets.

Introduction to Bitcoin Blockchain: Working with Consensus in Bitcoin: The Byzantine Generals Problem, Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW), Hashcash PoW, Bitcoin PoW, Attacks on PoW and the monopoly problem. Proof of Stake, Proof of Burn and Proof of Elapsed Time, Bitcoin Transaction, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.

UNIT-IV

Introduction to Ethereum: Bitcoin versus Ethereum, Ethereum and Smart Contracts, Ethereum stack, Turing Completeness of Smart Contract Languages and verifications, using smart contracts to enforce legal contracts, Ethereum transactions and accounts, Ethereum Virtual Machine (EVM), Decentralized Apps (DApps), The cryptocurrency Ether, Concept of Gas in Ethereum. Introduction to Hyperledger, Modular architecture of Hyperledger, Introduction to Truffle.

UNIT-V

Applications: Blockchain Applications in Healthcare, Finance and banking, Real estate, Retail, Supply chain and logistics, Insurance, Voting and governance. Blockchain Technologies for IoT, Supply Chain Management in Agriculture using Blockchain and IoT.

Text Books:

1. Paar Christof, Pelzl Jan, "Understanding Cryptography A Textbook for Students and Practitioners", Springer, 2010.
2. Joseph J. Bambara, Paul R. Allen, “Blockchain A Practical Guide to Developing Business, Law, and Technology Solutions”, 1st Edition, Mc. Graw Hill, 2018.
3. Daniel Drescher, “Block Chain Basics”, Apress; 1st Edition, 2017.
4. Shiho Kim, Ganesh Chandra Deka, "Advanced Applications of Blockchain Technology", Springer, 2020.

Suggested Reading:

1. Imran Bashir, “Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Packt Publishing, 2018.
2. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and Block Chain”, Packt Publishing, 2018.

e-Resources:

1. https://nptel.ac.in/courses/106105235.
2. https://nptel.ac.in/courses/106105162.

22ECE19

CPLD AND FPGA ARCHITECTURES

(Professional Elective-IV)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Digital logic design and digital integrated circuits.

Course Objectives:

This course aims to:

1. Study various PLD, CPLDs and FPGA Architectures and its features.
2. Understand the different programming technologies, placement and routing.
3. Study the design tools for FPGA and ASICs.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Explain the concepts of PLDs, CPLDs and FPGAs.
2. Analyze and compare the various architectures of CPLD and FPGA and its programming technologies.
3. Implement various logic functions on PLDs, CPLDs and FPGAs.
4. Understand the concepts of placement and routing and classifying ASICs.
5. Demonstrate VLSI tool flow for CPLDs and FPGAs.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	2	1	1	1	1	1	2	1	1	1	2	3	3	1
CO 2	2	3	1	3	2	1	1	2	1	1	1	2	3	3	1
CO 3	1	2	1	1	-	1	1	2	1	1	1	2	3	3	1
CO 4	2	3	1	3	2	1	1	2	1	1	1	2	3	3	1
CO 5	1	3	1	2	2	1	1	2	1	1	1	2	3	3	1

UNIT-I

Review of Logic Design: Implementation of logic functions with multiplexers.

Programmable Logic Devices: Architectures of PROM, PLA and PAL. Implementation of MSI circuits using Programmable Logic Devices.

UNIT-II

Complex Programmable Logic Devices: Introduction to CPLD Architecture of CPLD. Logic Block, I/O Block, Interconnect matrix, and features of Altera max 7000 series, AMD Mach 4 and Xilinx XC-9500 CPLD.

UNIT-III

Xilinx FPGAs: Introduction to FPGA, FPGA Programming Technologies. Architecture, Logic Blocks, I/O Block, Routing Architecture and features of Xilinx XC-4000, SPARTAN-II, Virtex-II and salient features of Virtex VII devices, Zynq and Artix-7.

UNIT-IV

Actel and Altera FPGAs: Anti-Fuse Programmed FPGAs: Introduction, Architecture of Actel's Act1, Act2, and Act3 FPGAs. Designing of logic circuits with the ACT devices. Logic Block, I/O Block, Routing Architecture and features of Altera's Flex 10000 series FPGA.

UNIT-V

Digital Design Flow: Digital design tools for FPGAs. Digital design flow for CPLDs and FPGAs. Importance of Placement and Routing, Introduction to ASICs: Semi-Custom and Full-Custom ASICs.

Text books:

1. S. Trimberger, Edr, "Field Programmable Gate Array Technology", Springer Pub., 2011.
2. Ronald J . Tocci, Neal S. Widmer, Gregory L. Moss "Digital Systems", 10/e, Pearson academic press 2011.
3. P.K.Chan& S. Mourad, "Digital Design Using Field Programmable Gate Array", PHI, 1994.

Suggested Reading:

1. S. Brown, R.J.Francis, J.Rose, Z.G.Vranesic, "Field programmable gate array", BSP, 2007.
2. Altera, AMD, Actel, "Manuals Xilinx", 2015.

e-Resources:

1. https://archive.nptel.ac.in/courses/117/108/117108040.

22ECE20

RADAR AND SATELLITE COMMUNICATION

(Professional Elective-IV)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Digital communications and microwave engineering.

Course Objectives:

This course aims to:

1. To understand principle and operation of different radar systems.
2. To understand the orbital aspects of satellite communication.
3. Study the satellite links and earth stations.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Examine the principles of operation of pulse, CW and MTI radar system.
2. Compare different types of tracking radars.
3. Demonstrate the fundamental concepts of Orbital Aspects and Orbital Mechanics.
4. Identify the mechanisms for placing satellites and examine the orbital effects on satellites, launch mechanisms.
5. Design an appropriate satellite communication link for the given specifications.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	1	3	1	1	1	1	1	1	1	3	2	1
CO 2	3	2	2	2	2	1	2	1	1	1	1	1	3	2	1
CO 3	2	2	2	1	3	2	1	1	1	1	1	1	3	1	1
CO 4	2	2	1	3	2	2	1	1	1	1	1	1	3	3	1
CO 5	2	2	2	2	2	1	1	1	1	1	1	2	3	1	1

UNIT-I

Radar Systems: Introduction to radar, radar block diagram, and operation, radar frequencies, Applications of radar, Radar range Equation, Prediction of range performance, minimum detectable signal, receiver noise, probability density function, SNR, Integration of radar pulses, radar cross-section of targets, PRF and range ambiguities, transmitter power, system losses.

UNIT-II

Radar Types: Doppler effect, CW radar, FM CW radar, multiple frequencies CW radar. MTI radar, delay line canceller, range-gated MTI radar, blind speeds, staggered PRF. Principles of Tracking radar. Concepts of SAR and its applications.

Fundamentals of EMI and EMC, Surveillance Radar, Applications and Advantages. Introduction to Electronic warfare: ECM and ECCM.

UNIT-III

INTRODUCTION AND ORBITAL ASPECTS OF SATELLITE COMMUNICATIONS : Introduction to Satellite Communication: Brief history of satellite communications, satellite services, frequency allocations, basic communication satellite system – earth segment and satellite segment, advantages and applications of satellite communications, salient features of Indian communication satellites. Geo-synchronous and Geo-stationary orbits. **Orbital Mechanics:** Kepler's laws, describing the orbit of a satellite, locating the satellite in the orbit and with respect to earth.

UNIT–IV

Look Angle Determination: sub-satellite point, elevation and azimuth angle calculations, visibility test.

Orbital Perturbations: Longitudinal changes and inclination changes.

Orbital Effects on Communication System Performance

Launches and Launch Vehicles: Launch vehicles, placing satellites into geo-stationary orbit.

UNIT–V

Satellite Sub Systems: Introduction, attitude and orbit control system, Telemetry, tracking, command and monitoring, Power Systems, Communication Subsystems, Satellite antennas.

Satellite Link Design: Basic transmission theory, system noise temperature and G/T ratio – noise temperature, calculation of system noise temperature, noise figure and noise temperature, design of down link, uplink design, design for specified C/N – combining C/N and C/I values, overall $(C/N)_0$ with uplink and downlink attenuation, attenuation in rain, uplink attenuation and $(C/N)_{up}$, downlink attenuation and $(C/N)_{dl}$, satellite communication link design procedure.

Text Books:

1. Merril. I. Skolnik, "Introduction to Radar Systems", 2/e, MGH, 2001.
2. T Pratt and W Bostiain - Satellite Communications, 2nd Edition, John Wiley, 2003.
3. Dennis Roddy, Satellite communications, McGraw Hill, 4 th Edition, 2009.
4. DC Agarwal, Satellite Communications, Khanna Publishers, 2003 Robert M Gagliard, Satellite.

Suggested Reading:

1. Introduction to Radar Systems – Merrill I. Skolnik, SECOND EDITION, McGraw-Hill, 1981.
2. M. Richharia, "Satellite Communication Systems: Design Principles", McGraw Hill, 2/e, 2003.
3. Gagliardi Robert M, "Satellite Communications", 2/e, Van Nostrand Reinhold, 1991.

e-Resources:

1. https://archive.nptel.ac.in/courses/117/107/108107107.

22ECE21

IMAGE AND VIDEO PROCESSING

(Professional Elective-IV)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: A prior knowledge of Signal Processing is required.

Course Objectives:

This course aims to:

1. To introduce the basic concepts and methodologies involved in image and video processing.
2. To understand the fundamentals of image compression.
3. To provide a conceptual foundation that can be used as a basis for further study and research in this field.

Course Outcomes:

Upon completion of this course, the student will be able to

1. To learn image representation.
2. Apply Image enhancement and segmentation techniques both in spatial and frequency domain.
3. To reduce the redundancy in both lossy and lossless compression models.
4. Apply 2D-Motion estimation algorithms and develop predictive coding.
5. Creatively apply contemporary theories, processes and tools in the development and evolution of solutions to problems related to image and video processing.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	2	1	1	1	1	1	1	1	1	1	2	1	2	1
CO 2	2	3	2	1	1	1	1	1	1	2	1	2	2	3	2
CO 3	1	2	3	2	1	1	1	1	1	1	1	3	1	2	3
CO 4	1	2	3	2	1	1	1	1	1	1	1	2	1	2	3
CO 5	1	2	3	1	3	1	1	1	1	1	1	3	1	2	3

UNIT-I

Fundamentals of Image Processing:

Basic steps of Image Processing System, Sampling and Quantization of an image, Basic relationship between pixels. Image Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms.

UNIT-II

Image Enhancement:

Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters.

Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening.

Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation.

UNIT-III

Image Compression: Image compression fundamentals - Coding Redundancy, Spatial and Temporal redundancy, Compression models: Lossy & Lossless, Arithmetic coding, Run length coding, Bit plane coding, Transform coding, Predictive coding, Wavelet coding.

UNIT-IV

Basic concepts of Video Processing:

Analog Video, Digital Video. Time-Varying Image Formation models: 3D motion models, Geometric Image formation, Photometric Image formation, Sampling of Video signals, Filtering operations.

UNIT-V

2-D Motion Estimation:

Optical flow, General Methodologies, Pixel Based Motion Estimation, Block- Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based transform coding, Predictive coding, Application of motion estimation in Video coding.

Text books:

1. Gonzaleze and Woods, Digital Image Processing, 4th ed., Pearson, 2018.
2. Yao Wang, Joem Ostermann and Ya–quin Zhang, Video processing and communication, 1st Ed., PH Int. 2001.

Suggested Reading:

1. M. Tekalp, Digital Video Processing, Prentice Hall International, 1995.

e-Resources:

1. https://archive.nptel.ac.in/courses/117/105/117105135.

22ECE22

EMBEDDED SYSTEMS

(Professional Elective - IV)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Computer Architecture, Microprocessors and Microcontrollers.

Course Objectives:

This course aims to:

1. Learn about fundamentals of the embedded systems.
2. Understand the hardware and software details of the embedded systems.
3. Acquire knowledge on the serial, parallel and network communication protocols.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the fundamentals of the embedded systems.
2. Analyze the hardware and software details of the embedded systems.
3. Design interfacing of the systems with other data handling / processing systems.
4. Evaluate the performance of an embedded system using various debugging tools.
5. Apply the embedded design approach for various applications.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1
CO 2	1	2	1	1	3	3	2	1	1	1	1	2	1	2	1
CO 3	2	2	1	3	3	3	3	1	1	1	1	2	2	2	1
CO 4	2	3	2	1	3	3	1	1	1	1	1	3	2	3	2
CO 5	3	3	2	1	3	3	3	1	1	1	1	3	3	3	2

UNIT-I

Introduction to Embedded Systems: Embedded systems versus General Computing Systems, History of embedded systems, classifications, applications areas, characteristics and quality attributes of embedded systems, Design metrics and challenges in embedded system design.

UNIT-II

Embedded Hardware and Software: Processor embedded into a system, Processor selection for embedded system, embedded hardware units and devices in a system, embedded software in a system and an overview of programming languages, challenges and issues related to embedded software development.

UNIT-III

Communication Protocols: I2C, CAN, Firewire-IEEE 1394 Bus standard, advanced serial high-speed buses. Parallel Bus device protocols: ISA, PCI, PCI-X, Internet Enabled Systems-Network protocols: Ethernet.

UNIT-IV

Embedded Software Development Process: Embedded System design and co-design issues in system development process, Design cycle in the development phase for an Embedded Systems. Embedded software development tools: Host and Target Machines, Linker/Locators for embedded software, Embedded Software into the Target system. Issues in hardware and software design and co-design.

UNIT-V

Testing, Debugging Techniques and Applications: Integration and testing of embedded hardware, testing methods, debugging techniques, Laboratory tools and target hardware debugging: Logic Analyzer, simulator, emulator and In-circuit emulator, IDE

Case Study: Embedded Systems design for automobiles, and automated meter reading system.

Text Books:

1. Raj Kamal, "Embedded Systems-Architecture, Programming and Design",3/e, McGraw Hill Education,2017.
2. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2011.

Suggested Reading:

1. Shibu K V, "Introduction to Embedded systems", 1/e McGraw Hill Education,2009.
2. David Simon, "An Embedded software primer", Pearson Education,2002.

e-Resources:

1. https://nptel.ac.in/courses/108102045.

22ECE23

GREEN COMMUNICATION

(Professional Elective - IV)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: The student must prior knowledge in Communication systems.

Course Objectives:

This course aims:

1. To learn the importance of energy conservation in green wireless communication system.
2. To compare the different types of energy reduction techniques for different traffic scenarios.
3. To inculcate the different green concepts for designing the energy efficient next generation wireless networks.

Course Outcomes:

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

1. Understand the challenges in energy efficiency and spectral efficiency for digital data transmission.
2. Conceptualize significant energy efficiency trade off in green wireless networks.
3. Discuss the methods to manage the dynamic loads of mobile communications for energy saving.
4. Indicate the design practices for power minimization at cellular base station.
5. Practice cell deployment strategies for efficient network management.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	3	2	2	3	1	1	1	1	1	1	3	3	1
CO2	3	1	2	1	2	3	1	1	1	1	1	1	3	3	3
CO3	3	1	3	3	3	3	1	1	1	1	1	1	3	3	2
CO4	3	1	3	3	3	3	1	1	1	1	1	1	3	3	2
CO5	1	1	1	1	2	2	1	1	1	1	1	1	3	3	2

UNIT-I

Introduction to Green Wireless Communications:

Introduction, Effective Capacity and Energy Per Information Bit, Variable-Rate/Variable- Power and Variable-Rate/Fixed-Power Transmissions, Fixed-Rate /

Fixed-Power Transmissions - Transmissions over Imperfectly-Known Wireless Channels, Energy Efficiency in the Low-Power Regime - Energy Efficiency in the Wideband Regime.

UNIT-II

Energy Efficiency-Spectral Efficiency Trade-off in Cellular Systems:

Spectral Efficiency, Energy Efficiency, Energy Efficiency-Spectral Efficiency Trade-Off, Idealistic vs. Realistic Power Consumption Model, MIMO vs. SISO: An Energy Efficiency Analysis, Power Model Implications.

UNIT-III

Energy Savings for Mobile Communication Networks through Dynamic Spectrum and Traffic Load Management:

Dynamic Spectrum and Traffic Load Management, Power Saving by Dynamically Powering Down Radio Network Equipment, Power Saving by Propagation Improvement, Power Saving by Channel Bandwidth Increase or Better Balancing, Performance Assessment, Power Saving by Propagation Improvement.

UNIT–IV

Minimizing Power Consumption to Achieve More Efficient Green Cellular Radio Base Station Designs:

Explosive Traffic Growth, Cellular Scenarios, Energy Metrics, Energy Reduction Techniques for High Traffic Load Scenarios, Energy Reduction Techniques for Low Traffic Load Scenarios, Other Energy Reduction Techniques.

UNIT–V

Green Wireless Access Networks:

Energy Efficiency and Network Technologies, Cell Deployment Strategies, Relaying Techniques, Base Station Coordination and Cooperation, Adaptive Network Reconfiguration, Radio Resource Management, Future Architectures, Green Ad Hoc and Sensor Networks, Energy Harvesting Techniques.

Text Books:

1. Jinsong Wu, Sundeep Rangan and Honggang Zhang, "Green Communications: Theoretical Fundamentals, Algorithms and Applications", CRC Press, 2016.
2. F. Richard Yu, Xi Zhang, Victor C.M. Leung "Green Communications and Networking", CRC Press, 2012.

Suggested Reading:

1. Ekram Hossain, Vijay Bhargava K and Gerhard Fettweis P, "Green Radio Communication Networks", Cambridge University Press, New York, 2012.
2. Mazin Al Noor, "Green Radio Communication Networks Applying Radio-Over-Fiber Technology for Wireless Access", GRINVerlag, 2012.
3. Mohammad Obaidat S, Alagan Anpalagan and Isaac Woungang, "Handbook of Green Information and Communication Systems", 1st Edition, Academic Press, 2012.
4. Ramjee Prasad, Shingo Ohmori and Dina Simunic, "Towards Green ICT", River Publishers, 2010.

22ECE24

DATA ANALYTICS FOR SIGNAL PROCESSING

(Professional Elective - IV)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: A course on Probability and stochastic process, Statistics is required.

Course Objectives:

This course aims to:

1. Understand the basics of Managing Data, Analytics performed and extrapolate the information.
2. Familiarize the students with the applications of data analytics with signal processing application such as object segmentation.
3. Learning the way to visualize the Data.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the impact of data analytics for signal Processing.
2. Carry out data analysis/statistical analysis.
3. To carry out standard data visualization and formal inference procedures.
4. Design a Data Architecture.
5. Understand various Data Sources.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	3	3	1	1	3	1	1	1	3	2	3	2
CO 2	3	3	3	3	3	1	1	3	1	1	1	3	2	3	2
CO 3	3	3	3	3	3	1	1	3	1	3	1	3	2	3	2
CO 4	3	3	3	3	3	1	1	3	1	1	1	3	2	3	2
CO 5	3	3	3	3	3	1	1	3	1	1	1	3	2	3	2

UNIT-I

Data Management: Data Analytics Overview - Importance of Data Analytics - Types of Data Analytics - Descriptive Analytics - Diagnostic Analytics - Predictive Analytics - Prescriptive Analytics - Benefits of Data Analytics - Data Visualization for Decision Making - Data Types, Measure Of central tendency, Measures of Dispersion - Graphical Techniques, Skewness & Kurtosis, Box Plot - Descriptive Stats - Sampling Funnel, Sampling Variation, Central Limit Theorem, Confidence interval

UNIT-II

Data Analytics: Introduction to Analytics, Introduction to Tools and Environment, Application of Modeling in Business, Databases & Types of Data and variables, Data Modeling Techniques, Missing Imputations etc. Need for signal processing.

UNIT-III

Regression: Concepts, Blue property assumptions, Least Square Estimation, Variable Rationalization, and Model Building etc. Logistic Regression: Model Theory, Model fit Statistics, Model Construction, Analytics applications to various Business Domains etc.

UNIT-IV

Object Segmentation: Regression Vs Segmentation – Supervised and Unsupervised Learning, Tree Building – Regression, Classification, Overfitting, Pruning and Complexity, Multiple Decision Trees etc. Time Series Methods: Arima, Measures of Forecast Accuracy, STL approach, Extract features from generated model as Height, Average Energy etc and Analyze for prediction

UNIT-V

Data Visualization: Pixel-Oriented Visualization Techniques, Geometric Projection Visualization Techniques, Icon-Based Visualization Techniques, Hierarchical Visualization Techniques, Visualizing Complex Data and Relations.

Text Books:

1. Student's Handbook for Associate Analytics – II, III.
2. Data Mining Concepts and Techniques, Han, Kamber, 3rd Edition, Morgan Kaufmann Publishers.

Suggested Reading:

1. Introduction to Data Mining, Tan, Steinbach and Kumar, Addision Wisley, 2006.
2. Data Mining Analysis and Concepts, M. Zaki and W. Meira
3. Mining of Massive Datasets, Jure Leskovec Stanford Univ. Anand Rajaraman Milliway Labs Jeffrey D Ullman Stanford Univ.

22BTO01

BIOLOGY FOR ENGINEERS

(Open Elective – II)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: The school level basic knowledge in Fundamental science is required

Course Objectives: The objectives of this course are

1. Understand the milestones reached by human in the field of biology.
2. Understand the human body and its parts.
3. Understand the human anatomy and medical devices.
4. Understand types of advanced therapies.
5. Understand the treatment of toxic pollutants in the environment.
6. Understand genome sequencing and NGS.

Course Outcomes: On Successful completion of the course, students will be able to

1. Appraise the values of Biology in classical and modern time.
2. Develop modern instruments related to skeletal, nervous, and circulatory system.
3. Apply concept of respiratory, excretory, and assisted reproductive process for developing related instruments.
4. Illustrate the modern interdisciplinary tools related to medical biotechnology and bioremediation.
5. Summarize the basic knowledge about nucleic acids, proteins and their sequencing.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	-	-	-	2	2	-	-	-	-	2	2	3	2
CO 2	1	-	-	-	2	-	1	-	-	-	-	-	2	3	2
CO 3	1	-	1	-	2	-	1	1	-	-	-	-	2	3	2
CO 4	2	1	1	-	2	-	2	-	-	1	-	-	2	3	2
CO 5	1	1	1	-	1	-	1	-	-	1	-	1	2	3	2

UNIT-I

Introduction to Biology: Classical Vs Modern Biology; Importance of Biological Science and Historical developments; Origin of Life, Urey Miller Experiment, Spontaneous Generation Theory; Three Domains of Life; Principle and Applications of Microscope (Light and Electron Microscope), Prokaryotic and Eukaryotic Cell- Structure and their differences.

UNIT-II

Human Anatomy and Functions-I: Human organ systems and their functions; Skeletal System-Bones, Tendon, Ligaments, principle and applications in knee replacement; Nervous System - Structure of Brain, Spinal Cord, Neuron, Neurotransmitters, Synapse, Alzheimer's - a case study, principle and applications of Imaging Techniques (CT & MRI scans); Circulatory System - Heart structure and functions, principle and applications of cardiac devices (Stent and Pacemaker), Artificial heart, blood components and typing, haemocytometer.

UNIT-III

Human Anatomy and Functions-II: Respiratory Systems - Lung structure and function, principle and applications of Peak Flow Meter, ECMO (Extra Corporeal Membrane Oxygenation); Excretory Systems-Kidney structure and function, principle and applications of Dialysis; Prenatal diagnosis; Assisted reproductive techniques- IVF, Surrogacy.

UNIT-IV

Medical Biotechnology and Bioremediation: Cells of Immune System, Etiology of cancer, Cancer treatment (Radiation Therapy); Stem Cells and its Clinical applications; Scaffolds and 3D printing of organs; Bio sensors and their applications; Parts of bioreactor and its types; Bioremediation.

UNIT - V

Bioinformatics: Nucleic acid composition, Genetic Code, Amino acid, Polypeptide, Levels of protein structure, Homolog, Ortholog and Paralog, Phylogenetics, Genome Sequencing, Human Genome Project, Next generation sequencing.

Text Books:

1. Champbell, N.A., Reece, J.B., Urry, Lisa, Cain, M,L., Wasserman, S.A., Minorsky, P.V., Jackson, R.B., "Biology: A global approach", Pearson Education Ltd, Edition 11, 2017.
2. Shier, David, Butler, Jackie, Lewis, Ricki., "Hole's Human Anatomy & Physiology"., McGraw Hill 2012.

Suggested Reading:

1. Bernard R. Glick, T. L. Delovitch, Cheryl L. Patten, "Medical Biotechnology", ASM Press, 2014.

22MEO01

PRINCIPLES OF DESIGN THINKING

(Open Elective – II)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Nil

Course Objectives:

This course aims to:

1. Create awareness of design thinking approaches.
2. Identify a systematic approach for defining/identifying a problem.
3. Create design thinking teams and conduct design thinking sessions collaboratively.
4. Apply both critical thinking and design thinking in parallel to solve problems.
5. Motivate to apply design thinking concepts to their real life scenarios.

Course Outcomes:

Upon completion of this course, the students are able to:

1. Understand design thinking and its phases as a tool of innovation.
2. Empathize on the needs of the users.
3. Define the problems for stimulating ideation.
4. Ideate on problems to propose solutions by working as a design thinking team.
5. Prototype and test the proposed solutions focusing on local or global societal problems.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
CO 2	1	1	2	1	2	2	2	2	1	2	2	2	2	2	2
CO 3	1	1	2	2	1	2	2	2	1	2	2	1	2	2	3
CO 4	2	1	2	2	1	2	2	2	1	2	2	2	2	2	3
CO 5	2	1	2	2	1	2	2	2	1	2	2	2	2	2	3

UNIT – I

Introduction to Engineering & Thinking: Engineering for social and economic development; impact of science/engineering. Thinking and behaviour; Types of thinking – Linear thinking, lateral thinking, systems thinking, design thinking.

Introduction to Design Thinking: Importance of Design Thinking & Human centric approach – Phases in design thinking process, five-stage model as iterative method, applications of design thinking in various domains.

UNIT – II

Empathize phase: Understanding the unique needs of the user, empathize with the users, steps in empathize phase, developing empathy towards people, assuming a beginner's mind-set (what? why?), steps in immersion activity, body storming; Case studies.

UNIT – III

Define phase: Define the problem and interpret the result, analysis and synthesis, Personas – Four different perspectives on Personas, steps to creating personas, problem statement, affinity diagrams, empathy mapping; Point of View – "How might we" questions, Why-how laddering; Case studies.

UNIT – IV

Ideation phase: What is ideation, need, uses, ideation methods; Brainstorming, rules for brainstorming; Mind maps, guidelines to create mind maps; Ideation games; Six Thinking Hats; Doodling, use of doodling in expressing creative ideas; Case studies.

UNIT – V

Prototyping phase: Types of prototyping, guidelines for prototyping, storytelling, characteristics of good stories, reaching users through stories, importance of prototyping in design thinking; Value proposition, guidelines to write value proposition; Case studies.

Testing phase: Necessity to test, user feedback, conducting a user test, guidelines for planning a test, how to test, desirable, feasible and viable solutions, iterate phase.

Text Books:

1. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires, 1st Edition, HarperCollins, 2009.
2. Michael Luchs, Scott Swan, Abbie Griffin, Design thinking: New product development essentials from the PDMA. John Wiley & Sons, 2015.
3. Pavan Soni, Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-solv ing, Penguin Random House India Private Limited, 2020.

Suggested Reading:

1. Jeanne Liedtka, Andrew King, Kevin Bennett, Solving problems with design thinking: Ten stories of what works. Columbia University Press, 2013.
2. Bala Ramadurai, Karmic Design Thinking - A Buddhism-Inspired Method to Help Create Human-Centered Products & Services, Edition 1, 2020.

22MTO01

FUNDAMENTALS OF QUANTUM COMPUTING

(Open Elective – II)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To learn basic mathematical Concept for Quantum Computing.
2. To understand the evaluation of the quantum bits. & building blocks.
3. To know the basics of Quantum logic gates and circuits.
4. To learn Quantum Algorithms by various Techniques.
5. To introduce fundamental of Quantum cryptography

Course Outcomes:

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

1. Compute basic mathematical operations on Quantum bits.
2. Solve Quantum operations.
3. Apply quantum Logical gates and circuits.
4. Implement quantum algorithm.
5. Implement Cryptography in Quantum.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	-	-	-	-	-	-	-	-	-	1	3	2	2
CO 2	2	2	-	-	-	-	-	-	-	-	-	2	2	2	2
CO 3	2	2	1	-	-	-	-	-	-	-	-	3	2	2	3
CO 4	2	2	2	2	-	-	-	-	-	2	2	3	3	2	2
CO 5	2	2	2	2	-	-	-	-	-	2	2	2	2	2	3

UNIT-I:

Math Foundation for Quantum Computing:

Introduction to Vector Space, Subspaces, Linear Independent and dependent Vectors, Basis and Finite Dimensions. Orthogonality of Vectors, Inner product and Outer product of Hilbert Spaces. Unitary operators and projections, Eigenvalues and Eigenvectors. Introduction to GCD and Congruence.

UNIT-II:

Introduction to Quantum Computing:

Quantum Mechanics (Huygens wave theory, Photo electric effect De-Broglie hypothesis and Heisenberg's uncertainty Principle), Origin of Quantum Computing, Qubits and multi-qubits states, Bra-ket notation, Quantum Superposition Motivation for Studying QuantumComputing, Major players in the industry (IBM, Microsoft, Rigetti, D-Wave). Block sphere representations, Multi-qubits, Inner and outer product of Multiple of qubits, Tensor product.

UNIT-III:

Quantum Logical gates and Circuits:

Single Qubit gates: Pauli, Hadamard, Phase shift, Controlled gates: C-NOT, CCNOT. Quantum Entanglement, Quantum Teleportation (EPR Model) and Bell State, Introduction to Discrete Fourier transform.

UNIT-IV

Quantum Algorithms:

Quantum Fourier Transform, Quantum Phase estimation, Major Algorithms: Shor's Algorithm, Grover's Algorithm, Deutsch's Algorithm, Deutsch-Jozsa Algorithm.

UNIT-V:

Quantum Cryptography:

Public and private key Cryptography, Quantum key distribution, Quantum Cryptography, Experimental implementation of quantum cryptography protocols.

Text Books:

1. Michael A. Nielsen, "Quantum Computation and Quantum Information", Cambridge University Press.
2. David McMahon, "Quantum Computing Explained", Wiley .

22CSO02

INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS

(Open Elective – II)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aims to:

1. Learn data models, conceptualize and depict a database system using E-R diagrams.
2. Understand the internal storage structures in a physical DB design.
3. Learn the fundamental concepts of transaction processing techniques.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the fundamental concepts of database and design using ER model.
2. Apply SQL to find solutions to basic queries.
3. Identify the inference rules for functional dependencies and apply the principles of normal forms to decompose the relations in a database.
4. Understand the concepts like data storage, indexing and transaction processing.
5. Analyze concurrency control and recovery mechanisms.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	3	-	1	-	-	-	-	-	-	-	2	2	2	2
CO 2	3	2	1	2	-	-	-	-	-	-	-	1	2	2	2
CO 3	3	2	1	1	-	-	-	-	-	-	-	1	2	2	2
CO 4	3	3	1	2	-	-	-	-	-	-	-	1	2	2	2
CO 5	3	2	1	2	2	-	-	-	-	-	-	2	2	2	2

UNIT - I

Introduction: Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Database Users and Administrators Database System Architecture, Application Architectures.

Database Design and E-R Model: Basic concepts, Constraints, E-R Diagrams, E-R Design Issues, Extended E-R Features, Specialization and Generalization.

UNIT - II

Relational Model: Structure of Relational Databases, Database Schema, Keys.

Structured Query Language: Overviews, SQL Data Types, SQL Queries, Data Manipulation Language Set Operations, Aggregate Functions, Data Definition Language, Integrity Constraints, Null Values, Views, Join Expression.

UNIT - III

Relational Database Design: Undesirable Properties in Relational Database Design, Functional Dependencies, Trivial and Nontrivial Dependencies, Closure of Set of Functional Dependencies, Closure of Set of Attributes, Irreducible Set of Functional Dependencies, Normalization – 1NF, 2NF, and 3NF, Dependency Preservation, BCNF, Comparison of BCNF and 3NF.

UNIT - IV

Indexing: Basic concepts, Dense and Sparse Indices, Secondary Indices, Tree-Structured Indexing, Indexed Sequential Access Method (ISAM), B+ Tree Index Files.

Transaction Management: Transaction Concept – ACID Properties, States of Transaction, Implementation of Atomicity and Durability, Serializability, Recoverability.

UNIT - V

Concurrency Control: Introduction, Lock-Based Protocols, Timestamp-Based Protocols.

Deadlocks Handling: Deadlock Detection and Prevention.

Recovery System: Failure Classification, Storage Structure, Recovery and Atomicity, Log-Based Recovery.

Text Books:

1. Abraham Silberschatz, Henry F Korth, S Sudarshan, "Database System Concepts", Sixth Edition, McGraw-Hill International Edition, 2011.
2. Date CJ, Kannan A, Swamynathan S, "An Introduction to Database Systems", Eight Edition, Pearson Education, 2006.

Suggested Reading:

1. Raghu Ramakrishnan, JohnnesGehrke, "Database Management Systems", Third Edition, McGraw Hill, 2003.
2. Ramez Elmasri, Durvasul VLN Somayazulu, Shamkant B Navathe, Shyam K Gupta, "Fundamentals of Database Systems", Fourth Edition, Pearson Education, 2006.

22CIO04

FUNDAMENTALS OF AR AND VR

(Open Elective – II)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-Requisites:
Basic knowledge on computer hardware and software components.

Course Objectives:
This course aims to:
1. Learn a ton about virtual and augmented reality; get familiar with the latest technology and software.
2. Virtual reality in different object & applications.
3. To understand key elements of virtual Reality with the components in VR systems.
4. To gain knowledge of various input and output devices required for interacting in virtual world along with rendering and modelling.

Course Outcomes:
By the end of this course, students should be able to:
1. Understand the components of the virtual reality system.
2. Describe various input and output devices used for virtual reality.
3. Apply the different modelling concepts to visual virtualization.
4. Understand the concepts of the augmented reality system.
5. Analyse the performance of given simple applications related to virtual reality.

Course Articulation Matrix

PO/ PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	3	1	-	-	-	-	-	-	3	3	3	3
CO 2	3	3	3	3	2	-	-	-	-	-	-	3	3	3	3
CO 3	3	3	3	3	3	-	-	-	-	-	-	3	3	3	3
CO 4	3	3	3	3	3	-	-	-	-	-	-	3	3	3	3
CO 5	3	3	3	3	3	-	-	-	-	-	-	3	3	3	3

Unit – I

Introduction to Augmented and Virtual Reality-: AR- VR, Understanding Virtual Space- Defining Visual Space and Content- Defining Position and Orientation in Three Dimensions- Navigation.
The Understanding the Human Senses and Their Relationship to Output/Input Devices- - The Mechanics of Sight - The Visual Pathway - Spatial Vision and Depth Cues.

Unit – II

Component Technologies of Head-Mounted Displays- Display Fundamentals- Related Terminology and Concepts- Optical Architectures. Augmenting Displays- Binocular Augmenting Displays- Monocular Augmenting Displays. **Fully Immersive Displays** - PC-Console Driven Displays- Smartphone-Based Displays- CAVES and Walls -Hemispheres and Domes.

Unit – III

The Mechanics of Hearing: -Defining Sound -The Auditory Pathway-Sound Cues and 3D Localization-The Vestibular System**. Audio Displays**-Conventional Audio- The Mechanics of Feeling- The Science of Feeling -Anatomy and Composition of the Skin.

Unit – IV

Tactile and Force Feedback Devices: -Haptic Illusions -Tactile Feedback Devices- Force Feedback Devices-Sensors for Tracking Position, Orientation, and Motion -Introduction to Sensor Technologies- Optical Trackers - Beacon Trackers - Electromagnetic Trackers - Inertial Sensors- Acoustic Sensors. **Devices to Enable Navigation and Interaction**: -2D Versus 3D Interaction and Navigation -The Importance of a Manual Interface - Hand and Gesture Tracking Gloves-Whole Body Tracking - Gaming and Entertainment Interfaces.

Unit – V

Applications of Augmented and Virtual Reality: Gaming and Entertainment - Virtual Reality and the Arts- Immersive Video/Cinematic Virtual Reality- Health and Medicine -Advancing the Field of Medicine- Training Applications-Treatment Applications. **Aerospace and Défense**:- Flight Simulation and Training- Mission Planning and Rehearsal-Dismounted Soldier Situational Awareness- Advanced Cockpit Avionics- Space Operations. Education - Tangible Skills Education- Theory, Knowledge Acquisition, and Concept Formation.

Text Books:

1. Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR, by Steve Aukstakalnis, Released September 2016, Publisher(s): Addison-Wesley Professional, ISBN: 9780134094328

Reference Books:

1. Virtual Reality Systems, John Vince, Pearson Education.
2. Virtual Reality Technology, Second Edition, Gregory C. Burdea & Philippe Coiffet, John Wiley & Sons, Inc.,
3. Understanding Virtual Reality, interface, Application and Design, William R.Sherman, Alan Craig, Elsevier (Morgan Kaufmann).

22ADO03

FREE AND OPEN – SOURCE SOFTWARES

(Open Elective – II)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aims to:

1. To be exposed to the context and operation of free and open source software (FOSS) communities and associated software projects.
2. To be familiar with participating in a FOSS project.
3. To get acquaintance of Programming Tools and Techniques.
4. To learn the language Perl.
5. To Learn Open Source Software Development.

Course Outcomes:

After the completion of this course, the student will be able to:

1. Differentiate between various open-source software licensing models, including Free Software Movement and Open-Source Movement.
2. Demonstrate proficiency in Linux installation, including configuring hardware and managing the boot process using tools like LILO and GRUB.
3. Create and execute Bash shell scripts, manipulate variables and input, and utilize control structures effectively.
4. Assess and select appropriate design tools like Argo UML, version control systems.
5. Configure and manage MySQL servers, work with MySQL databases and tables.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	3	2	2	2	1	1	2	2	2	2	3
CO 2	3	-	-	-	3	2	2	2	1	1	2	2	2	2	3
CO 3	3	1	2	2	3	2	2	2	2	2	2	2	2	2	3
CO 4	3	1	1	2	3	2	2	2	2	2	2	2	2	2	3
CO 5	3	1	2	2	3	2	2	2	2	2	2	2	2	2	3

UNIT-I

OPEN-SOURCE SOFTWARE OVERVIEW:

Introduction, Need and Advantage of Open-Source Software, FOSS, Free Software Movement, Open-Source Movement, Open Source Licensing Certification, OSS Development Model, Run a Free Software Project, Comparing OSS with other Software-OSS Licenses

UNIT-II

LINUX:

Linux Installation and Hardware Configuration, Boot Process-The Linux Loader (LILO), The Grand Unified Bootloader (GRUB), Dual-Booting Linux and other Operating System Options, X Windows System Configuration, System Administration, Backup and Restore Procedures, Strategies for Keeping a Secure Server.

UNIT-III

SHELL PROGRAMMING:

Bash Shell Scripting, Executing Script, Working with Variables and Input, Using Control Structures, Handling signals, creating functions, working sed and gawk, working with web using shell script: Downloading web page, Converting Web page content to a text file, parsing data, working cURL.

UNIT-IV

PROGRAMMING TOOLS AND TECHNIQUES:

Usage of Design Tools Like Argo UML or Equivalent - Version Control Systems Like Git or Equivalent – Bug Tracking Systems- Package Management Systems.

UNIT-V

OPEN SOURCE DATABASE AND APPLICATIONS:

MySQL: Configuring MySQL Server, working with MySQL Databases, MySQL Tables, SQL Commands – INSERT, SELECT, UPDATE, REPLACE, DELETE. Date and Time functions in MySQL. PHP – MySQL Application Development: Connecting to MySQL with PHP, Inserting data with PHP, Retrieving data with PHP.

Text Books:

1. Prof. Dayan and Ambawade, Deven Shah, “Linux Labs And Open Source Technologies” , Dream Tech Press, 2014.
2. Evi Nemeth, Garth Snyder, Trent R. Hein, Ben Whaley and Dan Mackin , “UNIX and Linux System Administration Handbook “, 5th Edition, Addison-Wesley Professional, 2017.
3. Julie C Meloni, “PHP, MySQL and Apache”, Sixth Edition, Pearson Education, 2017.

Suggested Reading:

1. Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, "Linux in a Nutshell", Sixth Edition, OReilly Media, 2009.
2. Tom Phoenix, Randal Schwartz, Brian Foy "Learning Perl" , 6th Edition, O'Reilly Media, 2011.
3. Wale Soyinka, Linux Administration- A beginner’s Guide, Tata McGraw Hills, 2012
4. Fadi P. Deek and James A. M. McHugh, Open Source Technology and Policy, Cambridge University Press, 2007
5. Andrew M. St. Laurent, “Understanding Open Source and Free Software Licensing”, O'Reilly Media, 2004.
6. Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, “Linux in a Nutshell”, Sixth Edition, Oreilly Media, 2009

22ECC25

MICROCONTROLLERS LAB

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Basic knowledge of programming in C language.

Course Objectives:

This course aims to:

1. Develop and understand the 8051 and ARM7 C programming.
2. Understand the usage of Integrated Development Environment (Keil)
3. Control the operation of various peripherals using 8051 and ARM7 microcontroller.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Develop the programs of 8051 and ARM using their respective instruction set.
2. Understand the usage of various debugging tools available to program different microcontrollers.
3. Build code for 8051 and ARM7 to interface various input/output modules.
4. Analyze the hardware and software interaction and integration.
5. Design and develop the 8051 and ARM 7 based embedded systems for various applications.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	3	-	-	-	-	-	-	-	-	2	2	-
CO 2	3	2	3	3	3	-	-	-	-	-	-	-	3	2	2
CO 3	2	3	2	3	3	-	-	-	-	-	-	2	3	3	2
CO 4	3	2	3	3	3	-	-	-	-	-	-	2	2	2	3
CO 5	3	2	3	3	3	2	1	-	2	-	1	2	3	2	3

List of Experiments

I. 8051 Programming

1. Familiarity and use of 8051 microcontroller trainer kit, Keil IDE and simple programs under different addressing modes.
2. Assembly programming using instruction set.
3. Timer and counter operations and programming using 8051.
4. Interfacing applications using LED, switch, relay and buzzer.
5. Stepper motor interfacing.
6. LCD interfacing.
7. Development of Embedded 'C' Code based on the module specifications. (under Structured enquiry)

II. ARM7 Programming

1. Study and use of LPC214x Microcontroller trainer kit and simple programs using its instruction set
2. Interfacing applications using LED, switch, relay and buzzer.
3. Programming on-chip PLL.
4. DC Motor interfacing.
5. Programming on-chip ADC.
6. Waveform generation using internal DAC.
7. Design an experiment related to the Embedded Application of your choice using 8051/ARM based architectures. (under Open ended enquiry)

Suggested Reading:

1. Mazidi M.A, Mazidi JG & Rolin D. Mckinlay, "The 8051 Microcontroller & Embedded Systems using Assembly and C", 2/e, Pearson Education, 2007.
2. Philips semiconductors, "ARM 7 (LPC 214x) user manual", 2005.

22ECC26

MICROWAVE ENGINEERING AND MOBILE COMMUNICATION LAB

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Knowledge of electromagnetics and antennas.

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Course Objectives:

This course aims to:

1. Facilitate the experimental setup for understanding the Cellular concepts and experiments using CDMA and LTE systems.
2. Provide the facility to learn DSSS technique for CDMA to observevarious spread spectrum parameters.
3. Build knowledge on concepts of software radio by studying building blocks such as Baseband and RFsection.
4. Understand the characteristics of microwave oscillators and various microwave components.
5. Learn frequency measurement techniques using cavity wave meters, measuring VSWR and plotting radiation pattern of any antenna.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Appraising Cellular concepts, CDMA and LTE networks.
2. Testing on DSSS kit for implementing CDMA concept.
3. Develop concepts of Software Radio in a real time environment.
4. Compare the relation between guide wavelength, free space wavelength and cut off wavelength.
5. Measure VSWR and unknown impedances for various loads at microwave frequencies.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	3	1	1	1	2	3	1	1	2	3	2	2
CO 2	3	2	2	2	2	1	1	1	3	1	1	2	3	1	1
CO 3	3	2	3	3	1	1	1	2	3	1	1	2	3	2	2
CO 4	3	3	2	3	1	2	2	2	3	1	1	2	3	2	2
CO 5	3	2	2	2	2	1	1	1	3	1	1	2	3	1	1

List of Microwave Experiments:

1. Characteristics of Reflex Klystron Oscillator- To find the mode numbers and efficiencies of different modes.
2. Characteristics of Gunn diode and Gunn diode oscillator.
3. Measurement of frequency and Guide wavelength: Verification of the relation between guide wavelength, free space wavelength and cut-off wavelength.
4. Measurement of VSWR for the given loads.
5. Measurement of impedance for horn antenna, matched load, slide screw tuner etc.
6. Characteristics of Directional coupler, E-plane, H-plane and Magic Tee, and Circulator.
7. Radiation pattern of horn antenna.
8. Measurement of radiation pattern of antenna using antenna trainer kit.

List of Mobile Communication Experiments:

1. Study Path-Loss in Wireless Channel Model.
2. Modeling of wireless communication systems using MATLAB (Two ray channel and Okumura – Hata model).
3. Modeling and simulation of Multipath fading channel: Rayleigh Fading, Rician Fading channels.

4. Evaluate the performance measurements such as BER, PER, Capacity, Throughput for wireless communication system.
5. Study of DSSS technique for CDMA to observe effect of PN codes, Chiprate, Spreading factor and Processing gain.
6. Modeling and simulation of 4G LTE OFDM signal for different modulation techniques.
7. Develop concepts of Software radio by studying building blocks such as Baseband and RF section.
8. Study and analyze different modulation techniques using SDR Kit.
9. **Structured Enquiry:** Calibration of given component in X-band frequency.
10. **Open ended Enquiry:** Measurement of impedance for inductive /capacitive window in X-band frequency.

Virtual lab Experiments (https://be-iitkgp.vlabs.ac.in/List%20of%20experiments.html**):**

1. Design of Rectangular Microstrip Patch Antenna using Stripline Feed.
2. Design of Microstrip Triangular Patch Antenna Using Co-Axial Feed.
3. Magic – Tee as Mixer.
4. Design of Rectangular MicroStrip Patch Antenna with U-Shaped Slot Fed with strip line.

Note:

1. A minimum of 14 experiments should be performed.

Suggested Reading:

1. T.S.Rappaport, “Wireless Communications Principles and Practice”, 2nd edition, PHI, 2002
2. Samuel Y. Liao, “Microwave Devices and Circuits”, 3/e, Pearson Education, 2003.
3. Merril. I. Skolnik, “Introduction to Radar Systems”, 2/e, MGH, 2001.
4. Prasad Kodali, Engineering Electromagnetic Compatibility: Principles, Measurements, and Technologies, WileyIEEE Press, IEEE, 2001.
5. Rizzi P, “Microwave Devices and Circuits”, 3/e, Pearson Education, 2003.

22ECC27

ELECTRONIC DESIGN AND AUTOMATION LAB

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Digital design fundamentals and synthesis & simulation concepts.

Course Objectives:
This course aims to:

1. Simulate and synthesize combinational and sequential logic circuits.
2. Simulate switch level modules.
3. Learn implementation procedure for any design on FPGA and to study the speed, power and area constraints of FPGA/CPLD.

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

1. Demonstrate the process steps required for simulation /synthesis.
2. Develop HDL codes/scripts with appropriate syntax.
3. Apply an appropriate modelling style to describe various combinational and sequential circuits in Verilog HDL.
4. Examine the successful execution of the codes/ schematic using various Simulation Tools.
5. Build various digital circuits on hardware boards like FPGA.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	1	1	2	2	1	1	2	1	3	1
CO 2	1	1	1	1	2	1	1	2	2	1	1	2	1	3	1
CO 3	1	1	1	1	2	1	1	2	2	1	1	2	1	3	1
CO 4	1	1	1	1	3	1	1	2	2	1	1	2	1	3	1
CO 5	1	1	1	1	1	1	1	2	2	1	1	2	1	3	1

List of Experiments

Part A

Write VERILOG Code, Simulate and Implement the following on FPGA:

1. Code Converters.
2. 4-bit Asynchronous Counter.
3. Sequence Detector using Mealy and Moore type state machines.
4. Any application of UDP.
5. Tasks and Functions.
6. Implement the AOI logic using Switch Level Modelling.
7. Implement a D Latch with NMOS and Transmission Gate using Switch Level Modelling.

Note:

1. All the codes should be implemented appropriately using Gate level, Dataflow and Behavioral Modelling.
2. All the programs should be simulated using test benches.

Part B

Using Layout tools

1. Implementation of NAND Gate.
2. Implementation of NOR Gate.
3. Implementation of XOR Gate.
4. Implementation of MUX with Transmission Gate.
5. Design and layout of Inverter.

Structured Enquiry Program:

1. Design and simulate a high-speed adder using Verilog HDL.

Open- ended Enquiry:

1. Simulate a design using System Vivado and implement the same on Zynq Evaluation Development Board.

Suggested Reading:

1. Michal D. Ciletti, "Advanced digital design with Verilog HDL", Pearson Edition, 2011.
2. Samir Palnitkar, "Verilog HDL-A Guide to Digital Design and Synthesis", Pearson 2nd edition, 2003.
3. Cadence Design Systems (Ireland) Ltd., "Cadence manual", 2013.

22ECC28

MINI PROJECT

Instruction	2P Hours per Week
Duration of SEE	-
SEE	-
CIE	50 Marks
Credits	1

Prerequisite: Knowledge of Electronic circuits and Communication systems.

Course Objectives:

This course aims to:

1. To enable students learning by practical realization.
2. To develop capability to analyse and solve real world problems.
3. To develop technical writing and presentation skills.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Formulate Mini project proposal through literature survey.
2. Plan, design and analyze the proposed Mini project.
3. To simulate and execute the Mini project for validation.
4. Enhance oral presentation skills.
5. Prepare and submit the Mini project report.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	3	2	2	1	2	1	1	3	1	2	3	2	3	2
CO 2	1	3	2	2	1	1	1	1	3	1	1	2	1	3	2
CO 3	1	2	1	2	2	1	1	1	3	1	1	1	1	2	1
CO 4	1	1	1	1	1	1	1	1	3	3	1	1	1	1	1
CO 5	1	1	1	1	1	1	1	1	3	3	1	1	1	1	1

The students are required to choose emerging technology area related to any theme such as agriculture, automation, transportation, etc. Project related to domain. The students have to design and simulate/ implement as per the given schedule. Students have to give oral presentation in presence of department review committee; finally report of the mini project work has to be submitted for evaluation.

Schedule

S. no	Description	Duration
1	Problem identification / selection	**2 weeks**
2	Preparation of abstract	**1 Week**
3	Design, implementation and testing of the project	**7 Weeks**
4	Documentation and Mini project presentation	**4 Weeks**

Guidelines for the Evaluation

S. no	Description	Maximum Marks
1	Weekly Assessment	**20**
2	PPT preparation	**5**
3	Presentation	**10**
4	Queries and Answers	**5**
5	Documentation of Mini project	**10**
	Total	**50**

Guidelines:

1. Each student will be allotted to a faculty supervisor for mentoring.
2. Mini project maybe targeted to achieve practical competences.
3. Mini project shall have inter-disciplinary/ industry relevance.
4. All the results obtained are to be clearly presented and documented with the reasons/explanations.

22ECU02

Up-skill Certification Course - II

Instruction	-
Duration of SEE	-
SEE	-
CIE	25 Marks
Credits	0.5

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

AICTE Model Curriculum with effect from AY 2027-28

BE (Electronics and Communication Engineering)

SEMESTER – VII

S.no	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	22ECC29	Computer Networks	3	-	-	3	40	60	3
2	22ECC30	IoT and Applications	3	-	-	3	40	60	3
3		Professional Elective-V	3	-	-	3	40	60	3
4		Professional Elective-VI	3	-	-	3	40	60	3
5	22MBC01	Engineering Economics and Accountancy	3	-	-	3	40	60	3
6	22CEM01	Environmental Science	2	-	-	2	-	50	Non-Credit
PRACTICALS									
7	22ECC31	Computer Networks Lab	-	-	2	3	50	50	1
8	22ECC32	IoT Lab	-	-	2	3	50	50	1
9	22ECC33	Project Part - I	-	-	4	-	50	-	2
Total			**17**	**-**	**8**	**23**	**350**	**450**	**19**
Clock Hours Per Week: 25									

L: Lecture **D: Drawing** **CIE: Continuous Internal Evaluation**

T: Tutorial **P: Practical/Project Seminar/Dissertation** **SEE: Semester End Examination**

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

AICTE Model Curriculum with effect from AY 2027-28

BE (Electronics and Communication Engineering)

SEMESTER – VII

S. no	List of Courses in Professional Elective-V		List of Courses in Professional Elective-VI	
	Course code	**Title of the Course**	**Course code**	**Title of the Course**
1	22ECE25	CAD for VLSI Verification	22ECE31	Design for Testability
2	22ECE26	5G Communications	22ECE32	Wireless Sensor Networks
3	22ECE27	DSP Processors and Architectures	22ECE33	Speech and Audio Processing
4	22ECE28	System on Chip	22ECE34	Linux and Scripting languages
5	22ECE29	Global Navigation Satellite Systems	22ECE35	RF and Millimetre Wave Circuit Design
6	22ECE30	Pattern Recognition Using Machine Learning	22ECE36	Network Security

22ECC29

COMPUTER NETWORKS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: A course on digital communications is required.

Course Objectives:

This course aims to:

1. Understand the general over view of the concepts and fundamentals of computer networks.
2. Familiarize the students with the standard models for the layered approach to communication between machines in a network and the protocols of the various layers.
3. Learn the Routing, congestion control algorithms and application layer protocols.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the architecture and principles of computer networks.
2. Identify the different types of network topologies and their functionalities.
3. Analyze the functionalities and performance of various network protocols.
4. Understand frame formats of different protocols.
5. Gain the knowledge of use of cryptography and network security.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	2	1	3	1	1	1	1	1	3	3	2	3
CO 2	3	3	3	3	1	2	2	2	1	2	2	3	3	2	3
CO 3	3	2	3	3	1	2	2	1	2	1	2	3	3	2	3
CO 4	2	2	2	3	1	2	2	2	1	2	1	3	3	2	3
CO 5	3	2	3	2	1	3	2	1	2	1	1	3	3	2	3

UNIT-I

Introduction: uses of computer networks, network topologies, network hardware**,** network software, reference models: the TCP/IP and OSI reference models, example networks: the internet.

UNIT-II

Data Link Layer: design issues, CRC for error detection, Hamming code for error detection and correction, elementary data link protocols: simplex stop-and-wait protocol for error free and noisy channels. Sliding window protocols: Go-Back-N, Selective Repeat. Example data link protocols – HDLC.

Medium Access Control Sublayer: The channel allocation problem, Multiple access protocols: ALOHA, Carrier sense multiple access protocols, LAN Protocols: Ethernet (IEEE 802.3), WiFi (IEEE 802.11), WiMAX (IEEE 802.16), Bluetooth (IEEE 802.15.1), Zigbee (IEEE 802.15.4).

UNIT-III

Network Layer: design issues, routing algorithms: the optimality principle, shortest path algorithm, flooding, distance vector routing, link state routing, hierarchical routing, broadcast routing, multicast routing, anycast routing. Congestion Control Algorithms, Quality of Service, Internetworking, network layer in the internet: IPv4, IPv6.

UNIT-IV

Transport Layer: Transport Services, Elements of Transport protocols, Internet transport layer protocols: UDP and TCP.

UNIT-V

Application Layer: Domain Name System (DNS), electronic mail, file transfer, the World Wide Web (WWW).

Cryptography and Network Security: security goals, attacks, services and techniques, symmetric-key ciphers and asymmetric-key ciphers.

Text Books:

1. Andrew S. Tanenbaum and David Wetherall, "Computer networks", 5th Edition, Prentice Hall, 2011.
2. William Stallings, "Data and computer communications", 10th Edition, Pearson, 2013.
3. Behrouz A. Forouzan, "Data Communications and Networking", 4th Edition, McGrawHill, 2013.

Suggested Reading:

1. James F.Kurose and Keith W.Ross, "Computer Networking – A top-down approach", 8th Edition, Pearson, 2021.
2. L. Peterson and B. Davie, "Computer Networks – A Systems Approach", 5th Edition, Elsevier Morgan Kaufmann Publisher, 2011.
3. S. Keshav, "An Engineering Approach to Computer Networking", 2nd Edition, Pearson, 2001.

e-Resources:

1. https://onlinecourses.swayam2.ac.in/cec21_cs04/preview.

22ECC30

IoT AND APPLICATIONS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge of Programming and Problem Solving, Computer Organization and Embedded systems.

Course Objectives:
This course aims to:
1. Provide an insight into the required infrastructure for IoT technology.
2. Introduce the Python programming language and familiarize yourself with the IoT concepts, their origin, and methodology.
3. Develop Django Framework and domain-specific applications.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Understand the terminology, enabling technologies, and various protocols of IoT.
2. Illustrate the Machine-to-machine, SDN, and NFV concepts and build simple IoT systems using Raspberry Pi board, NodeMCU, and Beagle Bone Black.
3. Apply the basics of Python programming language, which is used in many IoT devices.
4. Create the steps involved in IoT system design methodology.
5. Develop web applications using a Python-based framework called Django and IoT technologies for domain-specific applications.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	3	1	1	1	1	1	1	1	1	2	2	2
CO 2	2	2	2	2	2	1	1	1	1	1	1	1	2	2	2
CO 3	2	3	2	2	1	1	1	1	1	1	1	1	2	3	2
CO 4	2	2	2	2	1	1	1	1	1	1	1	1	2	2	2
CO 5	3	2	3	3	3	1	2	3	1	1	1	3	3	2	3

UNIT-I

Introduction and Concepts: Introduction to Internet of Things, Definitions and Characteristics of IoT, Physical Design of IoT: Things in IoT, IoT Protocols, Concepts of zigbee, BT. Logical Design of IoT, IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies, Wireless Sensor Networks, Cloud Computing, Big Data, Communication Protocols, IoT Levels & Deployment Templates.

UNIT-II

Machine To Machine and Networking: Introduction, MACHINE TO MACHINE, Differences between IoT and Machine To Machine, Software Defined Networking, Network Function Virtualization.
IoT Physical Devices and End Points: Basic building blocks of an IoT device, Raspberry Pi- about the Raspberry Pi board, Raspberry Pi interfaces- Serial, SPI & I2C, Introduction to NodeMCU, Introduction to BeagleBone Black.

UNIT-III

Introduction to Python: Motivation for using Python for designing IoT systems, Language features of Python, Data types: Numbers, Strings, Lists, Tuples, Dictionaries, Type Conversions, Data Structures: Control of flow-if, for, while, range, break/continue, pass, functions, modules, packaging, Python packages of Interest for IoT: JSON, XML, HTTPLib, URLLib, SMTPLib.

UNIT-IV

IoT Platforms Design Methodology: Introduction, IoT Design Methodology Steps-Purpose and Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specifications, IoT Level Specification, Functional View Specification, Operational View Specification, Device and Component Integration,Application Development, Case Study on IoT System for Weather Monitoring.

UNIT-V

IoT Physical Servers and Cloud Offerings: Introduction to cloud storage models and Communication APIs, WAMP: AutoBahn for IoT, Xively cloud for IoT.

Python Web Application Framework: Django Framework-Roles of Model, Template, and View.

Domain-Specific IoTs: IoT applications for Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, health, Lifestyle, and introduction to IIoT.

Text Books:

1. Arshdeep Bahga and Vijay Madisetti, “Internet of Things - A Hands-on Approach”, Universities Press, 2015.
2. Tony Gaddis, “Starting out with Python”, 4th edition, Pearson, 2017.

Suggested Reading:

1. Francis da Costa, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st edition,press Publications, 2014.
2. Matt Richardson, Shawn Wallace, O'Reilly, “Getting Started with Raspberry Pi”, SPD, 2014.
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases",1st edition, 2017.

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs53/preview.

22ECE25

CAD FOR VLSI VERIFICATION

(Professional Elective-V)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Knowledge of VLSI Design and basics of Digital system design.

Course objectives:

This course aims to:

1. Different CAD tools available for various aspects of VLSI Design and their flows.
2. Working of different simulators.
3. Design Flow of popular commercially used CAD tools.

Course Outcomes:

After completion of this course, students will be able to:

1. Justify the importance and use of CAD tools.
2. Differentiate design flow for different types of ASIC.
3. Understand the design flows of CADENCE Virtuoso, CADENCE NC Launch and XILINX ISE
4. Differentiate various types of simulators.
5. Understand the importance of design for testability.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	3	1	1	2	1	1	1	2	1	3	1
CO 2	2	2	2	1	3	1	1	2	1	1	1	2	1	3	1
CO 3	1	2	2	1	3	1	1	2	1	1	1	2	1	3	1
CO 4	2	1	1	1	1	1	1	2	1	1	1	2	3	1	1
CO 5	1	2	1	1	3	1	1	2	1	1	1	2	1	3	1

UNIT-I: Evolution and classification of CAD tools

Evolution from SSI to VLSI, Hardware description language (HDL), Register Transfer Level (RTL), Importance of Design Automation, Role of CAD Tools, Role of the Designer Types of CAD tools: Editor, Simulator, Analyzer, Synthesis. Types of editors.

UNIT-II: Digital Design Flow

Introduction to CPLD and types of CPLDS, FPGA Design Flow, Xilinx design flow, ISE simulator, RTL synthesis, Bit file generation, uploading an FPGA, Custom ASIC Design Flow, Cadence Digital Design Flow, NC launch. Comparison of ASIC and FPGA.

UNIT-III: Analog Design Flow

Introduction to CMOS, Implementation of Inverter, NAND, NOR, Ex- OR Gates in CMOS Logic, Cadence Analog Design Flow, Schematic editor, Spectra simulator, Layout editor, DRC, LVS, RC extraction.

UNIT-IV: Simulation tools for VLSI

Introduction, Liner Model of MOS, Switch Model of MOS Circuit Level Simulation, Gate level simulation: Compiled -Code simulation, Event -Driven Simulation, VLSI circuit Analysis, Timing Verification: Static and Dynamic Timing verification, Circuit Optimization.

UNIT-V: Design for Testability

Introduction to VLSI testing: Importance of testing, Challenges in VLSI testing, Levels of abstractions in VLSI testing, Functional vs. Structural approach to testing, Complexity of the testing problem, Controllability and Observability.

Textbooks:

1. Wolfgang Fichtner Martin Morf, "CAD for VLSI Design and Application" 2003.
2. Laung -Terng, Wang, Cheng -Wen Wu, Xiaoqing Wen, "VLSI Test Principles and Architectures" Morgan Kaufmann Publishers -Elsevier.

Suggested Reading:

1. Parag K. Lala, An Introduction to Logic Circuit Testing, Morgan & Claypool Publishers.

e-Resources:

1. https://nptel.ac.in/courses/106106088.

22ECE26

5G COMMUNICATIONS

(Professional Elective-V)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: The student must prior knowledge in Communication systems, Mobile Cellular Communications.

Course Objectives:

This course aims:

1. Understand the requirements & concepts of 4G/5G.
2. Expose the architecture and radio access technologies of 5G.
3. Learn Massive MIMO concepts.

Course Outcomes:

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

1. Recall the requirements and key functionalities of 4G LTEA/5G NR technology.
2. Compare various channel access technologies, modulation techniques used in 5G wireless systems.
3. Illustrate the architecture of 5G and its NextGen core network.
4. Apply the 5G concepts to D2D communications.
5. Discuss the concept of massive MIMO.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	3	2	2	3	1	1	1	1	1	1	3	3	1
CO2	3	1	2	1	2	3	1	1	1	1	1	1	3	3	3
CO3	3	1	3	3	3	3	1	1	1	1	1	1	3	3	2
CO4	3	1	3	3	3	3	1	1	1	1	1	1	3	3	2
CO5	1	1	1	1	2	2	1	1	1	1	1	1	3	3	2

UNIT-I

Overview of 4G/5G Wireless Communications:

Evolution of mobile technologies (1G to 5G), 3GPP Releases & its key aspects, Overview of 5G, three high level 5G usage scenarios (eMBB, URLLC, mMTC), Key capabilities & requirements, performance & efficiency indicators, 5G vs. LTE-A Comparison, 5G frequency bands, 5G Use cases.

UNIT-II

5G Channel access Techniques: Basic requirements of transmission over 5G, Modulation Techniques- generalized frequency division multiplexing (GFDM), filter bank multi-carriers (FBMC) and universal filtered multi-carrier (UFMC), Multiple Accesses Techniques –non-orthogonal multiple accesses (NOMA), Sparse Code Multiple Access (SCMA) –Comparison of multiple access methods.

UNIT-III

5G NextGen core network: Introduction, 5G system enablers, NFV framework, SDN architecture. Traditional network vs. NFV/SDN network, 5G deployment options and migration strategy, 5G NR simplified architecture, 5G NR system architecture, 3GPP reference point-based architecture, 3GPP Service based Architecture.

UNIT - IV

Device-to-device (D2D) communications: use cases of D2D communication in Cellular networks, D2D in 5G: research challenges, Radio resource management for mobile broadband D2D.Multi-hop D2D communications for proximity and emergency services.

UNIT-V

Massive Multiple-Input Multiple-Output (MIMO) Systems: Introduction to Multi-Antenna system, Theoretical background: MIMO requirement, MIMO vs. massive MIMO, Massive MIMO benefits, single user and multi-user MIMO, capacity of MIMO for unknown CSIT, massive MIMO capacity, Massive MIMO OFDM transmitter employing digital precoding, analog beamforming and hybrid of digital precoding and analog beamforming.

Text Books:

1. Saad Z. Asif, "5G Mobile Communications Concepts and Technologies" CRC Press, 2019.
2. Wei Xiang, Kan Zheng, Xuemin (Sherman) Shen, **"**5G Mobile Communications", Springer publications-2016.
3. William Stallings "5G Wireless: A Comprehensive Introduction", Pearson Education, 2021.

Suggested Reading:

1. R. S. Kshetrimayum, "Fundamentals of MIMO Wireless Communications", Cambridge University Press, UK, 2017.
2. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks" first edition, John Wiley & Sons, 2015.
3. SuvraSekhar Das and Ramjee Prasad, "Evolution of Air Interface Towards 5G: Radio Access Technology and Performance Analysis", Gistrup, Denmark:River Publishers series in Communication, 2018.
4. AfifOsseiran, Jose F. Monserrat, Patrick Marsch, "5G Mobile and Wireless Communications Technology" Cambridge University Press-2016.

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc24_ee152/preview.

22ECE27

DSP PROCESSORS AND ARCHITECTURES

(Professional Elective-V)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge of Digital Signal Processing**.**

Course Objectives:

This course aims to:

1. Learn the architectural differences between DSP and General-purpose processors.
2. Study the fixed and floating-point DSP processor architectures.
3. Study the various applications of DSP Processors.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Classify the differences between DSP Processor and General-Purpose processor.
2. Understand the basic architectural needs of Programmable DSPs.
3. Explain the architecture features of DSP processors.
4. Develop interface with DSP processor to external peripherals.
5. Design and implement various signal processing algorithms on DSP processors.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO 2	2	2	2	1	2	1	1	1	1	1	1	2	2	2	2
CO 3	2	2	2	1	2	1	1	1	1	1	1	2	2	2	2
CO 4	2	1	2	1	1	1	1	1	1	1	1	2	1	1	1
CO 5	2	2	3	2	1	1	1	1	1	1	1	2	2	2	2

UNIT-I

Introduction to DSP Processors: Differences between DSP and other microprocessor architectures. Number formats- Fixed point, Floating point and block Floating point formats, IEEE-754 Floating point, Dynamic range and precision, Relation between data word size and instruction word size, Q-notation. Basic elements of real time DSP systems, DSP Hardware.

UNIT-II

Overview of TMS320C55X: Architecture of TMS320C55X Processor - Multiplier and Multiplier Accumulator, VLIW Architectures, Pipelining, Special addressing modes in PDSPs, Buses, Memory map, addressing modes, Instruction set, Pipeline and parallelism, Mixed C and Assembly language programming and on-chip peripherals.

UNIT-III

Analog Devices Family of DSP Devices: Analog Devices Family of DSP Devices – ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP 2100, ADSP-2181 high performance Processor.

UNIT-IV

The Blackfin Processor: Introduction to Blackfin Processor, Introduction to Micro Signal Architecture, Overview of Hardware Processing Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals

UNIT-V

Interfacing Memory and Parallel I/O Peripherals to Programmable DSP Devices: Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct Memory Access (DMA). Software Development Tools-Code Composer Studio (CCS), C compiler, Assembler and Linker.

Textbooks:

1. Avatar Singh and S. Srinivasan, "Digital Signal Processing Implementations Using DSP Microprocessors", Thomson Brooks, 2012.
2. Digital Signal Processing Applications Using the ADSP-2100 Family by The Applications Engineering Staff of Analog Devices, DSP Division, Edited by Amy Mar, PHI.

Suggested Reading:

1. B. Ventakaramani, M. Bhaskar, "Digital Signal Processors Architecture Programming and Applications", Tata McGraw Hill, 10th reprint,2015.
2. Embedded Media Processing by David J. Katz and Rick Gentile of Analog Devices, Newnes, ISBN 0750679123, 2005.

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc22_ee99/previewrocessing.
2. https://archive.nptel.ac.in/courses/108/106/108106149.

22ECE28

SYSTEM ON CHIP

(Professional Elective-V)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Concept of Embedded Systems, Microprocessors, microcontrollers and ASIC.

Course Objectives:

This course aims to:

1. Introduce students to the fundamental concepts of SoC Design
2. Familiarize students with the various interconnects and design consideration of SoC
3. Aquitaine student with various Design Flows in the process of SoC design.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the concepts related to SoC.
2. Differentiate between various interconnects used in SoC Design.
3. Choose appropriate SoC architecture based on various design constraints.
4. Model SoC using high level language like System C.
5. Understand all the steps involved in the Design, fabrication and production of SoC.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	2	3	1	1	1	2	2	1	2	3	3	3
CO 2	3	3	2	3	3	1	1	1	3	2	2	2	3	3	3
CO 3	3	3	3	3	3	1	1	1	2	2	2	3	3	3	3
CO 4	3	3	3	3	3	1	1	1	2	2	2	2	3	3	3
CO 5	3	2	2	2	3	1	1	1	2	2	1	2	3	3	3

UNIT-I

Introduction to System-on-Chip: What is System on Chip? SoC Design Flows, SoC Technology, ISAs, Cache Design, snooping and other coherency Protocols, Interrupt and Interrupt Controller, Memory Technology, SoC I/Os – timers, DMA Controller, Network and streaming device,

UNIT-II

SoC Interconnect: Interconnect Requirements, Protocol Adaptors, On-chip Protocol Class, Simple Bus Structures, Ordered and Unordered Interconnects, AMBA AXI Interconnect, Basic Interconnect Topologies- Simple Bus with One Initiator, Shared Bus with Multiple Initiators, Bridged Bus Structure, Network-on-Chip, Interconnect Building Blocks, Long Distance Interconnect -Domain Crossing, Metastability, CD-crossing bridge, PD Crossing, SERDES.

UNIT-III

System Design Consideration: Design Trade-offs in Memory Systems, SoC Energy Minimization, Designing for Testability and Debug Integration, Reliability and Security, Clock Sources, PLL and Clock Trees, Clock Skewing and Multi-cycle Paths.

Electronic System-Level Modeling: Modelling Abstraction, SystemC Modelling Library, Transaction-level Modelling, Processor Modelling with Different Levels of Abstractions.

UNIT-IV

Architectural Design Exploration: Hardware and Software Design Partition, Design Space Exploration, Hazards, Design-entry Languages, High-level Synthesis.

Formal Methods and Assertion-based Design: Formal language tools, assertions, simulation with assertion, Equivalence Checking.

UNIT-V

Fabrication and Production: Evolution of Design Closure, Register Transfer Languages, Chip Types and Classifications, Floor and Power Planning, Flow Steps, Production Testing, STA and Timing Sign OFF

Text Books:

1. David J. Greaves, "Modern System-on-Chip Design on Arm", ARM Education Media -2021.
2. Michael J. Flynn and Wayne Luk, "Computer System Design: Systemon-Chip". Wiley, 2011.

Suggested Reading:

1. B. Al Hashimi, "System on chip-Next generation electronics", The IET, 2006.
2. RochitRajsuman, "System-on- a-chip: Design and test", Advantest America R & D Center, 2000.
3. P Mishra and N Dutt, "Processor Description Languages", Morgan Kaufmann, 2008.

22ECE29

GLOBAL NAVIGATION SATELLITE SYSTEMS

(Professional Elective-V)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Fundamental concepts of communication are required.

Course Objectives:

This course aims to:

1. Explain the basic principle of operation of GPS, GPS ephemerides and signal structure.
2. Make the students to understand various coordinate systems and highlight the effect of various errors affecting GPS signals.
3. Make the students to appreciate the significance of other GNSS systems, principle of DGPS and augmentation systems.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Demonstrate the fundamental concepts of communications in understanding of GPS architecture, operation and signal structure.
2. Apply the principles of orbital mechanics, time references, coordinate systems and range measurements in estimating user position.
3. Examine the effect of various error sources and satellite geometry on position estimates and analyze the suitability of a given data format.
4. Compare the architecture and working of other GNSS systems and make use of GNSS systems in a variety of civilian and defense applications.
5. Relate the knowledge of DGPS techniques in understanding augmentation systems.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	1	2	1	1	1	2	1	1	1	2	3	1	1
CO 2	3	3	2	2	1	1	1	2	1	1	1	2	3	1	1
CO 3	3	3	3	3	1	1	1	2	1	1	1	2	3	1	1
CO 4	2	2	2	1	-	1	1	2	1	1	1	2	3	1	1
CO 5	3	2	2	1	1	1	1	2	1	1	1	2	3	1	1

UNIT-I

GPS Fundamentals: Introduction to Radio Navigation system: VOR, ILS. GPS System Segments: space, control and user segments, Principle of operation, Current status of GPS satellite constellation. Orbital Mechanics: GPS ephemeris data, algorithm for computation of satellite's position from ephemeris data. Time References: solar and sidereal days, UTC time, GPS time.

UNIT-II

GPS Signals: Legacy GPS signals: Signal structure, Operating frequencies, C/A and P-Code, Navigation message, Modernized GPS signals: list of signals and their significance. Range measurements: code and carrier measurements, User position estimation with PRN codes.

Coordinate Systems: Earth Centered Earth Fixed (ECEF) coordinate system, Earth Centered Inertial (ECI) coordinate system, Geodetic coordinate system, Ellipsoid and Geoid, Regional and Global Datum, World Geodetic System (WGS-84).

UNIT-III

GPS Error Sources: Satellite clock error, ephemeris error, Receiver clock errors, satellite and receiver instrumental bias, Multipath error, receiver measurement noise, ionospheric error and tropospheric error, Klobuchar model, ionospheric delay estimation using dual frequency measurements and UERE. Dilution of precision: HDOP, VDOP, TDOP, PDOP & GDOP.

UNIT-IV

Data Formats: RINEX Observation and Navigation Data formats, NMEA format.
GNSS: Architecture, operation and signals of other navigational satellite systems Galileo, Beidou and GLONASS, QZSS.
IRNSS: Architecture and signals.

UNIT-V

Differential GPS (DGPS): Principle of DGPS, Types of DGPS: Local Area DGPS (LADPS), Wide Area DGPS (WADGPS).
GPS Augmentation Systems: Principle of operation of Satellite Based Augmentation system (SBAS) and Ground Based Augmentation System (GBAS).
GNSS Applications: Surveying, Mapping, Marine, air and land Navigation, Military and Space Application.

Text Books:

1. Elliot D Kaplan and Christopher J Hegarty, "Understanding GPS principles and applications", Artech House Publishers, 2/e Boston & London 2005.
2. Pratap Misra and Per Enge, "Global Positioning System Signals, Measurement, and Performance", Ganga- Jamuna Press, 2/e, Massachusetts, 2010.

Suggested Reading:

1. B. Hofmann-Wellenhof, H. Lichtenegger, and J. Collins, "GPS Theory and Practice", Springer Verlog, 5/e, 2008.
2. Ahmed El-Rabbany, "Introduction to GPS", Artech House Publishers, 2/e, Boston 2006.
3. Bradford W. Parkinson and James J. Spilker, "Global Positioning system: Theory and Application", Vol.II, American Institution of Aeronautices and Astronautics Inc., Washington, 1996.

e-Resources:

1. https://archive.nptel.ac.in/content/syllabus_pdf/105107194.pdf.

22ECE30

PATTERN RECOGNITION USING MACHINE LEARNING

(Professional Elective-V)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: The student should have knowledge of probability and random variables.

Course Objectives:

This course aims to:

1. Model of pattern recognition using decision theory.
2. Develop of linear models for classification problems.
3. Analyze the unsupervised learning models and also clustering.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the concepts of pattern recognition.
2. Apply the parametric and linear models for classification.
3. Design algorithms using neural networks for machine learning problems.
4. Implementation of Support Vector Machines (SVM) algorithm for real time applications.
5. Evaluate various unsupervised clustering techniques.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	1	1	-	-	-	-	-	-	-	2	-	-
CO 2	3	2	1	2	2	-	-	-	-	-	-	1	3	2	1
CO 3	3	2	3	2	3	-	-	-	-	-	1	2	3	2	2
CO 4	3	2	3	2	3	-	-	-	-	-	1	1	3	2	2
CO 5	3	2	3	2	2	-	-	-	-	-	2	2	3	3	2

UNIT-I

Introduction to Pattern Recognition: Pattern Recognition Systems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Bayesian Decision Theory, continuous Features, Minimum Error rate classification, Classifiers, Discriminant Functions and Decision surfaces, Bayesian Decision Theory- Discrete Features. Maximum-Likelihood and Bayesian parameter estimation: Maximum Likelihood estimation, Bayesian estimation.

UNIT-II

Linear Models for classification and regression: Linear Models for Regression: Linear Basis Function Models, The Bias - Variance Decomposition, Bayesian Linear Regression, Linear Models for Classification: Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models, Bayesian Logistic Regression.

UNIT-III

Artificial Neural Network for Classification and Regression: Overview of Artificial Neural Networks, Multilayer Feedforward Neural Networks with Sigmoidal activation functions, Backpropagation Algorithm; Representation abilities of feedforward networks, Feedforward networks for Classification and Regression; Backpropagation in practice, Radial Basis Function Networks; Gaussian RBF networks, Learning Weights in RBF networks; K-means clustering algorithm.

UNIT-IV

Support Vector Machines and Kernel Based Methods: Support Vector Machines; Introduction, Obtaining the optimal hyperplane, SVM formulation with slack variables; non linear SVM classifiers, Kernel functions for non-linear SVMs; Mercer and Positive Definite kernels, Support Vector Regression and ε-insensitive Loss function, examples of SVM learming, Overview of SMO and other algorithms for SVM; v-SVM and v-SVR; SVM as a risk minimizer, Positive definite kernels; RKHS; Representor Theorem.

UNIT-V

Feature Selection, Model Assessment and Cross-validation: Feature Selection and Dimensionality Reduction; Principal Component Analysis, No Free Launch theorem; Model selection and model estimation; Bias-variance trade-off, Assessing learnt Classifiers; Cross Validation.

Boosting and Classifier Ensembles: Bootstrap, Bagging and Boosting; Classifier Ensembles; Adaboost, Risk minimization view of Adaboost

Text Books:

1. C. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
2. Richard O. Duda, Peter E. Hart and David G. Stork, "Pattern Classification", 2nd Edition John Wiley & Sons, 2001.

Suggested Reading:

1. B. Yagnanarayana, Artificial Neural Networks, Prentice Hall, New Delhi, 2007.

e-Resources:

1. https://nptel.ac.in/courses/117108048.

22ECE31

DESIGN FOR TESTABILITY

(Professional Elective-VI)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: A prior knowledge of Digital System Design.

Course Objectives:

This course aims to:

1. Provide an in-depth understanding of the testing and faults affecting VLSI circuits.
2. Provide knowledge on various testing methods.
3. Evaluate various test cases.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the concepts of testing for VLSI circuits.
2. Apply techniques to improve testability of VLSI circuits.
3. Utilize logic simulation methods such as ATPG in testing of VLSI circuits.
4. Analyze the concepts of BIST in testing VLSI circuits.
5. Evaluate various Testing methods.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	1	1	2	1	1	1	2	3	1	1
CO 2	2	2	2	1	1	1	1	2	1	1	1	2	3	1`	1
CO 3	1	1	1	1	1	1	1	2	1	1	1	2	3	1	1
CO 4	1	2	1	1	1	1	1	2	1	1	1	2	3	1	1
CO 5	1	1	1	-	1	1	1	2	1	1	1	2	3	1	1

UNIT-I

Introduction to VLSI testing: Importance of testing, Challenges in VLSI testing, Levels of abstractions in VLSI testing, Functional vs. Structural approach to testing, Complexity of the testing problem, Controllability and Observability, Generating test for a single stuck at fault in combinational logic, D-algorithm, PODEM algorithms, Test optimization and fault coverage.

UNIT–II

Design for testability (DFT): Testability analysis, Scan cell design, Scan architectures, Scan design rules, Scan design flow, Special purpose scan designs Logic and fault simulation, Fault detection, Adhoc and structured approaches to DFT, Various kinds of scan design. Introduction to design for debug (DFD).

UNIT–III

Test generation: Random test generation, Boolean difference, ATPG algorithms for combinational circuits, Sequential ATPG, Untestable faults, IDDQ testing The LFSRs and their use in random test generation and response compression.

UNIT–IV

Built-in self-test (BIST): Design rules, Exhaustive testing, Pseudo-random testing, Pseudo-exhaustive testing, Output response analysis, Logic BIST architectures Test compression: Test stimulus compression.

UNIT–V

Boundary scan and core -based testing: IEEE standards for digital boundary scan, Embedded core test standards Analog and mixed signal testing, Delay testing, Physical failures, Soft errors Reliability, FPGA testing.

Text Books:

1. Parag K. Lala, An Introduction to Logic Circuit Testing, Morgan & Claypool Publishers.
2. Michael L. Bushnell and Vishwani D. Agrawal, Essentials of Electronic Testing, Springer India.
3. Laung -Terng, Wang, Cheng -Wen Wu, Xiaoqing Wen, "VLSI Test Principles and Architectures" Morgan Kaufmann Publishers -Elsevier.

Suggested Reading:

1. Parag K Lal, " Fault Tolerant and Fault Testable Hardware Design " , BS Publications, 2020.
2. M. Abramovici, M. Breuer, and A. Friedman, Digital System Testing and Testable Design, Jaico Publishing House.

e-Resources:

1. https://archive.nptel.ac.in/courses/117/105/117105137.

22ECE32

WIRELESS SENSOR NETWORKS

(Professional Elective-VI)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: A course on Computer Networks is required.

Course Objectives:

This course aims to:

1. Learn Wireless Sensor Network fundamentals.
2. Familiarize the protocols developed for Wireless sensor networks.
3. Learn the Wireless sensor network platforms, tools.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the characteristics, challenges and deployment mechanisms of WSNs.
2. Illustrate the Network architecture and design considerations for Physical and transport Layers.
3. Inspect the Specialized Features of WSN.
4. Examine the knowledge of various protocols of Wireless Sensor Networks.
5. Choose various sensor network platforms, tools, and applications.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	2	2	2	2	2	2	3	1	2	2	2	2
CO 2	3	3	2	2	2	2	2	2	2	2	1	2	2	2	2
CO 3	3	3	3	3	3	2	2	2	3	3	2	2	3	3	3
CO 4	3	3	3	3	2	2	2	2	2	2	1	2	3	3	2
CO 5	2	2	1	2	2	2	2	2	2	1	2	2	3	3	3

UNIT-I

Introduction to Wireless Sensor Network:

Introduction to Wireless Sensor Networks.: Features, Design challenges, characteristics of Wireless Sensor Networks, Advantages of WSN and applications. Sensor deployment mechanisms.

UNIT-II

Sensor Networks – Architectures:

Enabling Technologies for Wireless Sensor Networks. Single-Node Architecture - Hardware Components, Network Architecture Sensor Networks Scenarios, Design Principle, Physical Layer and Transceiver Design Considerations, Optimization Goals and Figures of Merit, Gateway Concepts.

UNIT-III

Specialized Features of WSN:

Sensor deployment mechanisms, coverage issues, connectivity, energy consumption of sensor nodes, Issues related to Power management, Synchronization, Localization. Data processing and aggregation, Data storage, Clustering, Time Synchronization, security challenges.

UNIT IV

WSN Networking Concepts and Protocols:

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts: S-MAC, Contention based protocols - PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols – examples of proactive and reactive, Challenges and Issues in Transport layer protocol.

UNIT V

Sensor Network Platforms and Tools:

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, CONTIKIOS, Node-level Simulators – NS2 and its extension to sensor networks.

Text Books:

1. Holger Karl, Andreas Willig, Protocol and Architecture for Wireless Sensor Networks, John Wiley Publication, Jan 2011.
2. F. Zhao and L. Guibas, “Wireless Sensor Networks: An Information Processing Approach”, Morgan Kaufmann, 1st Indian reprint,2013.
3. Edgar H. Callaway Jr. and Edgar H. Callaway, “Wireless Sensor Networks: Architectures and Protocols”, 1st edition, Auerbach Publications, 2003.

Suggested Reading:

1. Kazem Sohraby, Daniel Minoli, &TaiebZnati, “Wireless Sensor Networks-Technology, Protocols, and Applications”, John Wiley, 2007.
2. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.

e-Resources:

1. https://nptel.ac.in/courses/106105160.

22ECE33

SPEECH AND AUDIO PROCESSING

(Professional Elective-VI)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Digital Signal Processing, Digital Communications.

Course Objectives:

This course aims to:

1. Provide students with the knowledge of basic characteristics of speech signal in relation to production and hearing of speech by humans.
2. Describe basic algorithms of speech analysis and pitch extraction.
3. Learn the various algorithms for speech recognition like HMM and Dynamic warping.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the basic characteristics of speech signal in relation to production and hearing of speech by humans.
2. Analyze speech and extract features for speech applications.
3. Comprehend the spectral domain of speech and the resilience of spectral parameters.
4. Distinguish between different speech coding techniques.
5. Design various applications like recognition, synthesis, and coding of speech.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1
CO 2	2	2	3	1	3	3	1	1	1	1	1	1	3	3	2
CO 3	3	3	3	2	3	3	1	1	1	1	1	1	3	3	2
CO 4	3	3	3	2	3	3	1	1	1	1	1	1	2	3	3
CO 5	3	3	3	2	3	3	1	1	1	1	1	3	3	2	2

UNIT-I

Fundamentals of Speech:

Mechanism of speech production: Vocal track and physiology, LTI Model for Speech Production, Nature of Speech Signal, Phonetics, Types of Speech, Voiced and Unvoiced Decision Making, Speech vs Silence discrimination, Audio File Formats: Nature of WAV File.

UNIT-II

Parameters of Speech: Pitch Frequency, Pitch period Measurement – Autocorrelation Method, AMDF Method, Parallel Processing approach, FFT – based method.

Linear Prediction of Speech: Lattice Structure realization, Forward Linear Prediction, Autocorrelation Method, and Covariance Method.

UNIT-III

Spectral parameters of Speech:

Short -Time Spectral analysis of Speech: STFT, Spectrogram. Homomorphic Processing, Cepstrum – Pitch period and Formants Evaluation, The Auditory System as a Filter bank, Mel Frequency Cepstral Coefficients (MFCCs), Perceptual Liner Prediction (PLP), Rasta-PLP, Log Frequency Power Coefficients (LFPs).

UNIT-IV

Speech Quantization and Coding: Uniform and Non-Uniform Quantizers and Coder, Companded Quantizer, Adaptive Quantizers, Waveform coding of Speech, Comparison. Parametric Speech Coding Techniques, Transform domain coding of speech.

UNIT-V

Speech Processing Applications:

Speech Recognition Systems- Problems in Automatic speech recognition, Dynamic Time Warping, Hidden Markov Models, Speaker Recognition using Tensor flow, Speech Enhancement, Speech Synthesis – A Text to Speech System, HMM based Synthesis.

Text Books:

1. Dr.Shilpa D. Apte, “Speech and Audio Processing”, Wiley India edition, 2012.
2. Owens F.J., "Signal Processing of Speech", Macmillan New Electronics, 1/e, 2000.

Suggested Reading:

1. Daniel Jurefsky and James H. Martin, " Speech and Language Processing", PHI, 2/e, 2003.
2. Papamchalis, " Practical Approaches to speech coding", PHI, 1987 .

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc22_ee117/preview.

22ECE34

LINUX AND SCRIPTING LANGUAGES

(Professional Elective-VI)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Programming and Problem-Solving Skills.

Course Objectives:

This course aims to:

1. Linux programming and Networking.
2. Study the principles of Scripting languages.
3. Understand and make effective use of Linux utilities and scripting language to solve problems.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the Linux basic concepts and file management.
2. Familiarize with Linux networking file system.
3. Develop the programs using Perl Scripting.
4. TCL fundamentals and TK usage with example.
5. Implement programs using Python Scripting.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	1	2	1	1	1	1	1	1	1	2	2	1
CO 2	1	2	2	1	2	1	1	1	1	1	1	1	2	3	1
CO 3	2	2	3	2	2	1	1	1	1	1	1	1	3	2	2
CO 4	2	1	2	2	3	1	1	1	1	1	1	2	3	2	3
CO 5	1	1	1	1	2	1	1	1	1	1	1	1	2	2	1

UNIT-I

Linux Basics: Introduction to Linux, File System of the Linux, General usage of Linux kernel & basic commands, Linux users and group, Permissions for file, directory and users, Searching a file & directory, zipping and unzipping concepts.

UNIT-II

Linux Networking: Introduction to Networking in Linux, Network basics & tools, File transfer protocol in Linux, Network file system, Domain Naming Services, Dynamic hosting configuration Protocol & Network information Services.

UNIT-III

Perl Scripting: Introduction to Perl Scripting, working with Simple Values, Lists and Hashes, Loops and Decisions, Regular Expressions, Files and Data in Perl Scripting, References &Subroutines, Running and Debugging Perl, Modules, Object-Oriented Perl.

UNIT-IV

TCL/TK Scripting: TCL Fundamentals, String and Pattern Matching, TCL Data Structures, Control Flow Commands, Procedures and Scope, Evel, Working With UNIX, Reflection and Debugging, Script Libraries, TK Fundamentals, TK by Examples, The Pack Geometry Manager, Binding Commands to X Events, Buttons and Menus, Simple TK Widgets, Entry and List box Widgets Focus, Grabs and Dialogs.

UNIT-V

Python Scripting: Introduction to Python, Using the Python Interpreter, More Control Flow Tools, Data Structures, Modules, Input and Output, Errors and Exceptions, Classes, Brief Tour of the Standard Library.

Text Books:

1. Daniel J Barrett "Linux Pocket Guide: Essential Commands" O'REILLY, 1st Edition, 2016.
2. Brent Welch, Ken Jones, and Jeff Hobbs, "Practical Programming in Tcl and Tk", Prentice Hall, 4th edition, 2003.
3. Anurag Gupta, G Biswas "Python Programming" McGraw Hill, 1st Edition, 2019.

Suggested Reading:

1. Red Hat Enterprise Linux 4: System Administration Guide Edition 2 Copyrights 2005 Red Hat, Inc.
2. Tom Christiansen, brian d foy, Larry Wall, Jon Orwant "Programming Perl" O'REILLY, 4th Edition,2012.

e-Resources:

1. https://archive.nptel.ac.in/content/syllabus_pdf/117106113.pdf.

22ECE35

RF AND MILLIMETRE WAVE CIRCUIT DESIGN

(Professional Elective-VI)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic Concepts of RF, Microwave and Millimeter Wave Technology.

Course Objectives:

This course aims to:

1. State the concept of RF, Millimeter Wave (mmWave) technology.
2. Designing procedure and Comprehensive knowledge of the RF Power Amplifiers and Oscillators.
3. Comprehensive knowledge of the active and passive circuit elements for circuit design, measurement techniques and applications of mmWaves.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Explain the requirement of RF and mm-Wave technology.
2. Analyze the response of RF Power Amplifiers and Oscillators.
3. Analyze the active and passive circuit elements for RF and mm-Wave technology.
4. Examine different measurement techniques for mm-Wave technology.
5. Aspire for pursuing a carrier in system application for mm-Wave technology.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	1	1	1	1	1	1	1	1	1	2	1	1
CO 2	3	2	1	2	2	1	1	1	1	1	1	1	3	2	1
CO 3	3	2	3	2	3	1	1	1	1	1	1	2	3	2	2
CO 4	3	2	3	2	3	1	1	1	1	1	1	1	3	2	2
CO 5	3	2	3	2	2	1	1	1	1	1	2	2	3	3	2

UNIT-I

Introduction to RF and MM-Wave Technology: Basic architectures, Passive RLC Networks, Parallel RLC tank, Q, Series RLC networks, matching, Introduction to mm-Wave Integrated Circuits, GaAs Fabrication Technology and various processes, Materials used for mm-Wave Integrated Guides, Introduction to Monolithic Microwave Integrated Circuits (MMICs) technology.

UNIT-II

RF Power Amplifiers and Oscillators: Class A, AB, B, C amplifiers, Class D, E, F amplifiers, RF Power amplifier design examples, Voltage controlled oscillators, Resonators, Negative resistance oscillators, Phase locked loops, Linearized PLL models, Phase detectors, charge pumps, Loop filters, and PLL design examples.

UNIT-III

Active and passive circuit elements: Transmission lines for Microwave Integrated Circuits, Discontinuities, Lumped elements Passive Components: Ring Resonator Filters. Bipolar Transistors, MESFETs, HEMTs Active Components: Oscillators, Electronic Phase Shifters, Balanced Mixers, Amplifier Topologies.

UNIT-IV

Measurement Techniques: Introduction, mm-Wave measurement techniques: Electric field probe, Measurement of Attenuation constant and guide wavelength. Measurement at Radiation Loss at bents.

UNIT-V

System Application: MICs in Phased Array Radars, MICs in Satellite Television Systems, Microwave Radio Systems, Monolithic mm-Wave Transceiver.

Text Books:

1. The design of CMOS Radio frequency integrated circuits by Thomas H. Lee Cambridge university press, 2004.
2. RF Micro Electronics by Behzad Razavi, Prentice Hall, 1997.
3. MMIC Design by I. D. Robertson, The Institution of Electrical Engineers, U.K., 1995
4. Microwave Integrated circuit by K. C. Gupta, A. Singh, John Wiley & Sons, 1974
5. Millimeter wave Integrated Circuit by E. Carey and S. Lidholm, Springer, 2005
6. Millimeter Wave and Optical Dielectric Integrated Guides and Circuits by S. K. Koul, John Wiley & Sons, 1997.

Suggested Reading:

1. Stripline-like Transmission lines for Microwave Integrated circuits, B. Bhat, S. K. Koul, Wiley Eastern Ltd., New Delhi.
2. Microwave Integrated Circuits, I. Kneppo, J. Fabian, P. Bezousek, P. Hrnicko and M. Pavel, Springer.

22ECE36

NETWORK SECURITY

(Professional Elective-VI)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: A course Computer Networks is required.

Course Objectives:

This course aims to:

1. Learn the basic concepts of Security Attacks, Services, and mechanisms.
2. Understand the Symmetric Key Encryption and Public key Cryptography algorithms.
3. Learn the Network Security and System Security approaches.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Familiarize the basic concepts of Computer Security and Security Attacks, Services, Mechanisms, Design principles.
2. Understand the Symmetric Encryption and Message Confidentiality principles and operation.
3. Demonstrate the Public-Key Cryptography and Message Authentication algorithms.
4. Examine the Key Distribution using symmetric and asymmetric encryption and User Authentication using Public-Key Infrastructure.
5. Apply Network Security and System Security approaches for different applications.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	2	3	1	2	3	1	1	2	1	1	3	3	1	3
CO 2	3	3	3	2	3	3	2	2	1	1	1	3	2	3	2
CO 3	3	3	3	2	3	3	2	1	2	1	1	2	3	3	3
CO 4	3	3	2	1	3	3	1	1	2	1	1	3	3	2	2
CO 5	3	3	3	2	3	3	1	1	1	1	1	3	3	3	3

UNIT-I

Introduction to network security: Computer Security Concepts, the OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Fundamental Security Design Principles, Attack Surfaces and Attack Trees, A Model for Network Security, Standards.

UNIT-II

Symmetric Encryption and Message Confidentiality: Symmetric Encryption Principles, Symmetric Block Encryption Algorithms: DES, Triple DES and AES, Random and Pseudorandom Numbers, Stream Ciphers and RC4, Cipher Block Modes of Operation.

UNIT-III

Public-Key Cryptography and Message Authentication: Approaches to Message Authentication Secure Hash Functions, Message Authentication Codes, Public-Key Cryptography Principles, Public-Key Cryptography Algorithms: The RSA Public-Key Encryption Algorithm, Diffie–Hellman Key Exchange, Digital Signatures Standards.

UNIT-IV

Key Distribution and User Authentication: Symmetric Key Distribution Using Symmetric Encryption, Kerberos, Key Distribution Using Asymmetric Encryption, X.509 Certificates, Public-Key Infrastructure.

UNIT-V

Network Security: Wireless Network Security: Wireless Security, IEEE 802.11i Wireless LAN Security.

Electronic mail security: E-mail Architecture, E-mail Protocols, E-mail Threats and Comprehensive E-mail Security, S/MIME.

System Security: Intruders, Intrusion Detection. Firewalls: The Need for Firewalls, Firewall Characteristics, Types of Firewalls.

Text Books:

1. William Stallings, "Network security Essentials: Applications and standards", 6th Edition, Pearson Education Limited, 2017.
2. Atul Kahate, "Cryptography and Network Security", 4th Edition, McGraw Hill, 2019.
3. Kaufman, c., Perlman, R., and Speciner, M., "Network Security, Private Communication in a public world", 2nd Edition, Prentice Hall PTR, 2002.

Suggested Reading:

1. Stallings, W. "Cryptography and Network Security: Principles and Practice", 3rd Edition, Prentice Hall PTR.2003.
2. Behrouz A Forouzan, "Cryptography and Network Security", 4th Edition, McGraw Hill, 2019.
3. Calabrese Thomson, "Information Security Intelligence: Cryptographic Principles and Applications", Delmar Cengage Learning, 2003.

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs90/preview ity.
2. https://ocw.mit.edu/courses/6-857-network-and-computer-security-spring-2014/ urity.

22MBC01

ENGINEERING ECONOMICS AND ACCOUNTANCY

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aims to:

1. To demonstrate the importance of Managerial Economics in Decision Making.
2. To explain the concept of Accountancy and provide basic knowledge on preparation of Final accounts.
3. To understand the importance of Project Evaluation in achieving a firm's Objective.

Course Outcomes:

Upon completion of this Course, student will be able to:

1. Apply fundamental knowledge of Managerial Economics concepts and tools.
2. Analyze various aspects of Demand Analysis, Supply and Demand Forecasting.
3. Understand Production and Cost relationships to make best use of resources available.
4. Apply Accountancy Concepts and Conventions and preparation of Final Accounts.
5. Evaluate Capital and Capital Budgeting decision based on any technique.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	3	1	1	1	1	1	1	1	-	-	1	1	3
CO 2	2	2	2	2	-	1	1	1	-	1	-	1	2	2	2
CO 3	1	2	1	2	2	-	2	1	-	1	-	-	1	2	1
CO 4	2	2	1	2	2	1	1	3	-	1	-	-	2	2	1
CO 5	1	3	1	2	1	1	2	-	-	1	2	1	1	3	1

UNIT - I

Introduction to Managerial Economics: Introduction to Economics and its evolution - Managerial Economics - its Nature and Scope, Importance; Relationship with other Subjects. Its usefulness to Engineers; Basic concepts of Managerial economics - Incremental, Time perspective, Discounting Principle, Opportunity Cost, Equimarginal Principle, Contribution, Negotiation Principle.

UNIT - II

Demand and Supply Analysis: Demand Analysis - Concept of Demand, Determinants, Law of demand - Assumptions and Exceptions; Elasticity of demand - Price, Income and Cross elasticity - simple numerical problems; Concept of Supply - Determinants of Supply, Law of Supply; Demand Forecasting - Methods.

UNIT - III

Production and Cost Analysis: Theory of Production - Production function - Isoquants and Isocosts, MRTS, Input-Output Relations; Laws of returns.

Cost Analysis: Cost concepts – Types of Costs, Cost-Output Relationship – Short Run and Long Run; Market structures – Types of Competition, Features of Perfect Competition, Price Output Determination under Perfect Competition, Features of Monopoly Competition, Price Output Determination under Monopoly Competition Break-even Analysis – Concepts, Assumptions, Limitations, Numerical problems.

Unit - IV

Accountancy: Book-keeping, Principles and Significance of Double Entry Bookkeeping, Accounting Concepts and Conventions, Accounting Cycle, Journalization, Ledger accounts, Trial Balance concept and preparation of Final Accounts with simple adjustments.

Unit - V Capital and Capital Budgeting: Capital and its Significance, Types of Capital, Estimation of Fixed and Working capital requirements, Methods and sources of raising finance. Capital Budgeting, Methods: Traditional and Discounted Cash Flow Methods - Numerical problems.

Text Books:

1. Mehta P.L."Managerial Economics: Analysis, Problems and Cases", Sultan Chand & Son's Educational publishers, 2016.
2. Maheswari S.N. "Introduction to Accountancy", Vikas Publishing House, 12th Edition, 2018.

Suggested Readings:

1. Panday I.M. "Financial Management", 11th edition, Vikas Publishing House, 2016.
2. Varshney and K L Maheswari, Managerial Economics, Sultan Chand, 2014.
3. M. Kasi Reddy and S. Saraswathi, Managerial Economics and Financial Accounting, Prentice Hall of India Pvt Ltd, 2007.
4. A. R. Aryasri, Managerial Economics and Financial Analysis, McGraw-Hill, 2018.

22CEM01

ENVIRONMENTAL SCIENCE

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	No Credits

Prerequisite: -

Course Objectives:
This course aims to:

1. Figure out a more sustainable way of living.
2. Understanding the behaviour exhibited by organisms under some natural conditions.
3. Educating and making people aware of different environmental issues and problems.
4. Using natural resources in an effective manner without actually causing any harm to the environment.
5. Exposing students to how science and the scientific method address environment systems and issues.

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

1. Identify the natural resources and realize the importance of water, food, forest, mineral, energy, land resources and effects of over utilization.
2. Understand the concept of ecosystems and realize the importance of interlinking food chains.
3. Contribute to the conservation of bio-diversity.
4. Suggest suitable remedial measures for the problems of environmental pollution and contribute for the framing of legislation for protection of the environment.
5. Follow the environmental ethics and contribute to the mitigation and management of environmental disasters.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	1
CO 2	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1
CO 3	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1
CO 4	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1
CO 5	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1

UNIT - I
Environmental Studies: Definition, Scope and importance, need for public awareness.
Natural resources: Use and over utilization of Natural Resources - Water resources, Food resources, Forest resources, Mineral resources, Energy resources, Land resources.

UNIT - II
Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, role of producers, consumers and decomposers, energy flow in an ecosystem, food chains, food webs, ecological pyramids, Nutrient cycling, Bio-geo chemical cycles, Terrestrial and Aquatic ecosystems.

UNIT - III
Biodiversity: Genetic, species and ecosystem biodiversity, Bio-geographical classification of India, India as a Mega diversity nation. Values of biodiversity, hot-spots of biodiversity, threats to biodiversity, endangered and endemic species of India, methods of conservation of biodiversity.

UNIT – IV
Environmental Pollution: Cause, effects and control measures of air pollution, water pollution, marine pollution, soil pollution, noise pollution and Solid waste management, nuclear hazards

Environmental Legislations: Environment protection Act, Air, Water, Forest & Wild life Acts, issues involved in enforcement of environmental legislation, responsibilities of state and central pollution control boards.

UNIT – V

Social issues and the environment: Water conservation methods: Rain water harvesting and watershed management, Environmental ethics, Sustainable development and Climate change: Global warming, Ozone layer depletion, forest fires, and Contemporary issues.

Text Books:

1. Y. Anjaneyulu, "Introduction to Environmental Science", B S Publications, 2004.
2. Suresh K. Dhameja, "Environmental Studies", S. K. Kataria& Sons, 2009.

Suggested Reading:

1. C. S. Rao," Environmental Pollution Control Engineering", Wiley, 1991.
2. S. S. Dara, "A Text Book of Environmental Chemistry &Pollution Control", S. Chand Limited, 2006.

22ECC31

COMPUTER NETWORKS LAB

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Knowledge on Digital communications and familiarity with anyone programming language like C.

Course Objectives:

This course aims to:

1. Understand Link layer concepts.
2. Understand routing algorithms in Network layer.
3. Understand the network simulator environment and visualize a network topology and observe its performance.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Apply fundamental principles of computer networking.
2. Examine the performance of design issues of Link layer.
3. Construct a network and measure its performance with different routing algorithms.
4. Creation of both wired and wireless Networks.
5. Analyze the performance of various Network protocols.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	2	2	1	1	1	2	3	2	3	3	2	3
CO 2	3	2	3	2	3	1	1	1	3	3	1	3	3	2	3
CO 3	3	3	3	3	3	1	1	1	3	3	2	3	3	2	3
CO 4	3	4	3	3	3	1	1	1	3	3	2	3	3	2	3
CO 5	3	2	2	3	3	1	1	1	2	3	1	3	3	2	3

List of Experiments

1. Introduction to network simulation software's.
2. Creation of nodes links between nodes, assigning agents and traffic sources to nodes.
3. Implementation of Network Topologies.
4. Creation of wired network with at least four nodes and monitor the data transmission between any two nodes usingTCP/UDP using for loop.
5. Implementation of Stop & Wait and Sliding Window Protocols.
6. Implementation of the data link layer framing methods such as character stuffing and bit stuffing.
7. Implementation of Error Detection / Error Correction Techniques.
8. Implementation of Static Routing Protocol.
9. Implementation of dynamic routing protocols.
10. Construct Dijkstra's algorithm to compute the shortest path through a graph.
11. Construct a wired network with at least 5 nodes connected through switch/router.
12. Creation of a static wireless network and data transmission between the nodes with at least four nodes.
13. Creation of a wireless network with node movement and data transmission between the nodes with at least four nodesusing NS2.

Additional Experiments based on Structured Inquiry

1. Evaluate the performance of Data link / Network / Transport layer protocols.

Open-ended Inquiry

1. Design a Wireless Ad hoc Network and evaluate its performance.
2. Evaluation the performance of VoIP.

Note: All the experiments can be implemented using NETSIM, NS2 (Open Source) and MATLAB.

Suggested Reading:

1. Teerawat Issariyakul, Ekram Hossain, "Introduction to Network Simulator NS2", 2nd Edition, Springer, 2012.
2. Eitan Altman, Tania Jimenez, "Network Simulator for beginners", Lecture Notes, 2003-2004, University de LosAndes, Merida, Venezula and ESSI, Sophia-Antipolos, France, December 2003.
3. Amos Gilat, "MATLAB: An Introduction with Applications", 4th Edition, Wiley, 2012.

22ECC32

IoT LAB

Instruction	2 Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Knowledge of Programming and Problem Solving, Computer Organization, and Embedded systems.

Course Objectives:

This course aims to:

1. Implement hardware setup for IoT applications.
2. Develop basic programming skills for deploying various IoT protocols on hardware.
3. Design and develop IoT and Communication Network model environment-based solutions.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Analyze various software and hardware components required for IoT technology.
2. Interface analog and digital sensing & actuating equipment using Raspberry Pi.
3. Build basic applications using Bluetooth with Raspberry Pi programming environment.
4. Demonstrate the capabilities of a Raspberry Pi as an IoT device using protocols.
5. Create a Communication Network model (TCP/UDP) server on Raspberry Pi / Beaglebone Black.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	1	1	1	2	1	1	3	3	1	2	2	2	1
CO 2	2	2	3	1	1	2	1	1	3	3	1	3	2	2	3
CO 3	1	2	1	1	1	2	1	1	3	3	1	2	1	2	1
CO 4	2	3	3	1	1	2	1	1	3	3	1	3	2	3	3
CO 5	2	3	3	1	1	2	1	1	3	3	1	3	2	3	3

List of Experiments:

1. Familiarize with the Raspberry Pi hardware and install the necessary software.
2. Interface an LED and Switch with Raspberry Pi.
3. Interface an LDR/Sensor with Raspberry Pi.
4. Interface a surveillance camera with Raspberry Pi.
5. Interface Servo Motor with Raspberry Pi.
6. Interface a DHT11 sensor with Raspberry Pi to upload/retrieve temperature and humidity readings and upload data to Thing Speak.
7. Interface Bluetooth with Raspberry Pi and write a program to send sensor data to a smartphone using Bluetooth.
8. Interface Bluetooth with Raspberry Pi and write a program to turn ON/OFF when 1/0 is received from a smartphone using Bluetooth.
9. Interface sensor with Raspberry Pi to upload/retrieve data from a sensor to the Thing Speak cloud.
10. Demonstrate the capabilities of a Raspberry Pi as an IoT device by using it to publish and subscribe sensor data via an MQTT broker.
11. Write a program to create a TCP server on Raspberry Pi /Beagle bone Black and respond with sensor data to a TCP client when requested.
12. Write a program to create a UDP server on Raspberry Pi/Beagle bone Black and respond with sensor data to a UDP client when requested.

Additional Experiments based on Structured enquiry

a. Implementation of Smart Agriculture Monitoring System.

Open-ended enquiry

a. Implement a weather monitoring system with an interfacing temperature sensor, pressure, etc.

Text Books:

1. Tony Gaddis, "Starting out with Python", 3rd edition, Pearson, 2015.

22ECC33

PROJECT PART - I

Instruction	4 P Hours per Week
Duration of SEE	-
SEE	-
CIE	50 Marks
Credits	2

Prerequisite: Knowledge of preparing slides by using power point presentations, Capable of searching for suitable literatureand Presentation skills.

Course Objectives:

This course aims to:

1. The student takes up investigative study in the broad field of Engineering / Technology, either fully theoretical/practical or involving both theoretical and practical.
2. The work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a supervisor.
3. This is expected to provide a good initiation for the student(s) towards R&D.

Course Outcomes:

Upon completion of this course, students will be able to:

1. List the various approaches to the selected problem.
2. Interpret the advantages and disadvantages of various approaches.
3. Apply the selected approach for simulating / modeling / designing the problem.
4. Analyse and write a report on the results of the simulation/modeling of the problem selected.
5. Justify and present the results of the simulation/modeling / design before the departmental committee.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	2	2	2	2	3	3	2	2	2	3	2	2
CO 2	2	2	2	2	2	1	1	2	1	1	1	2	1	1	2
CO 3	3	2	2	2	3	1	1	2	2	2	2	2	2	3	2
CO 4	3	3	3	2	2	2	2	2	2	2	2	2	3	2	2
CO 5	3	3	2	3	3	2	1	2	2	3	2	3	2	3	2

The objective of Project Part - I is to enable the student take up investigative study in the broad field of Engineering/Technology, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a supervisor. This is expectedto provide a good initiation for the student(s) towards R&D. The work shall include:

1. Survey and study of published literature on the assigned topic.
2. Working out a preliminary Approach to the Problem relating to the assigned topic.
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility.
4. Preparing a Written Report in a standard format on the Study conducted and submitting to the Department.
5. Final Seminar, as oral Presentation before a departmental Committee.

Guidelines for the award of Marks: Max. Marks: 50

Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Supervisor	20	Project Status / Review
	5	Report
Departmental Committee	5	Relevance of the Topic
	5	PPT Preparation
	5	Presentation
	5	Question and Answers
	5	Report Preparation

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

AICTE Model Curriculum with effect from AY 2027-28

BE (Electronics and Communication Engineering)

SEMESTER – VIII

S.no	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1		Open Elective-III	3	-	-	3	40	60	3
PRACTICALS									
2	22ECC34	Technical Seminar	-	-	2	-	50	-	1
3	22ECC35	Project Part - II	-	-	8	-	100	100	4
Total			**3**	**-**	**10**	**3**	**190**	**160**	**8**
Clock Hours Per Week: 13									

L: Lecture **D: Drawing** **CIE: Continuous Internal Evaluation**

T: Tutorial **P: Practical/Project Seminar/Dissertation** **SEE: Semester End Examination**

S.no	List of Courses in Open Elective-III	
	Course code	Title of the Course
1	22CIO03	Basics of Cyber Security
2	22EGO02	Gender Sensitisation
3	22CSO03	Software Testing Methodology
4	22CAO03	Foundations of Deep learning
5	22ADO01	Industry 5.0 : Applications of AI
6	22ADO02	Data Science using Python

22CIO03

BASICS OF CYBER SECURITY

(Open Elective – III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-Requisites: Basic knowledge on computer hardware and software components.

Course Objectives:

This course aims to:

1. To describe the foundational concepts of cybersecurity, including the CIA triad (Confidentiality, Integrity, Availability), and explain their importance in information security practices.
2. To demonstrate understanding of various cyber offenses by explaining the methods used by criminals to plan and execute cyber-attacks.
3. To understand the legal perspective of Cyber Security.
4. To collect, process, analyse and present Computer Forensics Evidence.
5. To understand organizational implications of Cyber Security.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Demonstrate an understanding of cybersecurity by effectively analysing and evaluating the security implications of various scenarios.
2. Identify and describe different types of cyber offenses, understand the techniques used by cybercriminals, and analyse the potential impact of these attacks on individuals, organizations, and society.
3. Analyse and evaluate the legal framework of cyber laws in India.
4. Analyse the significance of digital evidence in cyber forensics.
5. Evaluate the organizational implications of cyber security by assessing the costs associated with cybercrimes.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	2	2	3	1	3	3	3	2	3	2	2	2
CO 2	2	3	2	2	3	3	1	3	3	3	2	3	1	2	2
CO 3	1	2	2	2	1	3	1	3	2	3	3	3	1	1	1
CO 4	2	2	2	2	3	3	1	3	3	3	3	3	2	2	2
CO 5	2	2	2	2	2	3	1	3	3	3	3	3	1	1	2

Unit – I

Introduction to Cyber Crime: Cyber Crime: Definition and Origins of the Word, Cybercrime and Information Security, Classification of Cyber Crimes.

Cyber Security Fundamentals: Definition and importance of cybersecurity, CIA triad: Confidentiality, Integrity, Availability, Security design principles: defence-in-depth, least privilege, separation of duties.

Unit – II

Cyber Offenses: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber Cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector.

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Password Managers, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

Unit – III

Cyber Laws: The Legal Perspectives, Need of Cyber laws: the Indian Context, The Indian IT Act, Amendments of Indian IT Act, Challenges to Indian Law and Cyber Crime Scenario in India.

Unit – IV

Understanding Cyber Forensics: Need for Computer Forensics, Cyber Forensics and Digital Evidence, Forensics Analysis of Email, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Cyber Forensics Investigation, Challenges in Computer Forensics.

Unit – V

Cyber Security Organizational Implications: Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations.
Capstone Project: Group project: analyse a real-world cyber-attack, develop a mitigation strategy, and present findings to the class.

Text Books:

1. Sunit Belpre and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt.Ltd, 2011.
2. William Stallings," Cryptography and Network Security - Principles and Practice", Pearson Education, 6th Edition,2013.
3. Whitman, M., & Mattord, H."Principles of information security" (6th ed.). CENGAGE Learning Custom Publishing, 2017.

Reference Books:

1. Alfred Basta, Nadine Basta, Mary Brown, Ravinder Kumar, "Cyber Security and Cyber Laws", Paperback – 2018.
2. Kevin Mandia, Chris Prosise, "Incident Response and computer forensics", Tata McGraw Hill, 2006.

e-Resources:

1. https://www.coursera.org/courses?query=cybersecurity&productDifficultyLevel=Beginner
2. https://onlinecourses.swayam2.ac.in/nou19_cs08/preview

22EGO02

GENDER SENSTISATION

(Open Elective – III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: No specific prerequisite is required.

Course Objectives:
This course aims to:
1. Sensibility regarding issues of gender in contemporary India.
2. A critical perspective on the socialization of men and women.
3. Popular debates on the politics and economics of work while helping them reflect critically on gender violence.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Understand the difference between "Sex" and "Gender" and be able to explain socially constructed theories of identity.
2. Recognize shifting definitions of "Man" and "Women" in relation to evolving notions of "Masculinity" and "Femininity".
3. Appreciate women's contributions to society historically, culturally and politically.
4. Analyze the contemporary system of privilege and oppressions, with special attention to the ways in which gender intersects with race, class, sexuality, ethnicity, ability, religion, and nationality.
5. Demonstrate an understanding of personal life, the workplace, the community and active civic engagement through classroom learning.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	1	-	-	2	2	1	1	-	-	1	-	-	1
CO 2	-	-	1	-	-	2	2	1	1	-	-	1	-	-	1
CO 3	-	-	1	-	-	2	2	2	2	1	1	1	-	-	-
CO 4	-	-	1	-	-	3	2	2	2	1	1	1	-	1	1
CO 5	-	-	1	-	-	2	2	2	3	1	1	1	1	1	1

UNIT – I
Understanding Gender:
Gender: Why Should We Study It? (*Towards a World of Equals*: Unit -1)
Socialization: Making Women, Making Men (*Towards a World of Equals*: Unit -2)
Introduction. Preparing for Womanhood. Growing up Male. First lessons in Caste. Different Masculinities.

UNIT – II
Gender and Biology:
Missing Women: Sex Selection and Its Consequences (*Towards a World of Equals*: Unit -4)
Declining Sex Ratio. Demographic Consequences.
Gender Spectrum: Beyond the Binary (*Towards a World of Equals*: Unit -10)
Two or Many? Struggles with Discrimination.

UNIT – III
Gender and Labour:
Housework: the Invisible Labour (*Towards a World of Equals*: Unit -3)

"My Mother doesn't Work." "Share the Load."
Women's Work: Its Politics and Economics (*Towards a World of Equals*: Unit -7)
Fact and Fiction. Unrecognized and Unaccounted work. Additional Reading:Wages and Conditions of Work.

UNIT-IV
Issues of Violence
Sexual Harassment: Say No! (*Towards a World of Equals*: Unit -6)
Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading:"*Chupulu".*
Domestic Violence: Speaking Out (*Towards a World of Equals*: Unit -8)
Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Additional Reading:
New Forums for Justice.
Thinking about Sexual Violence (*Towards a World of Equals*: Unit -11)
Blaming the Victim-"I Fought for my Life…." - Additional Reading: The Caste Face ofViolence.

UNIT – V
Gender: Co - Existence
Just Relationships: Being Together as Equals (*Towards a World of Equals*: Unit -12)
Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers.
Additional Reading: Rosa Parks-The Brave Heart.

Text Books:

1. A. Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu "Towards a World of Equals: A Bilingual Textbook on Gender"**,** Telugu Akademi, Hyderabad, 2015.

Suggested Reading:

1. Menon, Nivedita. "Seeing like a Feminist", Zubaan-Penguin Books, New Delhi, 2012.
2. Abdulali Sohaila, "I Fought For My Life…and Won", Available online at:
http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

e-Resources:

1. https://aifs.gov.au/publications/gender-equality-and-violence-against-women/introduction
2. https://theconversation.com/achieving-gender-equality-in-india

Note: Since it is an Interdisciplinary Course, Resource Persons can be drawn from the fields of English Literature or Sociology or Political Science or any other qualified faculty who has expertise in this field from engineering departments.

22CSO03

SOFTWARE TESTING METHODOLOGY

(Open Elective – III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Software engineering

Course Objectives:

This course aims to:

1. Understand the importance of software testing in the software development lifecycle.
2. Learn various software testing methodologies and techniques.
3. Gain hands-on experience with industry-standard testing tools.
4. Develop the skills to design and execute comprehensive test plans.
5. Analyze and interpret test results to improve software quality.

Course Outcomes:

Upon completion of this course, students will be able to:

1. List a range of different software testing techniques and strategies and be able to apply specific (automated) unit testing methods to the projects.
2. Distinguish characteristics of structural testing methods.
3. Demonstrate the integration testing which aims to uncover interaction and compatibility problems as early as possible.
4. Discuss the functional and system testing methods.
5. Demonstrate various issues for object-oriented testing.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	-	-	-	-	-	-	-	1	-	2	2	2
CO 2	3	2	2	2	-	-	-	-	2	-	-	-	2	2	2
CO 3	2	2	3	2	-	-	-	-	2	-	-	-	2	2	2
CO 4	3	3	2	-	-	-	-	-	-	-	-	-	2	2	2
CO 5	2	2	3	2	2	2	-	-	-	-	-	1	2	2	2

UNIT - I

Introduction: Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs.

Flow graphs and Path testing: Basics concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing.

UNIT - II

Transaction Flow Testing: Transaction flows, transaction flow testing techniques. Dataflow testing: Basics of dataflow testing, strategies in dataflow testing, application of dataflow testing.

Domain Testing: domains and paths, Nice & ugly domains, domain testing, domains and interfaces testing, domain and interface testing, domains and testability.

UNIT - III

Paths, Path products and Regular expressions: Path products & path expression, reduction procedure, applications, regular expressions & flow anomaly detection.

Logic-Based Testing: overview, decision tables, path expressions, kv charts, specifications.

UNIT - IV

State, State Graphs and Transition testing: State graphs, good & bad state graphs, state testing, Testability tips.

UNIT - V

Graph Matrices and Application: Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm, building tools. (Student should be given an exposure to a tool like JMeter or Win-runner).

Text Books:

1. Software Testing techniques - Baris Beizer, Dreamtech, second edition.
2. Software Testing Tools – Dr. K. V. K. K. Prasad, Dreamtech.

Suggested Reading:

1. The craft of software testing - Brian Marick, Pearson Education.
2. Software Testing Techniques – SPD(Oreille)
3. Software Testing in the Real World – Edward Kit, Pearson.
4. Effective methods of Software Testing, Perry, John Wiley.
5. Art of Software Testing – Meyers, John Wiley.

22CAO03

FOUNDATIONS OF DEEP LEARNING

(Open Elective – III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Calculus, Probability and Statistics, Python Programming, Machine Learning.

Course Objectives:

This course aims to:

1. Provide students with a foundational understanding of the history of deep learning, key concepts, and early neural network models.
2. Equip students with the skills to design and optimize feedforward neural networks using various gradient descent methods and optimization algorithms.
3. Develop students' competence in applying principal component analysis, singular value decomposition, and different types of autoencoders for data representation and regularization.
4. Enable students to design, implement, and apply convolutional neural networks (CNNs) for image and data processing tasks.
5. Enhance students' ability to design and apply recurrent neural networks (RNNs) and attention mechanisms for complex sequence modeling tasks.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Demonstrate a comprehensive understanding of deep learning history, key milestones, and foundational concepts.
2. Design, develop, and optimize feedforward neural networks and understand their representation power.
3. Apply principal component analysis, singular value decomposition, and various autoencoder models for data analysis and dimensionality reduction.
4. Develop and implement convolutional neural networks (CNNs) using modern architectures and techniques.
5. Design and utilize recurrent neural networks (RNNs) and advanced attention mechanisms for sequential data processing.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	2	2	1	1	1	1	2	1	1	3	3	3
CO 2	3	3	3	3	3	1	1	1	1	2	2	2	3	3	3
CO 3	3	3	3	3	3	1	1	1	1	2	2	2	3	3	3
CO 4	3	3	3	3	3	1	1	1	1	2	2	2	3	3	3
CO 5	3	3	3	3	3	1	1	1	1	2	2	2	3	3	3

Unit-I

History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent.

Unit-II

Feedforward Neural Networks, Representation Power of Feedforward Neural Networks Feed Forward Neural Networks, Backpropagation Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam, Eigenvalues and eigenvectors, Eigenvalue Decomposition, Basis

Unit-III

Principal Component Analysis and its interpretations, Singular Value Decomposition Auto encoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders, Contractive autoencoders

Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout

Unit-IV

Convolutional Neural Network: The Convolution Operation, Motivation, Pooling, Convolution and Pooling, Batch Normalization.

Pre-trained models: LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet.

Unit-V

Recurrent Neural Networks, Vanishing and Exploding Gradients, GRU, LSTMs. Encoder Decoder Models, Attention Mechanism, Attention over images.

Text Books:

1. Goodfellow. I., Bengio. Y. and Courville. A., "Deep Learning ", MIT Press, 2016.
2. Rothman, Denis, "Transformers for Natural Language Processing: Build innovative deep neural network architectures for NLP with Python, PyTorch, TensorFlow, BERT, RoBERTa, and more", Packt Publishing Ltd, 2021.
3. Ganguly Kuntal, "Learning generative adversarial networks: next-generation deep learning simplified", Packt Publishing, 2017

Suggested Reading:

1. Bishop, Christopher. Neural Networks for Pattern Recognition. New York, NY: Oxford University Press, 1995. ISBN: 9780198538646.
2. Bishop, Christopher M. Pattern Recognition and Machine Learning. Springer, 2006. ISBN 978-0-387-31073-2
3. Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY: Wiley-Interscience, 2000. ISBN: 9780471056690.
4. Mitchell, Tom. Machine Learning. New York, NY: McGraw-Hill, 1997. ISBN: 9780070428072.
5. Richard Hartley, Andrew Zisserman, Multiple View Geometry in Computer Vision, 2004. David Marr, Vision, 1982.

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc18_cs41.
2. https://onlinecourses.nptel.ac.in/noc22_cs22.
3. https://onlinecourses.nptel.ac.in/noc19_cs85.

22ADO01

INDUSTRY 5.0 : APPLICATIONS OF AI

(Open Elective – III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aims to:

1. To introduce Artificial Intelligence in detail from its basics to future applications and tools of Industry 5.0.
2. To provide insights on technological advancements and focus on preparing students and researchers for.Industry 5.0.
3. To impart the importance of AI technologies in assistive technology.
4. To discuss the available applications of AI for promoting early diagnosis of diseases.
5. To understand the various AI technologies.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Summarize the evolution, current applications, and future challenges of artificial intelligence.
2. Evaluate the foundational elements and impacts of AI within machine learning paradigms.
3. Analyze AI's effectiveness in diagnosing diseases and enhancing assistive technology.
4. Design AI-driven solutions for modernizing and improving agricultural practices.
5. Assess AI's role in advancing radiotherapy techniques and ensuring quality assurance.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	3	1	2	2	1	2	1	2	3	3	3	3
CO 2	3	3	3	3	1	2	2	1	2	1	2	3	3	3	3
CO 3	3	3	3	3	1	2	2	1	2	1	2	3	3	3	3
CO 4	3	3	3	3	1	2	2	1	2	1	2	3	3	3	3
CO 5	3	3	3	3	1	2	2	1	2	1	2	3	3	3	3

Unit-I

Artificial Intelligence Insight: Artificial Intelligence: What and Why, History of AI, What is AI?,The Basics, AI Environment, Challenges in AI, Current work in AI for environment, Customer Experience (CX) and the use of AI, Future of AI, Future challenges in AI

Unit-II

Influence of AI in Machine Learning: Definition, What is Machine Learning, Importance of Machine Learning, Types of Machine Learning, Approaches of Machine Learning - Machine Learning Algorithm, Programming Languages, Frameworks, Databases, Deployment tools, Methodology for Model Building, Machine learning methods, Statistical Measures, Application areas of Machine Learning, Medical Machine Learning , Influence of AI and ML in Clinical and Genomic Diagnostics.

Unit-III

Artificial Intelligence in Healthcare sector & Assistive Technology (AT): AI in diagnosis of Genetic Diseases, Cancer, Diabetes, AI in Diagnosis of Syndrome, AI in diagnosis of Psychiatric Disorders, Depression, Alzheimer's Disease, Autism Spectrum Disorder, Anxiety, Parkinson's Disease, AI in other Diagnosis, Infectious, Lung and Brain Disease, Case studies on AI in systems Biology, AI technologies in Systems Biology towards Pharmacogenomics, AI in Systems Biology for Cancer Cure, Applications of AI for COVID-19 Pandemic, Transformative impact of AI on AT, AI experience and AT for disables people in India, AI Powered technology for an inclusive world .

Unit-IV

Artificial Intelligence in Agriculture: Need of AI in Agriculture, Emerging Agricultural Technologies, Soil and water sensors, Weather Tracking, Satellite Imaging Agriculture, Automation Systems, RFID Technology, Potential Agricultural Domain for Modernization, AI transformation in Agricultural Scenarios.

Unit-V

Artificial Intelligence in Radiotherapy: Importance of Artificial Intelligence in Radiotherapy , AI tools for automated treatment planning (ATP), Present ATP techniques, AI applications, Advancements and Research Guidance in ATP, AI challenges in ATP, AI in Intensity-modulated Radiotherapy (IMRT), AI for IMRT Dose Estimation, AI for IMRT Planning Support, AI for Modeling IMRT outcome and plan deliverability, AI for AUTO- Segmentation of OAR in IMRT, AI in Brachytherapy, AI in Radiotherapy Quality Assurance, Challenges associate with AI for Quality Assurance in RT, Future directions to improve AI-based Quality Assurance in RT, AI in Radiation Biology, AI in Radiation Protection/Safety, Motivations to develop AI-Based systems for Radiation protection.

Text Book:

1. Kaliraj, P., & Devi, T. (Eds.). (2021). Artificial Intelligence Theory, Models, and Applications (1st ed.). CRC Press, Taylor & Francis Group, Boca Raton, ebook ISBN 9781032008097 Auerbach Publications. https://doi.org/10.1201/9781003175865

22ADO02

DATA SCIENCE USING PYTHON

(Open Elective – III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aims to:

1. To familiarize the data scientists, work environment like IPython and Jupyter.
2. To understand ndarray object for efficient storage and manipulation of dense data arrays in python using NumPy.
3. To understand DataFrame object for efficient storage and manipulation of labelled / columnar data in python using Pandas.
4. To perform data visualizations in python using Matplotlib.
5. To practice machine learning algorithms in python using Scikit-Learn.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Apply advanced IPython features including shell commands, magic commands, and debugging techniques.
2. Analyze NumPy functionalities such as data types, arrays, and computations, and implement them in data manipulation tasks.
3. Evaluate Pandas capabilities for data manipulation, aggregation, and grouping, and apply them to real-world datasets.
4. Create visualizations using Matplotlib, customize plots, and interpret various types of plots for effective data communication.
5. Implement machine learning algorithms using Scikit-Learn, validate models, and apply them to real-world problems.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	2	3	2	2	2	2	2	2	3	3	2	2
CO 2	3	2	2	2	3	2	2	2	2	2	2	3	3	2	2
CO 3	3	2	2	2	3	3	2	2	2	2	2	3	3	2	2
CO 4	3	3	3	3	3	3	2	2	2	3	3	3	3	2	2
CO 5	3	3	3	3	3	3	2	2	2	2	2	3	3	2	2

UNIT-I

Ipython: Beyond Normal Python

Shell and Notebook, Help and Documentation in IPython, Keyboard Shortcuts in the IPython Shell, IPython Magic Commands, Input and Output History, IPython and Shell Commands, Errors and Debugging Profiling and Timing Code.

UNIT-II

Introduction To Numpy

Understanding Data Types in Python, The Basics of NumPy Arrays, Computation on NumPy Arrays: Universal Functions, Aggregations, Computation on Arrays, Comparisons, Masks, and Boolean Logic, Fancy Indexing, Sorting Arrays, Structured Data.

UNIT-III

Data Manipulation with Pandas

Installing and Using Pandas, Introducing Pandas Objects, Data Indexing and Selection, Operating on Data in Pandas, Handling Missing Data, Hierarchical Indexing, Combining Datasets, Aggregation and Grouping, Pivot Tables, Vectorized String Operations, Working with Time Series, High-Performance Pandas.

UNIT-IV

Visualization with Matplotlib

General Matplotlib Tips, Simple Line Plots, Simple Scatter Plots, Visualizing Errors, Density and Contour Plots, Histograms, Binnings, and Density, Customizing Plot Legends, Customizing Colorbars, Multiple Subplots, Text and Annotation, Customizing Ticks, Customizing Matplotlib, Three-Dimensional Plotting in Matplotlib, Geographic Data with Basemap, Visualization with Seaborn.

UNIT-V

Machine Learning with Scikit-Learn

Machine Learning- Introducing Scikit-Learn, Hyperparameters and Model Validation, Feature Engineering, Naive Bayes Classification, Linear Regression, Support Vector Machines, Decision Trees and Random Forests, Principal Component Analysis, k-Means Clustering, Gaussian Mixture Models, Application: A Face Detection Pipeline.

Text Books:

1. Jake VanderPlas, ―Python Data Science Handbook: Essential Tools for Working with Data‖, O'Reilly, 2017.

Suggested Reading:

1. Wes McKinney, ―Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython‖, O'Reilly, 2nd Edition,2018.
2. Python for data science for dummies 2nd Edition, John Paul Mueller, Luca Massaron, Wiley

22ECC34

TECHNICAL SEMINAR

Instruction	2 P Hours per Week
Duration of SEE	-
SEE	-
CIE	50 Marks
Credits	1

Prerequisite: Student must have completed Project Part – I.

Course Objectives:
This course aims to:

1. To introduce students to critical reading, understanding, summarizing, explaining and preparing report on state-of-the-art topics in a broad area of his/her specialization.
2. Seminar topics may be chosen by the students with advice from the faculty members and the student shall readfurther relevant articles in the domain.
3. Documenting the seminar report in a prescribed format.

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

1. Collect, Organize, Analyze and Consolidate information about emerging technologies from the literature.
2. Exhibit effective communication skills, stage courage, and confidence.
3. Demonstrate intrapersonal skills.
4. Explain new innovations/inventions in the relevant field.
5. Prepare and experience in writing the Seminar Report in a prescribed format.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	1	2	2	1	1	3	2	3	1	2	2	2	2
CO 2	3	3	1	2	2	2	1	1	3	2	3	2	2	2	2
CO 3	2	2	1	2	2	2	1	2	3	3	2	2	2	1	1
CO 4	3	2	3	3	2	2	2	2	2	2	2	2	2	2	2
CO 5	3	2	2	2	2	2	3	3	2	3	2	2	2	2	2

The goal of a seminar is to introduce students to critical reading, understanding, summarizing, explaining and preparing report on state-of-the-art topics in a broad area of his/ her specialization. Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

The seminar must be clearly structured, and the power point presentation shall include following aspects:

1. Introduction to the field
2. Literature survey
3. Consolidation of available in formation
4. Summary and Conclusions
5. References

Each student is required to:

1. Submit a one-page synopsis of the seminar talk for display on the notice board.
2. Deliver the seminar for a maximum duration of 30 minutes, where the presentation should be for 20 minutes inPowerPoint, followed by Question and Answers session for 10 minutes.
3. Submit the detailed report of the seminar in spiral bound in a précised format as suggested by the department.

Seminars are to be scheduled from 3rd week to the last week of the semester and any change in schedule shall be discouraged. For the award of sessional marks, the students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Note: 1**.** Topic of the seminar shall be preferably from any peer reviewed recent Journal publications.
2. It is not appropriate for two students to present on the same topic.

Guidelines for awarding marks (CIE): Max. Marks: 50		
S.no	**Description**	**Max. Marks**
1	Contents and relevance	10
2	Presentation skills	10
3	Preparation of PPT slides	05
4	Questions and answers	05
5	Report in a prescribed format	20

22ECC35

PROJECT PART - II

Instruction	8 P Hours per Week
Duration of SEE	-
SEE	100 Marks
CIE	100 Marks
Credits	4

Prerequisite: Student must have earned the credits of "Project: Part – 1".

Course Objectives:

This course aims to:

1. The object of Project: Part-2 is to enable the student extend further the investigative study, either fully theoretical /practical or involving both theoretical and practical work.
2. The work shall be carried out under the guidance of a Supervisor from the Department alone or jointly with aSupervisor drawn from R&D laboratory/Industry.
3. Preparing an Action Plan for conducting the investigation, including teamwork.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Recall the details of the approach for the selected problem.
2. Interpret the approach to the problem relating to the assigned topic.
3. Determine the action plan to conduct investigation.
4. Analyze and present the model / simulation /design as needed.
5. Evaluate, present and report the results of the analysis and justify the same.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	2	2	2	1	2	3	3	2	2	2	2	2
CO 2	3	3	3	3	3	2	2	3	3	3	2	2	2	2	2
CO 3	2	3	3	3	3	2	2	2	2	3	3	2	2	2	2
CO 4	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2
CO 5	3	3	3	2	2	1	2	3	3	3	3	2	2	2	2

The objective of 'Project: Part - II' is to enable the student extend further the investigative study taken up, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. This includes:

1. In depth study of the topic assigned.
2. Review and finalization of the Approach to the Problem relating to the assigned topic.
3. Preparing an Action Plan for conducting the investigation, including teamwork.
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed.
5. Final development of product/process, testing, results, conclusions and future directions.
6. Preparing a Publication for Conference presentation/ Journals, if possible.
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar presentation before Departmental Committee.

Guidelines for awarding marks in CIE: (**Max. Marks: 100**)

Evaluation by	Max. Marks	Evaluation Criteria / Parameter
Department Review Committee	10	Review 1
	15	Review 2
	25	Submission
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of the work which may lead to publications
	10	Report Preparation
	10	Analytical / Programming / Experimental Skills

Guidelines for awarding marks in **SEE**: (**Max. Marks: 100**)

Evaluation by	Max. Marks	Evaluation Criteria / Parameter
External and Internal Examiners together	20	Power Point Presentation
	40	Thesis Evaluation
	20	Quality of the project • Innovations • Applications • Live Research Projects • Scope for future study • Application to society
	20	Viva-Voce

In the process of strengthening the quality of the projects, it is required for each B.E project outcome(s) must be mapped to

- Publications submitted/published
- Products/ prototypes/ working models
- IPRs (Patents & Etc) Submitted/published.
- Projects Showcased/ Presentations.
- Prizes won, if any like best Project.
- Leading to a start-up.

List of Open Elective Courses offered by ECE Dept. to other departments UG Programs

R-22 & R-22(A) Regulation with effect from AY 2024-25

S.no.	Course Code	Course Name
1	22ECO01	System Automation and Control
2	22ECO02	Remote Sensing and GIS
3	22ECO03	Fundamentals of Wireless Communications
4	22ECO04	Basics of Digital Signal Processing
5	22ECO05	Principles of Embedded Systems
6	22ECO06	Principles of VLSI
7	22ECO07	Neural Networks And Fuzzy Logic

22ECO01

SYSTEM AUTOMATION AND CONTROL

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge about physical parameters in industry is required

Course Objectives:

This course aims to:

1. Learn the concepts industrial control systems.
2. Learn how to measure the physical parameters in industry.
3. Learn the applications of Robots in industry.

Course Outcomes:

After completion of this course, students will be able to:

1. Understand the features of various automatic and process control systems.
2. Define and analyze various measuring parameters in the industry.
3. Compare performance of various controllers (P, PD, PI, and PID).
4. Illustrate the role of digital computers in automation.
5. Develop various robot structures for different applications.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	3	2	2	1	-	-	1	-	-	2	3	3	1
CO 2	3	3	3	2	1	1	-	-	1	-	-	1	3	3	1
CO 3	3	3	3	3	2	1	-	-	1	-	-	2	3	3	1
CO 4	2	2	2	2	2	2	-	-	1	-	-	2	3	3	1
CO 5	3	3	3	3	2	2	-	-	2	-	-	1	3	3	3

UNIT-I

Introduction to Automatic Control Systems: Purpose of Automatic Control, How an Industrial Control System is implemented, Introduction to Automatic Control theory.

Sensors: Sensor definition, Different types of Sensors:Motion, Position, Force, Level sensors, and Thermo couples.

UNIT-II

Theory of Measurements: Measurement goals and concepts, Scale factor, Linearity, accuracy, Range, Resolution, Precision and repeatability.

Measurement Techniques and Hardware: Typical Sensor outputs, Bridge measurements: General equation for bridge balance, Resistance balanced Wheatstone bridge, Variable voltage type measurements, Frequency type measurements.

UNIT-III

Process Controllers: What is a Controller, uses of Controllers, Open loop and closed loop Control, proportional, Analog and Digital methods of Control.

Controller Hardware: Analog and Digital Controllers, Pneumatic controllers, Integral, derivative, PI,PD,PID controllers.

UNIT-IV

Digital Computers as Process Controllers: Introduction, Information required by the computer, Information required by the process, Computer Interface electronics, Digital Computer input-output, computer processing of data, Digital Process control computer design, Computer programming.

Actuators: Electro mechanical - Linear motion and rotary motion solenoids, DC motors, AC motors and Stepped motors.

UNIT-V

Robots: What are robots, Robots and process Control systems, Degrees of freedom, factories of the future, Delivery, Disposal and transport systems, Sensing elements, Robot Classifications and Applications. Trouble shooting System failures: Preliminary steps and other troubleshooting aids.

Text Books:

1. Ronald P. Hunter, "Automated process control systems – concepts and Hardware", 2/e, PHI, 1987.
2. Norman A. Anderson, "Instrumentation for process measurement and Control", 3/e, CRC Press, 2005.

Suggested Reading:

1. Kuo B. C, "Automatic Control Systems", 9th edition
2. A.K Sawhney,"A course on Electrical and Electronic Measurements and Instrumentation".

22ECO02

REMOTE SENSING AND GIS

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic knowledge of Geography is required

Course Objectives:

This course is aims to:

1. Explain the fundamental concepts of remote sensing and digital imaging techniques.
2. Make the students to understand the principles of thermal and microwave remote sensing.
3. Make the students understand the significance of GIS and the process of GIS.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Demonstrate the understanding of basic concepts of remote sensing and interpreting energy interactions.
2. Choose an appropriate technique for a given scenario by appreciating the types of remote sensing.
3. Distinguish the principle behind the working of microwave and LiDAR sensing.
4. Apply Microwave remote sensing techniques
5. Explain the procedure for encoding data and geospatial data analysis.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	1	1	–	1	1	1	--	1	--	2	1	--	--
CO 2	3	1	1	1	–	1	1	1	--	1	--	2	1	--	--
CO 3	3	1	1	1	–	1	1	1	--	1	--	2	1	--	--
CO 4	2	1	1	1	–	1	1	1	--	1	--	2	1	--	--
CO 5	3	1	1	1	–	1	1	1	--	1	--	2	1	--	--

UNIT-I

Concept of Remote Sensing: Remote sensing definition, data, process, EM bands used in remote sensing, Interactions and recording of energy: interaction with atmosphere, interaction with earth surface features (soil, water, vegetation), recording of energy by sensors, Transmission, reception and processing, Image interpretation and analysis, Applications, Advantages, and limitations of Remote sensing.

UNIT-II

Digital Imaging: Types of Remote sensing, Sensor resolutions, Digital Image, Sensor components, Principle of a long-track and across-track scanning, Hyperspectral Imaging, Thermal Remote Sensing.

UNIT-III

Microwave Remote Sensing: Active and Passive Microwave Remote Sensing, Radar Imaging: Key components of imaging radar, viewing geometry, spatial resolution, principle of RAR, SAR and their range resolution, Satellite Radar Imaging, LIDAR.

UNIT-IV

Concept of Geographic Information Systems: Key components of GIS, joining spatial and attribute data, functions, advantages and applications of GIS, Spatial data model, Raster data model, Vector data model.

UNIT-V

Process of GIS and Geospatial analysis: Data sources, encoding raster data, encoding vector data, encoding attribute data, linking spatial and attribute data, Geospatial data analysis methods database query, geospatial measurement, overlay operations, network analysis and surface analysis. Integration of GIS and remote sensing.

Text Books:

1. Basudeb Bhatta, "Remote Sensing and GIS", 2/e, Oxford University Press, 2012.
2. Lillesand T.M., and Kiefer R.W. "Remote Sensing and Image Interpretation", 6/e, John Wiley &Sons, 2000.

Suggested Reading:

1. James B. Campbell and Randolph H. Wynne, "Introduction to Remote Sensing", the Guilford Press, 2011.
2. Michael N DeMers, "Fundamentals of GIS", 2/e, John Wiley, 2008.

22ECO03

FUNDAMENTALS OF WIRELESS COMMUNICATIONS

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: A course on basics of electronics is required

Course Objectives:

This course aims to:

1. To familiarize the concepts related to cellular communication and its capacity.
2. To teach students the fundamentals of propagation models and multipath fading.
3. To describe diversity schemes applied in wireless communication and understand the latest wireless technologies

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the overview of Wireless Communication.
2. Relate the cellular concepts like frequency reuse, hand off, coverage and capacity.
3. Analyse the mobile radio propagation with large scale and small scale fading.
4. Select the suitable diversity technique to combat the multipath fading effects.
5. Compare the multiple access techniques and apply to wireless standards

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	1	1	-	1	-	-	-	-	1	1	2	1
CO 2	2	1	1	2	1	-	1	-	-	-	-	1	2	2	1
CO 3	2	2	1	2	2	-	2	-	-	-	-	1	2	1	1
CO 4	2	1	1	1	1	1	1	-	-	2	-	2	1	1	1
CO 5	2	1	1	1	1	1	1	-	-	1	-	1	1	1	1

UNIT-I

An overview of wireless communications: Roadmap of cellular communications. First-Generation systems. Second-Generation systems. Third-Generation systems, Fourth-Generation systems and Fifth-Generation Systems.

UNIT-II

The Cellular Concept-System Design Fundamentals: Introduction, Frequency Reuse, Channel Assignment Strategies. Handoff Strategies. Interference and System Capacity. Power Control for Reducing Interference.

UNIT-III

Mobile Radio Propagation: Large-Scale Path Loss, Introduction to Radio Wave Propagation, Free Space Propagation Model, the Three Basic Propagation Mechanisms, Small-Scale Fading and Multipath: Small-Scale Multipath Propagation, Factors Influencing Small-Scale Fading, Doppler Shift, Types of Small-Scale Fading.

UNIT-IV

Diversity Techniques: Practical Space Diversity Considerations- Selection Diversity, Feedback or Scanning, Maximal Ratio Combining Diversity Equal Gain Combining. Orthogonal frequency division multiplexing: Introduction, Principle of OFDM. OFDM transceivers Cyclic prefix, Spectrum of OFDM, Fading mitigation in OFDM. Intercarrier interference.

UNIT-V

Multiple access techniques: Duplexing: FDD versus TDD. FDMA. TDMA. CDMA. OFDMA. SDMA

Wireless Standards: Global System for Mobile (GSM). GSM Services and Features, GSM System Architecture, GSM Radio Subsystem. GPRS and EDGE- features.

Text Books:

1. Theodore S. Rappaport - Wireless Communications Principles and Practice, 2nd Edition, Pearson Education, 2003.
2. Andreas F.Molisch - Wireless Communications John Wiley, 2nd Edition, 2006.
3. Ke-Lin Du, Concordia University, Montréal,M. N. S. Swamy- Wireless Communication Systems.From RF Subsystems to 4G Enabling Technologies. April 2010

Reference Books:

1. Sanjay Kumar, “Wireless Communication the Fundamental and Advanced Concepts” River Publishers, Denmark, 2015
2. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, First Edition, 2005.
3. Wireless Communications and Networking, Vijay Garg, Elsevier Publications, 2007.

22ECO04

BASICS OF DIGITAL SIGNAL PROCESSING

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic concepts of signals are required.

Course Objectives:
This course aims to:
1. Learn the advantages of DSP over analog signal processing.
2. Analyze discrete-time signals in the frequency domain using DFT and FFT.
3. Learn the theory of digital filters.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Understand the concept of Discrete time signals and systems
2. Analyze the frequency domain representation of discrete time sequence using DTFT and DFT.
3. Apply FFT to the given sequence.
4. Implementation of FIR filter for the given specifications
5. Design an IIR filter for the given specifications.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	03	03	03	02	03	02	-	-	02	02	-	02	03	03	02
CO 2	03	03	03	02	02	02	-	-	02	02	-	02	03	03	02
CO 3	03	03	03	02	03	02	-	-	02	02	-	02	03	03	01
CO 4	03	03	03	02	02	02	-	-	02	02	-	02	03	03	02
CO 5	03	03	03	02	03	02	-	-	02	02	-	02	03	03	02

UNIT-I
Discrete Time Signals and Systems: Introduction, basic elements of a digital signal processing system, advantages and disadvantages of Digital Signal Processing over Analog signal processing, sampling theorem, analog to digital and digital to analog conversion. Discrete-Time System: Mathematical representation of Discrete Time Systems, Concept of Impulse response, and Transfer function, Linear and Time invariant systems, Concept of causality and stability.

UNIT-II
Frequency Domain Analysis of Discrete Time Sequences: Discrete Time Fourier Transform (DTFT), properties of DTFT, Discrete Fourier Transform (DFT) and its properties, relationship between DFT to the DTFT, circular convolution.

UNIT-III
Fast Fourier Transform (FFT): Introduction, Radix-2 Decimation–In-Time FFT(DIT-FFT) and Decimation-In-Frequency FFT(DIF- FFT) algorithms, Bit reversal order, In-place computation.

UNIT-IV
FIR Filter Design: Introduction, Linear phase filters, Design of FIR (LPF, HPF, BPF and BSF) filters using Windows, Comparison between FIR and IIR filters.

UNIT-V

IIR Filter Design: Butterworth & Chebyshev approximations, Conversion from analog filters to digital filters using Impulse Invariance Method (IIM) and Bilinear Transformation (BLT) methods, prewarping. Realization of IIR filters- Direct form I & II, Realization of FIR filters-Direct from, linear phase.

Text Books:

1. Alan V. Oppenheim & Ronald W. Schafer, “Digital Signal Processing,” PHI, 2/e, 2010.
2. John G. Proakis&Dimtris G. Manolakis, “Digital Signal Processing Principles, Algorithms and Application,” PHI, 4/e, 2012.

Suggested Reading:

1. Sanjit K Mitra, " Digital Signal Processing", Tata Mc Graw Hill, Third edition, 2006
2. ChiTsong Chen, "Digital Signal Processing", Indian edition, 2009.

22ECO05

PRINCIPLES OF EMBEDDED SYSTEMS

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge about computer Architectures, Microprocessors and Microcontrollers.

Course Objectives:

This course aims to:

1. Learn the fundamentals of the embedded system design.
2. Learn architecture details of embedded processors
3. Analyze various embedded applications and debugging tools.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand hardware and software details of embedded system.
2. Analyze the architecture and instruction set of embedded processors.
3. Develop the embedded system design cycle
4. Apply various debugging tools for embedded system applications.
5. Design different case studies for embedded applications

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	1	1	2	-	-	-	-	-	-	1	2	3	-
CO 2	2	3	2	2	2	-	-	-	-	-	-	-	2	3	-
CO 3	2	2	3	2	2	-	-	-	-	-	-	-	2	3	-
CO 4	2	2	3	2	3	-	-	-	-	-	-	-	2	3	-
CO 5	2	2	3	2	3	-	-	-	-	-	-	1	2	3	-

UNIT I

Embedded systems: Embedded systems vs General computing systems, Classifications, Applications areas, Processor embedded into a system, Processor selection for embedded system, Embedded hardware units and devices in a system, Design metrics and Challenges in embedded system design.

UNIT II

Embedded Processors: PIC 18 Family Overview, Architecture, Instruction Set, Addressing modes, Timers and Interrupts of PIC 18. Capture/Compare and PWM modules of PIC 18.

UNIT III

Introduction to advanced processor architectures: ARM design philosophy. ARM data flow model, Register organization, Program Status Register, Pipeline, Introduction to exceptions. ARM instruction set, Introduction ARM cortex series, salient features.

UNIT IV

Embedded System Design Cycle: Embedded system design and co-design issues in system development process, Design cycle in the development phase for an embedded system. Embedded software development tools: Host and Target machines, Linker/Locators for embedded software, Embedded software into the target system.

UNIT V

Debugging tools and Applications: Integration and testing of embedded hardware, testing methods, Debugging techniques, Laboratory tools and target hardware debugging: Logic Analyzer, Simulator, Emulator and In-Circuit Emulator, IDE.

Case Studies: Design of Embedded Systems using Microcontrollers – for applications in the area of communications and automotives. (GSM/GPRS, CAN, Zigbee).

Text Books:

1. Raj Kamal, "Embedded Systems-Architecture, Programming and Design," 3/e, Tata McGraw Hill Education, 2015.
2. Andrew N.SLOSS, DomonicSymes Chris Wright "ARM System Developers Guide- Designing and optimizing system software" ELSEVIER 1st Edition2004.
3. Mazidi, MCKinlay and Danny Causey, "PIC Microcontrollers and Embedded Systems", Pearson Education. 2008

Suggested Readings:

1. David E.Simon, "An Embedded software primer", Pearson Education,2004.
2. Steve Furber "ARM System on Chip Architecture" 2/e Pearson education, 2000.

22ECO06

PRINCIPLES OF VLSI

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic Electronics and Digital Logic Fundamentals are required

Course Objectives:

1. To study various characteristics of MOS transistor.
2. To learn various concepts required to obtain the digital logic layout diagrams.
3. To learn various memory design concepts.
4. To study various VLSI Fabrication process steps.

Course Outcomes:

The student will be able to

1. Understand characteristic behavior of MOSFET
2. Describe various MOS layers and layout design rules.
3. Implement various CMOS logic circuits.
4. Design various MOS memories.
5. Understand the concepts of VLSI technology.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	1	1	-	-	-	-	-	-	-	2	1	1	1
CO 2	1	1	2	1	-	-	1	1	-	-	-	2	2	2	2
CO 3	1	2	1	1	1	-	1	1	-	-	-	2	2	2	2
CO 4	1	2	1	-	1	-	1	1	-	-	-	2	2	2	1
CO 5	-	1	-	1	-	-	-	1	-	-	-	2	1	1	1

UNIT – I

Introduction to MOS Technology: Basic MOS Transistor action. Enhancement and Depletion Modes. Basic electrical properties of MOS. Threshold voltage and Body Effect.

UNIT-II

MOS and CMOS circuit Design Process: N-Well, P-Well and Twin-Tub process. MOS Layers, Stick diagrams, Lambda based Design rules and Layout diagrams.

UNIT – III

CMOS Design: Design of MOS inverters with different loads. Basic Logic Gates with CMOS: INVERTER, NAND, NOR, AOI and OAI gates. Transmission gate logic circuits, BiCMOS inverter, D flip flop using Transmission gates.

UNIT – IV

Memories: Design of Dynamic Register Element, 3T, 1T Dynamic RAM Cell, 6T Static RAM Cell. NOR and NAND based ROM Memory Design.

UNIT-V

Introduction to VLSI Technology and Fabrication Process: Introduction to microelectronics and moore's law, Various layers of IC, Wafer preparation and crystal growth, Oxidation, CVD, Lithography, Etching, Ion implantation, Diffusion techniques.

Text Books:

1. Kamran Eshraghian, Douglas A. Pucknell, SholehEshraghian, "Essentials of VLSI circuits and systems", PHI, 2011.
2. Neil H E Weste, David Harris, Ayan Banerjee "CMOC VLSI Design –A circuit and System Perspective", 3/e, Pearson Education, 2006.
3. J.D.Plummer, M.D.Deal and P.B.Griffin, "The Silicon VLSI Technology Fundamentals", Practice and modeling, Pearson Education 2009.

Suggested Reading:

1. John P. Uyemura, "Introduction to VLSI Circuits and systems", John Wiley & Sons, 2011.
2. Simon Sze" VlSI Technology, 2/E", McGraw-Hill Education (India) Pvt Limited-2003

22ECO07

NEURAL NETWORKS AND FUZZY LOGIC

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: The student should have knowledge on fundamentals of computing.

Course Objectives:

This course aims to:

1. Study the learning strategies of artificial neural networks and their training algorithms.
2. Acquire knowledge about associate memory and training algorithms of various associate memory networks.
3. Study the fuzzy rule base system, decision making system, different methods of defuzzification and applications of fuzzy logic.

Course Outcomes:

Upon completion of this course, students will be able to:

1. To differentiate Biological system, intelligent systems and the concepts of crisp and fuzzy set theory
2. To analyze the learning strategies of Artificial Neural networks and learning rules
3. To understand training algorithms and are able to provide adequate knowledge about feed forward and feedback neural networks.
4. To design training algorithms for associative memory network for pattern recognition problems
5. To demonstrate knowledge and understanding of fuzzy system as they apply in real time systems and apply different methodologies to solve the problem related to the problem related to defuzzification.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	2	1	-	-	-	-	-	-	-	3	3	1
CO 2	3	3	2	2	2	-	-	-	-	-	-	-	3	3	1
CO 3	3	3	3	3	2	-	-	-	-	-	-	1	3	3	1
CO 4	3	3	3	2	3	-	2	-	-	-	-	2	3	3	1
CO 5	3	3	3	3	2	-	-	-	-	-	-	2	3	3	1

UNIT-I

Artificial Neural Networks:

Introduction, Biological Neuron, Artificial Neuron, Basic concepts of Neural Networks, Basic Models of ANN Connections, McCulloch-Pitts Model, Characteristics of ANN, Applications of ANN.

UNIT-II

Essentials of Artificial Neural Networks:

Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity,
Learning, Strategies (Supervised, Unsupervised, Reinforcement), Learning Rules, Numerical problems, Types of Application

UNIT-III

Supervised Learning Networks:

Perceptron Network, Perceptron Learning Rule, Architecture, Perceptron Training Algorithm, ADALINE, MADALINE, Back Propagation Network, BP Learning Rule, Input Layer Computation, Hidden Layer Computation, Output Layer Computation, Radial Basis Function Demonstration through MATLAB- Introduction to Associate Memory Network

UNIT-IV

Classical & Fuzzy Sets:

Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

UNIT-V

Fuzzy Logic System Components:

Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods, Applications.

Text Books:

1. Neural Networks and Fuzzy Logic System by Bart Kosko, PHI Publications.
2. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Pai – PHI Publications.
3. Fundamental of Artificial Neural Network and Fuzzy Logic-by Rajesh Kumar, Lakshmi publications

Reference Books:

1. Neural Networks – James A Freeman and Davis Skapura, Pearson Education.
2. Neural Networks – Simon Hakins , Pearson Education

Suggested Videos:

1. https://onlinecourses.nptel.ac.in/noc21_ge07/preview#:~:text=This%20course%20will%20start%20with,help%20of%20some%20numerical%20examples.

ADDITIONAL MINOR ENGINEERING DEGREE

I. Communications and Networking
II. Embedded Systems & IoT
III. Signal Processing
IV. VLSI

The list of courses for Additional Minor Engineering Degree

S.No	Course Code	Course Name
Communications and Networking		
1	noc24-ee25	Principles of Digital Communication
2	noc23-ee102	Microwave Engineering
3	noc24-ee31	Electromagnetic Waves in Guided and Wireless Media
4	noc24-ee35	Principles of Communication Systems - I
5	noc24-ee42	Transmission lines and electromagnetic waves
6	noc24-ee47	An Introduction to Information Theory
7	noc24-ee51	Digital Communication using GNU Radio
8	noc24-ee54	Evolution Of Air Interface Towards 5G
9	noc24-ee58	Network Analysis
10	noc24-ee59	Optical Wireless Communications for Beyond 5G Networks and IoT
11	noc24-ee71	Communication Networks
12	noc24-ee72	Fundamentals Of MIMO Wireless Communication
13	noc24-ee75	RF Transceiver Design
Embedded Systems & IoT		
1	noc24-ee09	A brief introduction of Micro - Sensors
2	noc24-ee09	A brief introduction of Micro - Sensors
3	noc24-ee15	Control engineering
4	noc24-ee23	Optical Fiber Sensors
5	noc24-ee40	Microprocessors And Interfacing
6	noc24-ee45	Sensors and Actuators
7	noc24-ee46	Microprocessors and Microcontrollers
8	noc24-ee62	State space Approach to Control System Analysis and Design
9	noc24-ee65	Control System Design
10	noc24-ee68	Embedded Sensing, Actuation and Interfacing Systems
Signal Processing		
1	noc24-ee04	Deep Learning
2	noc24-ee16	Digital Signal Processing and its Applications
3	noc24-ee18	Foundations of Wavelets and Multirate Digital Signal Processing
4	noc24-ee20	Microwave Integrated Circuits
5	noc24-ee21	Modern Computer Vision
6	noc24-ee22	Multirate DSP
7	noc24-ee28	Signals and Systems
8	noc24-ee36	Principles of Signals and Systems
9	noc24-ee38	Computer Vision And Image Processing - Fundamentals And Applications
10	noc24-ee49	Biomedical Signal Processing
11	noc24-ee57	Medical Image Analysis
12	noc24-ee67	EMI /EMC and Signal Integrity: Principles, Techniques and Applications
13	noc24-ee69	Basics of Semiconductor Microwave Devices
14	noc24-ee76	Signal Processing Techniques and its Applications

VLSI		
1	noc24-ee02	Fundamentals of semiconductor devices
2	noc24-ee03	Photonic integrated circuit
3	noc23-ee108	Electronics Enclosures Thermal issues
4	noc24-ee06	Electronics equipment integration and Prototype building
5	noc24-ee08	Integrated Circuits, Mosfets, OP-Amps and their Applications
6	noc24-ee11	Analog Circuits
7	noc24-ee08	Integrated Circuits, Mosfets, OP-Amps and their Applications
8	noc24-ee12	Analog Electronic Circuits - IITM
9	noc24-ee13	Analog Ic Design
10	noc24-ee14	Circuit Analysis for Analog Designers
11	noc24-ee17	Digital System Design
12	noc24-ee27	Semiconductor device modeling and Simulation
13	noc24-ee29	CMOS Digital VLSI Design
14	noc24-ee43	Digital IC Design
15	noc24-ee44	Design and Analysis of VLSI Subsystems
16	noc24-ee52	Digital Electronic Circuits
17	noc24-ee63	VLSI Signal Processing
18	noc24-ee73	Integrated Circuits and Applications
19	noc24-ee74	Millimeter Wave Technology
20	noc24-ee77	VLSI Physical Design with Timing Analysis

HONORS DEGREE

The list of courses for Honors Degree

Sno	Course Code	Course Name
1	noc23-bt38	Fundamentals Of Micro And Nanofabrication
2	noc23-ee100	Applied Linear Algebra For Signal Processing, Data Analytics And Machine Learning
3	noc23-ee103	Stochastic Control And Communication
4	noc23-ee83	Phase-Locked Loops
5	noc23-ee88	System Design Through Verilog
6	noc23-ee139	Nano bio photonics: Touching Our Daily Life
7	noc23-ee108	Enclosure Design Of Electronics Equipment
8	noc23-ee109	Fabrication Techniques For Mems-Based Sensors : Clinical Perspective
9	noc23-ee113	Modern Digital Communication Techniques
10	noc23-ee105	Transducers For Instrumentation
11	noc23-ee93	Real-Time Digital Signal Processing
12	noc23-ee96	Applied Electromagnetics For Engineers
13	noc23-ee99	Applied Optimization For Wireless, Machine Learning, Big Data
14	noc23-ee119	Pattern Recognition And Application
15	noc23-ee120	Microelectronics: Devices To Circuits
16	noc23-ee121	Basics Of Software Defined Radios
17	noc23-ee122	Advanced Linear Continuous Control Systems: Applications With Matlab Programming And Simulink
18	noc23-ee130	Analysis And Design Principles Of Microwave Antennas
19	noc23-ee132	Discrete Time Signal Processing
20	noc23-ee133	Principles And Techniques Of Modern Radar Systems
21	noc23-ee135	VLSI Interconnects
22	noc23-ee136	Simulation Of Communication Systems Using Matlab
23	noc23-ee137	VLSI Design Flow: RTL to GDS
24	noc23-ee138	Introduction To Adaptive Signal Processing

List of Value added Courses

S.no	Course Code	Title of the Course	Coordinator	Expected Month of start
1	CBITECVO1	Embedded Networks	Dr P.Anuradha, Associate Professor, Dept. of ECE. Email id: anuradhap_ece@cbit.ac.in. Ph no:9848479974	August 2024
2	CBITECVO2	Programming for Network Engineers	Dr.Sai Krishna Kondoju, Assistant Professor, Dept. of ECE. Email id: ksaikrishna_ece@cbit.ac.in Ph no:9000285206	August 2024
3	CBITECVO3	Automatic Train Protection System-Kavach	Sri P.Ranjith Assistant Professor, Dept. of ECE. Email: pranjith_ece@cbit.ac.in Ph no:8919126650 Sri.P.Chandra Sekhar, Assistant Professor, Dept. of ECE. Email id: pchandrasekhar_ece@cbit.ac.in Ph no:9395161120	August 2024

CBITECV01 EMBEDDED NETWORKS

Instruction	30 Lectures

Embedded Networking: Introduction, Serial/Parallel Communication, Serial communication protocols, RS232 standard, RS485, Synchronous Serial Protocols, Serial Peripheral Interface (SPI), PC Parallel port programming, ISA/PCI Bus protocols, Firewire.

USB bus – Introduction, Speed Identification on the bus, USB States, USB bus communication Packets, Data flow types, Enumeration, Descriptors, PIC 18 Microcontroller USB Interface

Building a Network Hardware options, Cables, Connections and network speed, Design choices: Selecting components, Ethernet Controllers, Using the internet in local and internet communications, Inside the Internet protocol.

Exchanging messages using UDP and TCP, Serving web pages with Dynamic Data, Serving web pages that respond to user Input, Email for Embedded Systems – Using FTP, Keeping Devices and Network secure.

Network Topology, Localization, Time Synchronization, Energy efficient MAC protocols, SMAC, Energy efficient and robust routing, Data Centric routing.

TEXT BOOKS:

1. Embedded Systems Design: A Unified Hardware/Software Introduction - Frank Vahid, Tony Givargis, John & Wiley Publications, 2002

2. Parallel Port Complete: Programming, interfacing and using the PCs parallel printer port - Jan Axelson, Penram Publications, 1996.

REFERENCE BOOKS:

1. Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F series -Dogan Ibrahim, Elsevier 2008.

2. Embedded Ethernet and Internet Complete - Jan Axelson, Penram publications, 2003.

3. Networking Wireless Sensors - Bhaskar Krishnamachari, Cambridge press 2005.

CBITECVO2 PROGRAMMING FOR NETWORK ENGINEERS

Instruction	30 Lectures

Python Foundation for Network Engineers: Python, Some questions to do within the session, lists Dictionaries, Methods and Functions, Loops Working with Files.

Python libraries and Data Types: Python Libraries/Packages, Data Encoding Formats, JSON and YAML.

API Concepts and Young data modeling: Data Modelling Fundamentals, YANG

REST, NET, CONFRESTCON.

CISCO solutions APIs: CISCO IOS-XE REST CONF APIs, Exploring CISCO DNA Centre API.

Introduction to Devops / IAC: Exploring CISCO Viptela SDWAN APIs, Infrastructure as Code Tools and Technologies, Version Control Concepts-GIT, Working with Git local and remote repositories.

Text Books:

1) Jose Manuel Ortega, Dr. M. O. Faruque and Sam Washington, “Learning Python Network Programming” 2nd Edition, Packt Publishing, 2015.

2) Chou E., “Mastering Python Networking: Your one-stop solution to using Python for network automation, programmability, and DevOps”, 4th Edition, Packt Publishing, 2023.

CBITECV03

AUTOMATIC TRAIN PROTECTION SYSTEM- KAVACH

Instruction	30 Lectures

Introduction to Train Protection Systems:
Auxiliary Warning Systems, European Train Control Systems Communication Based Interlocking System, Spot and Continuous Relay of Information.

Train Protection System - Kavach Overview of Kavach and its Working, Features, Subsystems, and Communication Interfaces, Signalling Interfaces. Driver Machine Interlocking, Braking Interface, Radio Equipment, On-board Computer, Transponder Receiver, Odometry, GNSS, GPRS, GSM Station Kavach, Track Side Equipment, Signalling Interface, Radio & Tower, GNSS, Transponders, Network Monitoring System. Location Referencing – Train position, Modes of Onboard subsystem, Train Characteristics, Mode Transitions, Braking Curves, Speed Profiles, Speed Limits, Speed Monitoring, Target Speed, Target Distance, Movement Authority, Communication Protocols, Key Management System (KMS), Messages & Language.

Design –Kavach
Station Layout, Radio Signal Strength, Tower Location, Power Requirement, Cable Survey, Loco Fitment Survey. Kavach Scheme Plan, Kavach Control Table, Signalling Interface Diagram, Connectivity Plans for Remote Interface Units (RIUs), Power Supply Plan. Soil Testing, Foundation design, Super Structure Design

Installation:
Interlocking Interface, RFID Tags, Station Master Operation Console Indication Panel (SM_OCIP), GPS/GSM Antennas, Pre-commissioning Checklist, Testing. DMI, Speed Sensors, RFID Reader, Onboard Computer, Brake Interface Unit, Pre-commissioning Checklist, Testing.

Text Book:

1) S-28 A,KAVACH Indian Railway “Automatic Train Protection System” by IRISET,2022

HOD-ECE