SCHEME OF INSTRUCTION AND SYLLABI R-22 (A)

OF

B.E. I TO VI SEMESTERS OF FOUR YEAR DEGREE COURSE

IN

ELECTRONICS ENGINEERING (VLSI Design and Technology)

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

(R-22 (A) Regulation)

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

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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 cultivate technical and innovative proficiency by fostering collaborative learning in Cutting edge Integrated Circuit technologies to excel in global challenges

Department Mission:

M1:
To foster analytical thinking, creativity and technical expertise through theoretical foundation and hands-on experience in cutting edge technologies/tools.

M2:
To nurture a collaborative learning environment and promote research excellence through industry interaction.

M3:
To inculcate good practices that emphasizes critical thinking, and ethical practices for the betterment of the society.

PEOS

PEO1:
Graduates will have a strong foundation in electronics principles with specialized knowledge in VLSI design and related tools, enabling them to solve complex engineering problems in the domain of microelectronics (foundation in engineering)

PEO2:
Graduates will be successful in their professional careers by exhibiting the ethical standards, leadership skills and effective communication. (successful career and professionalism / professional ethics)

PEO3:
Graduates will engage in lifelong learning adapting to technological advancements, pursuing higher education, research and professional development in emerging fields of VLSI.(innovation and lifelong learning)

PEO4:
Graduates will contribute to sustainable solutions for real time societal problems by collaborating across multi-disciplinary teams/approaches (problem solving/interdisciplinary collaboration/social responsibility/ sustainablility).

PSOs

PSO1:
Ability to apply the acquired knowledge for electronic system design using Integrated Circuit technologies.

PSO 2:
Analyze and solve the complex Electronic System Design problems using software and hardware tools.

PSO3:
Will be competent enough to carry research and contribute to the societal needs.

Program Outcomes of BE (Electronics Engineering – VLSI Design and Technology) 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 the world	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. Ethics	Apply ethical principles and commit to professional ethics, diversity, behaviour and norms of the engineering practice.
8. Individual and Collaborative Team Work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
9. 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.
10. 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.
11. 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 Engineering – VLSI Design and Technology)

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	22CSC40N	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, EE (VLSID&T), 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	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.

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	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	-	-	2	-	-	-	-	2	-	-	-
CO 2	3	2	2	-	-	2	-	-	-	-	2	1	-	1
CO 3	3	2	3	-	-	2	-	-	-	-	2	-	-	-
CO 4	3	2	3	-	-	2	-	-	-	-	2	-	-	-
CO 5	3	2	2	-	-	2	-	-	-	-	2	2	-	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	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	-	-	-	-	1	2	-	3	2	2	1
CO 2	3	3	2	-	-	-	-	1	2	-	3	2	2	1
CO 3	3	3	2	1	-	-	-	1	2	-	3	1	1	1
CO 4	2	1	-	-	-	-	-	1	2	-	3	-	-	-
CO 5	2	-	2	-	-	-	-	1	2	-	3	-	-	-

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.

22CSC40N

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	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	1	1	1	-	-	-	-	1	1	1	1
CO 2	3	3	3	1	1	1	-	-	-	-	2	1	1	1
CO 3	3	3	3	1	1	1	-	-	-	-	2	1	1	1
CO 4	3	3	2	1	1	-	-	-	-	-	2	1	1	1
CO 5	3	3	3	1	2	1	-	-	-	-	2	1	1	1

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. JeevaJose, "Taming Python by Programming", Revised Edition, Khanna Book Publications, 2019.
2. Reema Thareja, "Python Programming", Oxford Press, 2017.
3. Yashavant Kanetkar and Aditya Kanetkar, "Let Us Python", 1st Edition, BPB Publications, 2019.

SUGGESTED READING:

1. Zed A. Shaw, "Learn Python3 the Hard Way", 1st Edition, Pearson Education Inc, 2018.
2. Mike Mc Grath, "Python in easy steps: Makes Programming Fun", Kindle Edition, 2017.
3. Doug Hellmann, "The Python Standard Library by Example", 2nd Edition, 2017.

Online 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.

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	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	-	-	2	-	-	-	-	2	-	-	-
CO 2	3	2	1	-	-	2	-	-	-	-	2	2	2	2
CO 3	3	2	3	-	-	2	-	-	-	-	2	-	-	-
CO 4	3	2	2	-	-	2	-	-	-	-	2	1	1	-
CO 5	3	2	3	-	-	2	-	-	-	-	2	2	2	2

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:

This course aims 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	PSO 1	PSO 2	PSO 3
CO 1	1	2	2	2	-	3	1	2	-	-	2	1	1	2
CO 2	-	1	2	2	-	2	-	2	1	-	1	1	1	2
CO 3	-	1	1	2	-	3	1	3	1	2	1	1	1	2
CO 4	2	2	3	2	-	2	1	2	2	1	-	1	1	2
CO 5	1	2	2	1	-	2	-	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).

22CSC41N

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	PSO 1	PSO 2	PSO 3
CO 1	2	1	-	1	1	-	-	-	-	-	2	1	1	1
CO 2	3	3	3	1	1	1	-	-	-	-	2	1	1	1
CO 3	3	3	3	1	2	1	-	-	-	-	2	1	1	1
CO 4	3	3	3	1	1	1	-	-	-	-	2	1	1	1
CO 5	3	3	3	1	2	1	-	-	-	-	2	1	1	1

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:

This course aims 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	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:

This course aims 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	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	-	-	2	-	-	-	-	2	2	2	1
CO 2	3	2	1	-	-	2	-	-	-	-	2	2	2	1
CO 3	3	2	3	-	-	2	-	-	-	-	2	1	1	1
CO 4	3	2	2	-	-	2	-	-	-	-	2	-	-	-
CO 5	3	2	3	-	-	2	-	-	-	-	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

B.E. - ELECTRONICS ENGINEERING (VLSI DESIGN AND TECHNOLOGY)

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	22ECC01	Electronic Devices	3	-	-	3	40	60	3
4	22EGC01N	English	2	-	-	3	40	60	2
PRACTICALS									
5	22PYC09	Electromagnetic Theory and Quantum Mechanics Lab	-	-	3	3	50	50	1.5
6	22ECC05	Electronic Devices Lab	-	-	2	3	50	50	1
7	22EGC02N	English lab	-	-	2	3	50	50	1
8	22MEC01N	Engineering Graphics	-	1	3	3	50	50	2.5
9.	22MEC38N	Digital Fabrication Workshop	-	-	3	3	50	50	1.5
TOTAL			**11**	**2**	**13**	**27**	**360**	**440**	**19.5**
Clock Hours Per Week: 26									

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

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

22MTC05

VECTOR CALCULUS AND DIFFERENTIAL EQUATIONS
(Common to ECE, EE (VLSID&T), 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:

This course aims 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	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.

22PYC06

ELECTROMAGNETIC THEORY AND QUANTUM MECHANICS
(ECE, EE(VLSID&T), & 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	PSO 1	PSO 2	PSO 3
CO 1	3	1	1	1	1	2	2	1	1	2	1	3	3	2
CO 2	3	2	2	1	1	1	1	1	1	2	2	3	3	2
CO 3	3	1	2	1	2	2	2	1	2	2	2	3	3	2
CO 4	2	2	1	1	1	1	1	1	1	2	1	3	3	2
CO 5	3	2	2	2	2	1	2	2	1	2	1	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.

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	PSO 1	PSO 2	PSO 3
CO 1	1	2	1	1	1	1	2	1	1	1	2	3	3	2
CO 2	2	3	1	3	2	1	2	1	1	1	2	3	3	2
CO 3	1	2	1	1	1	1	2	1	1	1	2	3	3	2
CO 4	2	3	1	3	2	1	2	1	1	1	2	3	3	2
CO 5	1	3	1	2	2	1	2	1	1	1	2	3	3	2

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.

22EGC01N

ENGLISH

(Common to All Branches)

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	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.

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	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	2	2	3	3	2	3	1	1	1
CO 2	1	1	1	1	1	2	1	1	2	1	3	1	-	1
CO 3	1	2	1	1	-	2	1	1	3	1	3	1	-	1
CO 4	1	2	1	1	-	2	2	2	2	2	3	2	2	2
CO 5	1	2	1	2	1	3	2	3	3	2	3	1	1	1

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.
3. Michael Swan, "Practical English Usage", Oxford University Press, 4th Edition,2016.
4. Meenakshi Raman and Sangeetha Sharma, "Technical Communication: Principles and Practice" 3rd Edition, Oxford University Press, 2015.

22PYC09

ELECTROMAGNETIC THEORY AND QUANTUM MECHANICS LAB
(ECE, EE(VLSID&T), & 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	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	3	1	2	3	3	2	1	2	3	3	2
CO 2	3	2	1	2	2	2	2	2	1	1	3	3	3	2
CO 3	3	2	3	2	3	2	2	3	2	1	2	3	3	2
CO 4	3	3	2	2	2	2	3	2	1	1	3	3	3	2
CO 5	3	1	2	3	2	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.

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	PSO 1	PSO 2	PSO 3
CO 1	2	2	1	1	2	1	2	2	2	2	2	3	3	2
CO 2	2	2	1	1	2	1	2	2	2	2	2	3	3	2
CO 3	2	2	1	1	2	1	2	2	2	2	2	3	3	2
CO 4	2	2	1	1	2	1	2	2	2	2	2	3	3	2
CO 5	2	2	1	1	2	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.

22EGC02N

ENGLISH LAB

(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.

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	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	-	-	-	-	1	2	1	3	3	3	3
CO 2	-	-	-	-	-	-	-	2	2	1	3	3	3	3
CO 3	-	-	-	-	-	-	-	2	1	1	2	3	3	3
CO 4	1	1	1	1	1	1	1	3	3	1	3	3	3	3
CO 5	-	1	1	1	1	2	1	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	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	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
   (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.

3 Stair case wiring Wiring of one light point controlled from two different places independently using two 2way switches.
4 To make external threads for GI pipes using die and connect the GI pipes as per the given diagram using taps, couplings, and bends.
5 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 Workshop Technology", 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

B.E. - ELECTRONICS ENGINEERING (VLSI DESIGN AND TECHNOLOGY)

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	22MTC19	Complex Variables and Special Functions	3	-	-	3	40	60	3
2	22EVC01	Analog Circuits Analysis	3	-	-	3	40	60	3
3	22EVC02	Digital Electronics	3	-	-	3	40	60	3
4	22ECC03N	Network analysis and synthesis	3	1	-	3	40	60	4
5	22ITC24N	Data Structures using C	3	-	-	3	40	60	3
6	22ECC04	Signals and Systems	3	-	-	3	40	60	3
PRACTICALS									
7	22EVC03	Analog and Digital Circuits Lab	-	-	2	3	50	50	1
8	22ITC25N	Data Structures using C Lab	-	-	2	3	50	50	1
9	22ECC06	Network analysis and synthesis Lab	-	-	2	3	50	50	1
10	22EVI01	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**

22MTC19

COMPLEX VARIABLES AND SPECIAL FUNCTIONS

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

COURSE OBJECTIVES:

1. To discuss the power series solution of differential equations.
2. To discuss the properties of Legendre's Polynomials.
3. To discuss the properties of Bessel's functions
4. To learn Differentiation and Integration of complex valued functions.
5. To evaluate real and definite integrals.

COURSE OUTCOMES:

Upon completing this course, students will be able to:

1. Solve differential equations by using series solution method
2. Express polynomials as Legendre's functions.
3. Express polynomials as Bessel's functions.
4. Apply Cauchy's integral theorems to evaluate complex integrals.
5. Solve Real and Complex integrals by using Cauchy's residue theorems.

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	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	2	-	-	-	-	-	-	2	1	1	2
CO 2	3	2	2	2	-	-	-	-	-	-	2	1	1	2
CO 3	3	2	2	2	-	-	-	-	-	-	2	1	1	2
CO 4	3	3	2	2	-	-	-	-	-	-	2	1	1	2
CO 5	3	3	2	2	-	-	-	-	-	-	2	1	1	2

UNIT – I

Series Solutions of Differential Equations: Ordinary point, singular point and regular singular point, series solution when **x=0** is an ordinary point of the equation, Frobenius method (Series solution when x=0 regular singular point).

Beta and Gamma functions: Beta function, Gamma function, relation between gamma and beta functions and related problems

UNIT-II

Legendre's Polynomial: Legendre's equation, Legendre's Polynomial of first kind (without proof), Rodrigue's formula, calculation of Legendre's polynomials, generating function, recurrence formulae and orthogonality of Legendre polynomials .

UNIT-III

Bessel's function: Bessel's equation, Bessel's function of the first kind of order n (without proof), recurrence formulae for Jn(x) and related problems, generating function. Sturm-Liouville problems, Orthogonality of Eigen functions.

UNIT-IV

Theory of Complex variables: Limit of a complex function, derivative of complex function, analytic function, Cauchy Riemann equations (Cartesian and polar forms), construction of Analytic functions by using Milne-Thomson's method. Harmonic function. Complex integration, Cauchy's theorem, Cauchy's

Integral formula and its derivatives and related problems.

UNIT-V

Expansion of functions, Singularities & Residues: Taylor's and Laurent's series Expansions (without proof). Zeros of analytic function and types of singularities. Residues and Cauchy's Residue theorem. Evaluation of improper integrals. Bilinear transformations and conformal transformation.

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.
3. R.K.Jain, S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5th edition, 2016.

SUGGESTED READING:

1. N.P.Bali and Manish Goyal, Atext book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. James ward Brown, Ruel V. Churchill, "Complex variables an Applications", McGraw Hill Higher Education, 2013.

22EVC01

ANALOG CIRCUITS ANALYSIS

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

Prerequisite: Student should have knowledge on Electronic Devices and Network Analysis.

COURSE OBJECTIVES:

This course aims to:

1. The Understand the applications of BJT & FET as an amplifier.
2. Analysis of BJT & FET in various configurations using small signal equivalent models and their frequency response.
3. Know concept of multistage, feedback amplifiers, power amplifier and their analysis

COURSE OUTCOMES:

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

1. Acquire the knowledge of BJT and FET behaviour in the design of various biasing and amplifier circuits.
2. Apply low and high frequency models of transistor in the analysis of single stage and multistage amplifiers.
3. Design and analyse feedback amplifier and oscillator circuits.
4. Compare and contrast different types of biasing, Multistage, Feedback and Power amplifiers.
5. Interpret a given analog circuit and evaluate its performance parameters by applying acquired knowledge.

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	PSO 1	PSO 2	PSO 3
CO 1	2	2	1	2	-	-	-	-	-	1	1	3	1	2
CO 2	2	2	1	2	-	-	-	-	-	1	1	3	2	2
CO 3	2	2	1	2	-	-	-	-	-	1	1	3	1	2
CO 4	2	2	1	2	-	-	-	-	-	1	1	3	2	2
CO 5	2	2	1	2		-	-	-	-	1	1	3	2	2

UNIT-I

Biasing

Transistor Biasing: BJT biasing techniques, stability factors, Bias compensation techniques, Thermal runaway, Thermal stability, BJT as an amplifier and as a switch.

JFET biasing: Zero current drift biasing, biasing of JFET, FET as an amplifier and as a switch.

UNIT-II

Single stage amplifiers

BJT Amplifiers: Analysis of BJT circuits using h-parameters in CB, CE and CC configurations - their comparison (approximate and exact analysis), Millers Theorem & its duality – application circuits, Frequency response of BJT

FET Amplifiers: Analysis of FET circuits using small-signal model for CS and CD configurations - their comparison. Frequency response of FET Amplifiers.

UNIT -III

Multistage amplifiers: Coupling schemes - RC coupling, Transformer coupling and Direct coupling; Analysis of CE-CE, CE-CB, CE-CC, CC-CC – Darlington pair.

Transistor at high frequencies: Hybrid π CE transistor model, CE short circuit current gain, Current gain with resistive load.

UNIT-IV

Feed Back Amplifiers: The feedback concept, General characteristics of negative feedback amplifier, Effect of negative feedback on input and output impedances. Method of analysis of feedback amplifiers, Analysis of 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, Wein bridge oscillator, LC oscillator, Crystal oscillator.

Large Signal Amplifies: BJT as large signal audio 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.

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. Donald Schilling, Charles Belove, Tuvia Apelewicz Raymond Saccardi, “Electronic Circuits: Discrete and Integrated”, TMH, 3rd Edition, 2012.

22EVC02

DIGITAL ELECTRONICS

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 concepts related to Digital Electronics and Boolean laws and Theorems.
2. Analyze various minimization techniques and Simplify the Boolean expressions,
3. Comprehend the concepts of various combinational and sequential logic Designs.

COURSE OUTCOMES:

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

1. Understand the basic concepts related to Digital Electronics and Boolean Theorems.
2. Apply the Minimization techniques for the simplification and implementation of logic functions using suitable gates namely NAND, NOR etc.
3. Design the Combinational Circuits such as Adders, Subtractors, Code Convertors, Decoders, Multiplexers, Magnitude Comparators etc.
4. Analyze the design Sequential Circuits such as Flip flops, different types of Counters and Shift Registers,
5. Apply the Sequential design concepts to implement Finite Sate Machines and implementation on PLDs.

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	PSO 1	PSO 2	PSO 3
CO 1	2	1	1	1	1	-	-	-	-	-	2	3	2	2
CO 2	2	2	2	1	1	-	-	-	-	-	2	3	2	2
CO 3	3	3	3	2	1	-	-	-	-	-	2	3	2	3
CO 4	3	3	3	2	1	-	-	-	-	-	2	3	2	2
CO 5	3	3	3	2	1	-	-	-	-	-	2	3	2	2

UNIT – I

Introduction to Digital Electronics:

Introduction to Digital Systems and Switching Circuits, Number Systems: Decimal, binary, octal, hexadecimal number system and conversion, binary weighted codes, signed numbers, 1s and 2s complement codes, Binary arithmetic.

Boolean Algebra: Boolean laws, truth tables, Basic Theorems, Commutative, associative, distributive and DeMorgan's theorems, Realization of switching functions using logic gates. SOP & POS forms, Canonical forms, Introduction to Logic Gates, Ex-OR, Ex-NOR operations.

UNIT - II

Minimization of Switching Functions:

Karnaugh map method, two, three and four variable Karnaugh maps, simplification of expressions, Quine-McCluskey Tabular Minimization Method, Logic function realization: AND-OR, OR-AND and NAND/NOR realizations. combinational circuits, multiple output functions.

UNIT-III

Combinational Logic 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-IV

Sequential Logic Design:

Latches, Flipflops, Difference between latch and flipflop, types of flipflops like S-R,D, JK, T, Master-Slave JK Flip Flop, Flip flop conversions, setup and hold times, Ripple and Synchronous counters, Shift registers

Unit-V

Finite state machines:

Finite State Machine- Moore and Mealey models, Implementation of sequence detector: state transition diagrams, state tables, state assignments, realization with different types of Flipflops. Introduction to Algorithmic State Machines charts.

Programmable Logic Devices (PLD): Introduction, Architecture of PLDs, Implementation of Logic function on PROM, PLA, PAL.

TEXT BOOKS:

1. Morris Mano M. and Michael D.Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog, 6e", 6th Edition, Pearson May 2018.

2. Charles H. Roth, Jr. | Larry L. Kinney | Raghunandan G. H "Fundamentals of Logic Design" 1st edition, - Cengage Engineering, 2020

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

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 magneticcoupled 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 coupledcircuits, 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	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	2	1	1	1	2	3	1	3	3	2	2
CO 2	3	3	2	2	1	1	1	2	3	1	3	3	3	2
CO 3	3	3	2	2	1	1	1	2	3	1	3	3	1	2
CO 4	3	3	2	2	1	1	1	2	3	1	3	3	2	2
CO 5	3	3	3	2	1	1	1	2	3	1	3	3	1	2

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 simplecircuits.

UNIT - IV

Frequency Domain Analysis: Concept of complex frequency, impedance and admittance functions, Series and parallelresonance, 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, McGrawHill, 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.

22ITC24N

DATA STRUCTURES USING C
(Common to ECE, EE (VLSID&T), 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: Programming and Problem Solving (22CSC01), Programming Laboratory (22CSC02).

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	PSO 1	PSO 2	PSO 3
CO 1	2	1	1	-	-	-	-	-	-	-	1	3	3	2
CO 2	2	1	1	-	-	-	-	-	-	-	1	3	3	2
CO 3	2	2	2	-	-	-	-	-	-	-	1	3	3	2
CO 4	2	2	2	-	-	-	-	-	-	-	1	3	3	2
CO 5	2	2	2	-	-	-	-	-	-	-	1	3	3	2

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.

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	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	1	1	1	1	1	2	1	2	2	1	1
CO 2	3	2	1	1	1	1	1	1	2	1	2	2	1	1
CO 3	3	2	1	1	1	1	1	1	2	1	2	2	1	1
CO 4	3	2	1	1	1	1	1	1	2	1	2	2	1	1
CO 5	3	2	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.

22EVC03

ANALOG AND DIGITAL CIRCUITS LAB

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

Prerequisite: Student should have knowledge on Electronic Devices lab and Network lab.

COURSE OBJECTIVES:

This course aims to:

1. The Understand the design of biasing and amplifiers.
2. Analysis of BJT & FET in various configurations using small signal equivalent models and their frequency response.
3. Know concept of logic gates and ICs

COURSE OUTCOMES:

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

1. Design of BJT/FET biasing circuits.
2. Experiment with single and multi-stage amplifiers.
3. Compare different performance of different oscillators.
4. Compare and contrast different types logic gates operation.
5. Implement different logic functions using different 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	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	1	1	1	1	3	2	1	1	3	2	2
CO 2	3	3	3	1	1	1	1	3	2	1	1	3	2	2
CO 3	3	3	3	1	1	1	1	3	2	1	1	3	2	2
CO 4	3	3	3	1	1	1	1	3	2	1	1	3	2	2
CO 5	3	3	3	1	1	1	1	3	2	1	1	3	2	2

List of experiments

1. Design of a Common Emitter BJT amplifier and study of its frequency response.
2. Frequency response of two stage RC - Coupled Common Source FET amplifier
3. Design of a voltage shunt amplifier and study of its frequency response.
4. Desing of current series amplifier and study of its frequency response.
5. Design and implementation of RC Oscillator.
6. Design and implementation of LC Oscillator
7. Design of Class-B power amplifier.
8. Functional verification of logic gates using ICs.
9. Implementation of logic function using decoder IC.
10. Implementation of logic function using Multiplexer IC.
11. Implementation of code converter.
12. Implementation of BCD Adder.

- Structured enquiry: Design a Frequency Divider Circuit using ICs
- Open ended Enquiry: Design and implement a classroom sound monitoring system using BJTs and a 0.5W speaker.

22ITC25N

DATA STRUCTURES USING C LAB
(Common for ECE, EE (VLSID&T), 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 (22CSC01), Programming Laboratory (22CSC02).

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. Practice 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	PSO 1	PSO 2	PSO 3
CO 1	2	2	1	-	-	-	-	-	-	-	1	2	3	1
CO 2	2	2	1	-	-	-	-	-	-	-	1	2	3	2
CO 3	2	2	2	-	-	-	-	-	-	-	1	2	3	2
CO 4	2	2	2	-	-	-	-	-	-	-	1	2	3	3
CO 5	2	2	2	-	-	-	-	-	-	-	1	2	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.

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	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	1	1	1	1	1	1	2	1	3
CO 2	3	3	3	2	2	2	1	1	2	1	2	2	1	2
CO 3	1	2	1	1	1	1	1	1	1	1	1	2	1	2
CO 4	2	2	1	1	1	1	1	1	1	1	1	2	1	1
CO 5	1	1	1	1	1	1	1	1	1	1	1	2	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.

22EVI01

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	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	2	2	3	3	3	1	2	3	3	2	3
CO 2	3	3	3	3	3	2	2	2	2	3	3	2	2	3
CO 3	3	2	3	2	2	3	1	2	1	2	2	2	2	3
CO 4	3	3	2	3	3	3	2	2	2	3	2	2	2	3
CO 5	3	3	3	3	2	2	2	2	2	3	3	1	2	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

B.E. - ELECTRONICS ENGINEERING (VLSI DESIGN AND TECHNOLOGY)

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	22ECC09	Control Systems	3	-	-	3	40	60	3
2	22EVC04	Linear Integrated Circuits	3	-	-	3	40	60	3
3	22EVC05	Verilog HDL	3	-	-	3	40	60	3
4	22EVC06	Digital VLSI 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	22EVC07	HDL Lab	-	-	2	3	50	50	1
9	22EVC08	IC Applications Lab	-	-	2	3	50	50	1
10	22EVC09	Digital VLSI Design Lab	-	-	2	3	50	50	1
11	22EGC03	Employability skills	-	-	2	3	50	50	1
12	22EVU01	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**

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	PSO 1	PSO 2	PSO 3
CO 1	2	1	-	1	-	-	2	1	-	2	2	3	2	1
CO 2	2	2	2	2	1	1	2	2	2	3	2	3	1	1
CO 3	2	2	1	2	2	2	2	2	-	3	3	3	2	2
CO 4	3	2	2	2	2	1	2	1	-	2	2	3	3	2
CO 5	3	2	2	2	2	3	2	2	2	3	3	3	1	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.

22EVC04

LINEAR INTEGRATED CIRCUITS

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

COURSE OBJECTIVES:

This course aims to:

1. To learn the basic building blocks of linear integrated circuits.
2. To study the applications of Operational Amplifiers.
3. To learn the theory and applications of active filters, PLL, 555 timers, ADC and DAC.

COURSE OUTCOMES:

1. Understand the building blocks of Op-Amp.
2. Implement the applications of Operational Amplifiers.
3. Analyse and Design of active filters and Oscillators.
4. Implementation of 555 IC Timer Applications.
5. Design and Implementation of ADC and DAC Converters.

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	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	1	2	2	2	1	2	1	1	3	2	3
CO 2	3	3	2	1	2	1	2	2	2	1	2	3	2	2
CO 3	3	3	3	1	1	2	2	2	2	2	1	3	2	2
CO 4	3	3	3	2	1	1	2	2	1	1	1	3	2	2
CO 5	3	3	3	1	2	2	1	2	1	2	1	3	2	2

UNIT-I

Fundamentals and basic Applications of operational Amplifiers: Op-Amp block diagram, ideal and Practical Op-Amp Characteristics, Op-Amp and its features. Frequency response and compensation techniques. Op-Amp Applications: Inverting and Non-inverting amplifiers with ideal and non-ideal Op-amps, Voltage Follower, Difference Amplifier, Summing Amplifier, ideal and practical Integrator and differentiator.

UNIT-II

Linear Applications of Op-Amp: Comparator, Schmitt Trigger with and without reference voltage, Astable Multivibrator, Monostable Multivibrator, Triangular waveform generator. Op amp as an Instrumentation amplifier, Voltage to current and Current to Voltage converters with Floating and Grounded load, Sample and hold circuit, log and Anti log amplifiers using diode.

UNIT-III

Active Filters and Oscillators: Introduction, Analysis of Butterworth first order, second order lowpass and high pass filters, Band-pass filters, Band-stop filters, Notch filter, All-pass filter. RC Phase shift Oscillators and Wein bridge oscillator

UNIT-IV

Specialized LIC Applications:

555 Timer: Introduction and its functional diagram. Modes of operation: Monostable, Astable multivibrators, applications of 555 Timer. Function Generator: Analysis and Design of Function Generator using IC 8038. Voltage Controlled Oscillator: Operation and applications using IC 566. Phase Locked Loops: Introduction, Principles, Block diagram and Description of IC 565, Applications of PLL: frequency multiplication and frequency synthesis.

UNIT-V

Data Converters and Regulators: Data Converters: Introduction, specifications, DAC- Weighted Resistor, R-2R Ladder, ADC- Parallel Comparator, Successive Approximation and Dual Slope. Introduction, Analysis and design of regulators using 78XX and 723 monolithic ICs, Current limiting and Current foldback techniques using IC 723.

TEXT BOOKS:

1. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits," 4/e, PHI, 2010.
2. Roy Chowdhury D, Jain S.B., "Linear Integrated Circuits,"4/e, New Age International Publishers, 2010.

SUGGESTED READING:

1. K.R.Botkar, "Integrated Circuits," 10/e, Khanna Publishers, 2010.
2. David A.Bell, 'Op-Amp & Linear ICs', Oxford, 2013.
3. Sedra and Smith, "Micro Electronic Circuits", 6/e, Oxford University Press, 2009.

22EVC05

VERILOG HDL

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

Prerequisite: Knowledge of Digital Electronic concepts.

COURSE OBJECTIVES:

This course aims to:

1. Learn various concepts related to Verilog HDL.
2. Analyze and identify the suitable Abstraction level for a particular digital design.
3. Comprehend the various Verilog Constructs and use them to write efficient codes.

COURSE OUTCOMES:

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

1. Understand the basic concepts related to Verilog HDL.
2. Analyze the Verilog construct for gate Level and Data Flow (RTL) and write codes using those modeling styles.
3. Design Combinational and Sequential circuits using behavioral modeling.
4. Write the codes more effectively using Verilog tasks, functions, UDPs and switch Level modeling levels
5. Generate the Logic Synthesis with the 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	PSO 1	PSO 2	PSO 3
CO 1	1	2	1	1	3	-	-	-	-	-	3	3	3	3
CO 2	2	3	2	3	3	-	-	-	-	_	3	3	3	3
CO 3	3	3	2	3	3	-	-	-	-	-	3	3	3	3
CO 4	2	3	2	3	3	-	-	-	-	-	3	3	3	3
CO 5	1	1	1	2	3	-	-	-	-	-	3	3	3	3

UNIT – I: Introduction to Verilog HDL:

Verilog as HDL, Evolution of CAD, Importance of HDLs, Design Flow, Popularity of Verilog HDLs. Design Methodologies, Module, Instances, components of Simulation, Design and Stimulus blocks.

Language Constructs and Conventions: Introduction, Keywords, Identifiers, White Space Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Memory, Operators, System Tasks.

Modules and Ports: Module definition, port declaration, connecting ports, hierarchical name referencing.

UNIT - II: Gate level and Data Flow Modelling:

Gate Level Modeling: Introduction, Gate Primitives, Gate Types, Buffer gates, Array instances, Gate delays, Rise, Fall and Turnoff delays, Min/Typ/Max values. Digital logic circuits Examples with Gate Level modelling.

Data Flow Modeling: Introduction, Continuous Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators. Digital logic circuits examples with Data Flow modelling

UNIT-III: Behavioral Modeling:
Structured Procedures, Initial, Always Construct, Procedural Assignment, Timing Control, Conditional Statements, Multiway Branching, Loops, Sequential and parallel blocks and Generate blocks. Digital logic circuits examples with Behavioral Modelling.

Unit-IV: Advanced Verilog topics:
Functions, Tasks: Introduction, Function, Tasks, declaration, Automatic (Re-entrant) Tasks, Functions.
User-Defined Primitives (UDP): Basics of UDP, combinational UDP, Sequential UDP,
Switch Level Modeling: Introduction, Basic Transistor Switches, CMOS Switch, Bi-directional Gates, Time Delays with Switch Primitives, Examples with SLM

Unit-V: Logic Synthesis with Verilog:
Logic Synthesis, Verilog HDL Synthesis, Synthesis Design flow, Modelling Tips for Logic Synthesis
Verilog Models for Memories: Static RAM Memory, Dynamic RAM memories.

TEXT BOOKS:
1. Samir Palnitkar, "Verilog HDL, A guide to Digital design and synthesis", 2nd Edition, Pearson Education, 2010.
2. T.R. Padmanabhan and B. Bala Tripura Sundari, "Design through Verilog HDL", WSE, IEEE Press 2008.

SUGGESTED READING:
1. Morris Mano M. and Michael D.Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog, 6e", 6th Edition, Pearson May 2018.
2. Thomas and Moorby, "The Verilog Hardware Description Language", kluwer academic publishers, 5th edition, 2002.

22EVC06

DIGITAL VLSI DESIGN

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

Prerequisite: MOS Basics, electronic circuit analysis and Digital Electronics.

COURSE OBJECTIVES:

This course aims to:

1. To train the students in the design of basic digital logic cells.
2. To familiarize students with various digital logic styles.

COURSE OUTCOMES:

Student will be able to:

1. Apply different Models of the MOSFET for a given application context.
2. Design Combinational gates / leaf-cells as per the given specifications.
3. Differentiate between various CMOS logic design styles
4. Differentiate and Choose between Static and Dynamic CMOS Circuits
5. Design CMOS sequential 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	PSO 1	PSO 2	PSO 3
CO 1	1	2	1	1	3	-	-	-	-	-	3	3	3	2
CO 2	2	3	2	3	3	-	-	-	-	-	3	3	3	2
CO 3	3	3	2	3	3	-	-	-	-	-	3	3	3	2
CO 4	2	3	2	3	3	-	-	-	-	-	3	3	3	2
CO 5	1	1	1	2	3	-	-	-	-	-	3	3	3	2

UNIT-I

Basic Electrical Properties of MOS circuits: Evolution of IC Design, MOS transistor operation in linear and saturated regions, MOS transistor threshold voltage, MOS switch and inverter, latch-up in CMOS inverter; wiring capacitances;

UNIT-II

CMOS inverter properties - Robustness: Switching Threshold, Noise Margins. Dynamic performance: Computing Capacitances, Inverter delay times; static and dynamic power dissipation, MOSFET scaling - constant-voltage and constant-field scaling;

UNIT-III

Static CMOS Combinational Circuit: Static CMOS Gates, Ratioed Logic, Logic Effort, Design of arithmetic building blocks: adders – static & dynamic, multipliers - serial & parallel, barrel multipliers, area-time tradeoff, power consumption issues. Layout Techniques for complex Combinational gates.

UNIT-IV

Dynamic CMOS Combinational Circuits: Steady-State behavior of Dynamic Gate Circuits, Speed and Power Dissipation of Dynamic Logic, Noise considerations in dynamic design, charge sharing, cascading dynamic gates, domino logic, np-CMOS logic, problems in single- phase clocking, two-phase non-overlapping clocking scheme.

UNIT-V

CMOS Sequential Logic Circuits: Timing Metrics for Sequential Circuits, Classification of Memory Elements, Static Latches and Registers, The Bistability Principle, Multiplexer-Based Latches, Master-Slave Edge-Triggered Register, Static SR Flip-Flops, Dynamic Latches and Registers, True Single-Phase Clocked Register (TSPCR), Sense-Amplifier Based Registers.

TEXT BOOKS:

1. J.M. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits- A Design Perspective, 2nd ed., PHI, 2003
2. S.M. Kang and Y. Leblevici, CMOS Digital Integrated Circuits Analysis and Design, 3rd ed., McGraw Hill, 2003
3. N.H.E. Weste and K. Eshraghian, Principles of CMOS VLSI Design - a System Perspective, 2nd ed., Pearson Education Asia, 2002.

SUGGESTED READING:

1. Behzad Razavi, “CMOS Analog IC Design”-2nd edition , McGraw Hill.

22ECC11

PROBABILITY THEORY AND STOCHASTIC PROCESS
(Common to ECE, EE(VLSID&T))

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	PSO 1	PSO 2	PSO 3
CO 1	1	2	1	1	1	1	2	1	1	1	2	1	1	2
CO 2	2	3	1	3	2	1	2	1	1	1	2	1	1	2
CO 3	1	2	1	1	1	1	2	1	1	1	2	1	1	2
CO 4	2	3	1	3	2	1	2	1	1	1	2	1	1	2
CO 5	1	3	1	2	2	1	2	1	1	1	2	1	1	2

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	PSO 1	PSO 2	PSO 3
CO 1	-	-	1	-	-	1	-	1	-	-	1	1	1	1
CO 2	-	-	1	-	-	1	-	1	-	1	1	1	1	1
CO 3	--	-	-	-	-	1	-	-	1	-	-	1	-	1
CO 4	-	-	-	-	-	1	1	-	-	-	-	-	-	1
CO 5	-	-	-	-	-	1	1	-	-	-	-	-	-	1

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:

This course aims 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	PSO 1	PSO 2	PSO 3
CO 1	-	-	1	-	-	1	1	1	-	-	-	-	-	1
CO 2	-	-	2	-	-	3	2	1	-	-	-	-	-	1
CO 3	-	-	1	-	-	1	-	-	-	-	-	-	-	1
CO 4	-	-	1	-	-	1	-	-	-	-	-	-	-	1
CO 5	-	-	2	-	-	3	1	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

22EVC07

HDL LAB

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

Prerequisite: Concepts of Digital Electronics and C language.

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	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	2	3	-	-	-	2	2	1	3	3	3
CO 2	2	2	2	2	3	-	-	-	2	2	1	3	3	3
CO 3	2	3	3	2	3	-	-	-	2	2	1	3	3	3
CO 4	2	3	3	3	3	-	-	-	2	2	1	3	3	3
CO 5	3	3	3	3	3	-	-	-	2	2	1	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 and Subtractors.
3. Multiplexers and De-multiplexers.
4. Encoders, Decoders and Comparator.
5. Implementation of logic function using Multiplexers and Decoders.
6. Code Converter : Binary to Gray, Gray to Binary, BCD to SSD.
7. Arithmetic and Logic Unit.
8. Flip-Flops: SR, D, T, JK.
9. Counters and Shift register.
10. FSM.
11. Tasks and Functions.
12. UDPs.
13. NAND, NOR gate, Adders and MUX using Switch Level Modelling.
14. Implementation of SSI Circuits on FPGA.

15. **Structured Enquiry:** Design of a High-Speed Adders.
16. **Open ended Enquiry:** Design of Digital System for real time applications.
17. **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.

22EVC08

IC APPLICATIONS LAB

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

COURSE OBJECTIVES:

This course aims to:

1. To measure the characteristics of Op Amp and implementing the arithmetic circuits, filters, oscillators using Op Amp.
2. To analyse the operation and implementation of circuits using IC 566, IC 723, IC 555.
3. To know and verify the concepts of data converters.

COURSE OUTCOMES:

1. Measure the characteristics of Op-Amp
2. Demonstrate the circuits of Op-Amp for various applications
3. Implement the arithmetic circuits, filters, oscillators
4. Implementation of voltage regulators
5. Design and analyse the data converters

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	PSO 1	PSO 2	PSO 3
CO 1	2	2	3	2	3	1	2	1	2	1	1	3	2	1
CO 2	3	3	3	2	3	2	2	2	1	1	2	3	2	1
CO 3	2	3	2	1	2	1	1	2	2	2	2	3	2	1
CO 4	3	3	2	2	2	2	1	2	1	2	-	3	2	1
CO 5	2	2	2	3	2	1	1	1	2	1	2	3	2	1

Lab Experiments:

1. Measurement of Op-Amp parameters.
2. Voltage Follower, Inverting and Non-Inverting Amplifiers using Op-Amp.
3. Arithmetic Circuits: Summer, Subtractor, Integrator and Differentiator using Op-Amp.
4. Active filters: LP, HP and BP using Op-Amp.
5. Astable, Monostable multi vibrators using Op-Amp.
6. Triangle and Square wave generators using Op-Amp.
7. Oscillators using Op-amp.
8. Voltage Controlled Oscillator Using IC 566.
9. Low and High Voltage Regulators using IC 723.
10. Astable, Monostable multi vibrators using IC 555 Timer.
11. Binary Weighted and R-2R Ladder network ADC.
12. Successive Approximation Resistor and Dual slope Counter method DAC.

Reference Book: Laboratory Manual.

22EVC09

DIGITAL VLSI DESIGN LAB

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

Prerequisite:

Digital electronics, MOS Fundamentals, Electronic Design Analysis.

COURSE OBJECTIVES:

This course aims to:

1. To train students to design basic combinational and sequential logic blocks at transistor level i.e. leaf-cells of a library.
2. To train students to design and characterize a given digital block.
3. To train students to develop layouts of the leaf cells for a standard cell library.

COURSE OUTCOMES:

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

1. Demonstrate expertise in using the tool to design and simulate a given leaf cell.
2. Perform appropriate simulations to characterize the designed block.
3. Develop Layout for a specified standard cell library.
4. Develop GDS following all checks like DRC, LVS, Post Layout, EMI, EMC,etc.
5. Write a professional Report to conclude the experiment.

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	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	2	3	1	3	3	1	1	1	3	3	3
CO 2	3	3	3	3	3	1	1	1	1	1	1	3	3	3
CO 3	3	2	3	3	3	2	3	3	1	1	1	3	3	3
CO 4	3	3	3	3	3	2	3	3	1	1	1	3	3	3
CO 5	3	2	2	3	1	1	3	3	3	3	3	3	3	3

Experiments (Simulation Based):

1. Static CMOS Logic Gates
2. Ratioed Logic Gates
3. Dynamic Logic Gates
4. Adders
5. SR-Latch
6. D-Flip flop
7. Dynamic D-Flip Flop
8. Memory Cell

Experiments (Simulation and Layout Leading to GDS)

1. Static CMOS Inverter
2. Static CMOS NAND Gates

3. Transmission Gate based Mux
4. Implementation of Half Adder using Mux.

REFERENCE:

1. "Digital VLSI Design Lab Manual" for R22a BE(VLSI)

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:

This course aims to:

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	PSO 1	PSO 2	PSO 3
CO 1	-	1	-	-	-	1	2	3	3	1	3	-	-	1
CO 2	-	-	-	-	-	-	1	-	2	-	1	-	-	1
CO 3	-	-	-	-	-	1	1	2	1	1	3	-	-	-
CO 4	-	1	1	-	-	1	2	3	3	1	3	-	-	1
CO 5	-	-	-	-	-	-	2	3	2	1	3	-	-	-

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.

22EVU01

Up-skill Certification Course - I

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

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	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	2	2	3	3	3	1	2	3	3	2	2
CO 2	3	2	3	3	3	2	2	2	2	3	3	3	2	3
CO 3	3	3	3	2	2	3	1	2	1	2	2	3	3	2
CO 4	3	3	3	3	3	3	2	2	2	3	2	3	1	3
CO 5	3	3	3	3	2	2	2	2	2	3	3	3	2	2

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

AICTE Model Curriculum with effect from AY 2026-27

B.E. - ELECTRONICS ENGINEERING (VLSI DESIGN AND TECHNOLOGY)

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	22ECC17	Digital Signal Processing	3	-	-	3	40	60	3
2	22ECC02	EM Waves and Transmission Lines	3	-	-	3	40	60	3
3	22EVC10	Analog VLSI Design	3	-	-	3	40	60	3
4	22ECC16	Computer Architecture and Microprocessors	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	22ECC20	Digital Signal Processing Lab	-	-	2	3	50	50	1
9	22EVC11	CMOS Analog IC Design Lab	-	-	2	3	50	50	1
10	22EVC12	Microprocessor Lab	-	-	2	3	50	50	1
11	22EVI02	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

B.E. - ELECTRONICS ENGINEERING (VLSI DESIGN AND TECHNOLOGY)

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	22ECE11	MEMS
2	22ECE04	Embedded C Programming	22ECE16	Real time operating systems
3	22ECE19	CPLD and FPGA Architectures	22EVE02	Memory Design
4	22EVE01	Opto Electronics	22EVE03	Mixed Signal Circuits

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

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	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	2	3	2	-	-	3	-	2	2	3	3
CO 2	3	2	3	2	3	2	-	-	3	-	2	3	3	3
CO 3	3	2	3	2	3	2	-	-	3	-	2	3	2	3
CO 4	3	2	2	2	2	2	-	-	3	-	3	3	3	3
CO 5	3	2	2	2	3	2	-	-	3	-	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.

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	PSO 1	PSO 2	PSO 3
CO 1	2	3	2	2	1	3	1	2	1	1	2	3	2	2
CO 2	2	3	2	1	1	3	1	2	1	1	2	3	2	1
CO 3	2	2	1	3	1	3	2	3	1	1	2	3	2	2
CO 4	2	2	1	3	1	3	2	1	1	1	2	3	2	3
CO 5	2	2	1	2	1	3	1	3	1	1	2	3	2	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:

2. Matthew N.O. Sadiku, "Elements of Electromagnetics" 6th edition, 2015, Newyork Oxford University Press.
3. E.C. Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems", 2nd edition., 2000, PHI.
4. 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.

22EVC10

ANALOG VLSI DESIGN

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

COURSE OBJECTIVES:

This course aims to:

1. Educate about different models of MOSFET for analytical analysis and modeling of analog circuits.
2. Demonstrate the construction, analysis, and design of basic analog integrated circuits.
3. Familiarize students with current mirrors, single-stage and differential amplifiers, and operational amplifiers.

COURSE OUTCOMES:

1. Choose and apply appropriate MOSFET models for analog circuit analysis.
2. Design single-stage amplifiers and current mirrors based on performance specifications.
3. Analyze and design frequency response of analog amplifier stages.
4. Design and analyze differential amplifiers and operational amplifiers.
5. Evaluate stability, noise, and compensation techniques in analog VLSI circuits.

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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	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	1	2	2	2	1	2	1	1	3	3	3
CO 2	3	3	2	1	2	1	2	2	2	1	2	3	3	3
CO 3	3	3	3	1	1	2	2	2	2	2	1	3	3	3
CO 4	3	3	3	2	1	1	2	2	1	1	1	3	3	3
CO 5	3	3	3	1	2	2	1	2	1	2	1	3	3	3

UNIT – I

MOS Modelling: MOS structure, I/V Characteristics, Threshold Voltage, Derivation of I/V Characteristics, Second Order Effects.

MOS Device Layout and Capacitances, Low Frequency Small Signal Models, Long Channel vs Short Channel Effects, Latch-up.

UNIT – II

Single Stage Amplifiers: Common Source with Resistive Load, Current Source Load, Triode Load, Source Degeneration.Source Follower, Common Gate Stage, Cascode Stage, Folded Cascode.

UNIT – III

Current Mirrors: Basic, Cascode, Wide-Swing, Wilson, and Wildar Current Mirrors.

Frequency Response of Amplifiers: Miller Effect, Association of Nodes with Poles, Frequency Response of CS, Source Follower, CG, and Cascode Stages.

UNIT – IV

Noise: Statistical Characteristics, Noise Spectrum, Amplitude Distribution, Correlated and Uncorrelated Sources.

Types of Noise: Flicker and Thermal Noise, Noise Representation in Circuits, Noise in Common Source and Differential Amplifiers.

UNIT – V

Differential Amplifiers: Basic Differential Pair, Common Mode Response, Differential Pair with MOS Load.

Operational Amplifiers: One and Two Stage Op-Amps, Gain Boosting, CMFB, Slew Rate, PSRR.Stability and Compensation: Phase Margin, Frequency Compensation, Design of Two-Stage Op-Amp.

TEXT BOOKS:

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2002.

SUGGESTED READING:

1. David Johns, Ken Martin, "Analog Integrated Circuit Design", John Wiley & Sons, 2004.
2. Paul R. Gray & Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2004.
3. Jacob Baker R. et al., "CMOS Circuit Design", IEEE Press, Prentice Hall India, 2000.

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	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	3	1	1	1	1	3	1	2	2	3	1
CO 2	3	2	3	3	2	1	1	1	3	1	2	2	3	1
CO 3	3	2	2	3	2	1	1	1	3	2	2	3	3	2
CO 4	3	2	2	3	2	1	1	1	3	2	2	3	3	3
CO 5	3	1	2	3	2	1	1	1	3	2	2	2	3	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.

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	PSO 1	PSO 2	PSO 3
CO 1	2	2	1	2	1	1	1	1	1	1	1	3	2	3
CO 2	2	2	2	2	2	1	1	1	1	1	1	3	2	3
CO 3	3	2	3	2	3	1	1	1	1	1	1	3	2	3
CO 4	3	3	2	3	3	1	1	1	1	1	1	3	2	3
CO 5	3	2	3	3	3	1	1	1	1	1	1	3	2	3

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 SiO_2, 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.

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	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	2	1	-	-	1	-	-	2	2	2	-
CO 2	2	3	2	2	2	-	-	1	-	-	2	2	3	-
CO 3	3	2	3	2	3	-	-	1	1	1	2	3	2	2
CO 4	2	2	2	2	3	2	-	1	1	-	3	3	2	3
CO 5	3	3	3	2	3	2	1	2	2	2	3	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.

22ECE19

CPLD AND FPGA ARCHITECTURES

(Professional Elective-I)

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	PSO 1	PSO 2	PSO 3
CO 1	1	2	1	1	1	1	2	1	1	1	2	3	3	1
CO 2	2	3	1	3	2	1	2	1	1	1	2	3	3	1
CO 3	1	2	1	1	-	1	2	1	1	1	2	3	3	1
CO 4	2	3	1	3	2	1	2	1	1	1	2	3	3	1
CO 5	1	3	1	2	2	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.

22EVE01

OPTOELECTRONICS

(Professional Elective-I)

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

PREREQUISITE: Introduction to Electronics.

COURSE OBJECTIVES:

This course aims to

1. Understand fundamentals of Semiconductor Optoelectronics, which deals with the physics and technology of semiconductor optoelectronic devices.
2. Impart the knowledge of designs and configurations of these devices have been emerging with application-specific characteristic.
3. Analyze the basic optoelectronics including electromagnetism, light propagation in waveguides, light amplification and detection, lasers, modulators, and detectors.

COURSE OUTCOMES:

After completion of this course, students will be able to

1. Interpret the concepts of fundamentals of optoelectronics and principles of the optoelectronic devices operation.
2. Demonstrate basic concepts of electromagnetic theory, optical waveguides, and introduction to the light emitting devices, detectors, and modulators.
3. Understand the background in optoelectronics, help students meet the demand of growing semiconductor optoelectronic industry.
4. Evaluate the basic optical and electro-optical properties of semiconductors and low-dimensional semiconductor structures.
5. Discuss the applications of various types of devices such as in communication (optical Fiber and free space optical communication).

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	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	-	1	1	-	1	-	1	1	-	-
CO 2	3	2	1	-	2	2	2	-	2	-	1	1	1	-
CO 3	2	-	2	1	-	3	2	1	2	2	2	2	2	1
CO 4	3	2	2	1	-	1	1	-	1	-	1	1	1	-
CO 5	1	1	3	3	2	2	3	3	3	3	2	3	2	2

UNIT – I

Review of basic principles from physics: optical wave representation, interferometers, optical resonators, planar mirror resonators, modes of resonators, spherical mirror resonators, confinement, Gaussian beams, photons and matter, energy levels

UNIT – II

Photon optics: interactions of photons and atoms, population inversion, spontaneous and stimulated emission; Lasers: gain mechanism, rate equations, pumping, gain and gain coefficient, laser oscillation theory, laser types, power and spectral distribution, polarization, mode selection, light emitting diodes, fabry-perot lasers, erbium-doped fiber amplifiers (EDFA)

UNIT – III

Photo detectors: properties of photo detectors, photoconductors, photodiodes. Avalanche photodiodes, phototransistors and noise mechanisms, signal-to-noise analysis, and modulation of optical signals, formats, and receivers.

UNIT – IV

Noise and detection: types of noise and distortion which affects optical signals, methods of reducing effects of noise and distortion, optimal detection methods and devices

UNIT – V

Overview of opto-electronic networks: FDDI, Fiber channel, sonnet.

TEXT BOOKS:

1. Saleh and Teich, "Fundamentals of Photonics," Wiley Interscience, 2nd edition, 2007.
2. J. Senior, "Optical Fiber Communications. Principle and Practice," Prentice Hall, 3rd edition, 2014.

SUGGESTED READING:

1. Wilson and Hawkes, "Optoelectronics: An Introduction, 3rd. Ed., Prentice Hall, 1

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	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	2	3	2	1	1	3	2	1	3	3	3
CO 2	3	3	3	2	3	2	1	1	3	2	1	3	3	3
CO 3	3	3	3	2	3	2	1	1	3	2	1	3	3	3
CO 4	3	3	3	2	3	2	1	1	3	2	1	3	3	3
CO 5	3	3	3	2	3	2	1	1	3	2	1	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.

22ECE16

REAL TIME OPERATING SYSTEMS

(Professional Elective-II)

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	PSO 1	PSO 2	PSO 3
CO 1	3	1	1	1	1	2	1	2	3	1	2	2	3	2
CO 2	3	3	2	2	2	2	1	1	3	1	2	2	2	2
CO 3	3	3	2	3	3	1	1	1	3	1	2	2	3	2
CO 4	3	3	3	2	3	1	1	1	2	2	2	2	2	2
CO 5	3	2	3	2	3	1	1	1	2	2	2	1	2	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.

22EVE02

MEMORY DESIGN

(Professional Elective –II)

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

Prerequisite(s): Digital Electronics, Semiconductor Devices, CMOS Basics.

COURSE OBJECTIVES:

1. Understand the need and evolution of emerging non-volatile memory technologies.
2. Explore the principles and mechanisms of operation in emerging memory devices.
3. Analyze the structure, behavior, and characteristics of memory devices such as RRAM, PCM, and MRAM.
4. Study integration challenges, performance parameters, and reliability concerns.

COURSE OUTCOMES (COs):

After completing this course, students will be able to:

1. Identify and classify traditional and emerging memory technologies based on their functional and structural characteristics.
2. Illustrate the physical principles and switching mechanisms behind RRAM, PCM, MRAM, and FeRAM devices.
3. Analyze the advantages, limitations, and application areas of emerging memory technologies.
4. Compare the electrical and material properties of different non-volatile memories.
5. Evaluate the integration challenges of emerging memory technologies with conventional CMOS 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	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	1	2	–	–	1	–	2	–	2	2	2
CO 2	3	3	2	2	2	–	1	1	–	1	–	2	2	2
CO 3	3	3	3	2	3	1	1	1	2	2	1	2	2	2
CO 4	2	2	3	2	3	–	–	1	1	2	1	2	2	2
CO 5	2	2	2	1	2	2	2	2	1	2	1	2	2	2

Unit I: Overview of Emerging Memory Technologies

Introduction to memory technology evolution. Comparison of traditional (SRAM, DRAM, Flash) and emerging memory devices. Classifications: volatile vs non-volatile. Role of memory in advanced computing architectures. Introduction to Resistive RAM (RRAM), Phase Change Memory (PCM), Magnetic RAM (MRAM), and Ferroelectric RAM (FeRAM). Need for next-gen memory in AI, IoT, and mobile systems.

Unit II: Resistive RAM (RRAM)

Fundamentals of resistive switching mechanisms. Structural design and materials involved in RRAM. Types of switching: unipolar and bipolar. Operation principles and I-V characteristics. Applications of RRAM in storage and neuromorphic computing. Advantages in terms of scalability and energy efficiency. Comparison with flash technologies.

Unit III: Phase Change Memory (PCM)
Theory of phase transitions between amorphous and crystalline states. Chalcogenide material properties and working mechanisms. Electrical behavior: write/erase cycles, RESET/SET operations. Integration issues such as thermal stability and write endurance. Case studies on PCM deployment in commercial applications. Suitability in high-performance computing and persistent memory.

Unit IV: Magnetic RAM (MRAM) and Ferroelectric RAM (FeRAM)
Spintronics and magnetoresistance principles. Structure of MRAM cells, particularly STT-MRAM. Tunneling magnetoresistance (TMR) effect and spin-transfer torque (STT). Applications in embedded and cache memory. FeRAM principles based on ferroelectric polarization. Characteristics such as write speed, endurance, and fatigue. Comparison between MRAM, FeRAM, and other emerging NVMs.

Unit V: Integration Challenges and System-Level Considerations
Challenges in integrating emerging memories with CMOS processes. Issues related to interface, reliability, write endurance, and retention. Impact on system architecture and software design. Techniques for compatibility and performance optimization. Overview of industry-standard testing approaches: fault models, endurance characterization, error correction. Prospects and research directions in memory system integration.

TEXT BOOKS:

1. A. Sharma, Semiconductor Memories: Technology, Testing and Reliability, Wiley, 2002.
2. K. Itoh, VLSI Memory Chip Design, Springer, 2001.
3. Ye Zhou, Advanced Memory Technologies: Functional Materials and Devices, Royal Society of Chemistry, 2023.

SUGGESTED READING:

1. Daniele Ielmini, Resistive Switching, Wiley, 2016.
2. Andrea Redaelli, Phase Change Memory, Springer, 2018.
3. Denny Tang, Magnetic Memory Technology, Wiley, 2021.

22EVE03

MIXED SIGNAL CIRCUITS

(Professional Elective-II)

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

COURSE OBJECTIVES:

This course aims to:

1. Educate about different models of MOSFET for analytical analysis and modeling of analog circuits.
2. Demonstrate the construction, analysis, and design of basic analog integrated circuits.
3. Familiarize students with current mirrors, single-stage and differential amplifiers, and operational amplifiers.

COURSE OUTCOMES:

1. Understant different comparator and switched capacitor circuits.
2. Explain various performance measures of sample and hold, Data converters.
3. Design of different DAC circuits.
4. Design and analyze of 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	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	1	2	2	1	2	1	2	1	3	2	3
CO 2	3	3	2	1	2	1	1	2	2	2	1	3	2	3
CO 3	3	3	3	1	1	2	2	2	2	2	2	3	3	3
CO 4	3	3	3	2	1	1	2	2	2	1	1	3	2	3
CO 5	3	3	3	1	2	2	1	1	2	1	2	3	2	3

UNIT – I

OP-Amp: OP-Amp as comparator, Charge injection error, Charge injection signal independent, multi stage comparator, latched camparator, switched capacitor basic operation and analysis, first order filter, switched capacitor gain circuits,

UNIT – II

Sample and hold circuit-its performance parameters, swithced capacitor sample and hold.

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, Thermometer coded 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

SUGGESTED READING

1. BehzadRazavi, "Design of Analog CMOS Integrated Circuits", Tata-McGraw Hill Publications, 2002
2. Philip E. Allen & Douglas R. Holberg, "CMOS Analog Circuit Design", Oxford University Press, 2002

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	PSO 1	PSO 2	PSO 3
CO 1	-	2	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	2	3	2	2	1	1	1
CO 4	2	2	1	3	-	2	1	3	3	2	2	1	2	2
CO 5	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	PSO 1	PSO 2	PSO 3
CO 1	1	1	2	1	1	2	3	2	2	1	2	1	1	1
CO 2	1	1	2	1	1	2	3	2	2	1	2	2	1	2
CO 3	1	1	2	1	1	2	3	2	2	1	2	1	1	1
CO 4	1	1	2	1	1	2	3	2	2	1	2	1	1	2
CO 5	1	3	2	1	1	2	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 OBJECTIVES: To enable the students to

1. To learn about the types, causes, impacts and management concept of disaster.
2. To learn about the disaster management cycle and early warning systems
3. To make the students become aware of stress and trauma management during a disastér.
4. To identify the role of technology and institutional framework behind disaster management in India.
5. To identify the structural and non-structural measures of disaster mitigation and learn about the provisions of Disaster management Act.

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	PSO 1	PSO 2	PSO 3
CO 1	2	-	-	-	-	3	-	-	-	-	-	1	-	-
CO 2	2	-	-	-	-	3	-	-	-	-	-	1	-	-
CO 3	2	-	-	-	-	3	-	-	-	-	-	1	-	-
CO 4	2	-	-	-	2	3	-	-	-	-	-	1	-	-
CO 5	2	-	-	-	-	3	-	-	-	-	-	1	-	-

UNIT-I

Fundamental concepts in disaster management: Hazard and disaster-concepts, vulnerability and risk, Hazard and 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 and Tsunami". 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	PSO 1	PSO 2	PSO 3
CO 1	1	-	1	1	1	2	2	1	1	1	1	1	-	3
CO 2	1	1	1	1	1	2	2	2	2	3	1	1	-	3
CO 3	1	1	1	2	2	2	2	2	2	3	1	1	-	3
CO 4	2	1	1	2	2	2	2	1	2	3	1	1	-	3
CO 5	1	-	1	1	1	-	2	1	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	PSO 1	PSO 2	PSO 3
CO 1	2	1	1	2	-	-	-	-	-	-	1	2	2	2
CO 2	1	2	2	2	2	2	-	-	-	1	2	2	2	2
CO 3	2	1	2	2	1	1	3	-	-	-	-	2	2	2
CO 4	2	1	-	3	2	1	3	1	1	1	2	2	2	3
CO 5	2	2	1	2	1	2	3	-	1	1	2	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	PSO 1	PSO 2	PSO 3
CO 1	2	1	1	-	-	-	-	-	2	-	-	3	1	1
CO 2	2	1	3	2	2	3	-	-	1	-	1	3	2	1
CO 3	2	2	3	2	2	3	-	-	1	-	1	3	2	1
CO 4	2	2	3	2	2	3	-	-	1	-	1	3	1	2
CO 5	2	2	3	3	3	3	-	1	1	1	1	3	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/

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	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	3	3	1	-	1	-	-	2	3	1	3
CO 2	3	2	3	3	3	1	-	1	-	-	2	3	2	3
CO 3	3	2	3	3	2	1	-	1	-	-	3	3	2	3
CO 4	3	2	2	2	3	1	-	1	-	-	3	3	2	3
CO 5	3	2	3	2	3	1	-	1	-	-	3	3	3	3

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: $\leq$ 2dB
Stop band attenuation: $\geq$ 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: $\leq$ 3dB
Stop band attenuation: $\geq$ 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.

22EVC11

CMOS ANALOG IC DESIGN LAB

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

Prerequisite:
Familiar with Analog IC Design Concepts

COURSE OBJECTIVES:

1. To develop Circuit simulation and Layout Skills among students.
2. To demonstrate the procedure for characterization of MOSFETs.
3. To demonstrate the design and simulations of various MOS Circuits.

COURSE OUTCOMES:

The students will be able to

1. Demonstrate skills to effectively utilize CADENCE Tools for IC Design, Simulation and Layout.
2. Design, Test and validate an Analog Circuits to meet given specifications.
3. Develop Layout and Validate for a given specifications.
4. Design and develop an Analog IP for given Specification
5. Create and Maintain a Professional, Presentable Record of the designs developed.

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	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	2	3	-	-	-	3	-	2	3	2	3
CO 2	3	3	3	3	3	-	-	-	3	-	-	3	2	3
CO 3	3	3	3	3	3	-	-	-	3	-	-	3	2	3
CO 4	3	3	3	3	3	2	2	2	3	2	2	3	2	3
CO 5	3	3	3	3	3	2	2	2	3	2	2	3	2	3

List of Experiments:

1. Introduction to CADENCE Virtuoso
2. CMOS Inverter – Design, Simulation, Rise Time, Fall Time, Power Consumption
3. CMOS Inverter – Layout, Postlayout Simulation
4. Characteristics of MOSFET
5. MOS Common Source Amplifier
6. MOS Common Drain Amplifier
7. Simple Current Mirros
8. Advanced Current Mirrors
9. Differential Amplifier
10. Single Stage OP-Amp
11. Two Stage Op-Amp

Note: All the above preferably using SCL 180nm technology

Activity:
Design, Simulate and Develop Layout of a fully functional Analog Circuit (like BGR, OP-Amp, VCO, etc) for a given specification and validation of the same. (Fabrication of same if possible)

SUGGESTED READING:
Cadense Design System Ltd., “Cadence Manual”, 2013.

22EVC12

MICROPROCESSOR LAB

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

COURSE OBJECTIVES:
To develop and understand the Assembly language Programming Concepts of 8086 Microprocessor.

COURSE OUTCOMES:
1. Understand the 8086 instruction set and Assembly Language Programming to solve computational problems.
2. Develop algorithms and implement code for conversions, string searching, and sorting operations.
3. Apply DOS function calls to perform system-level input/output operations.
4. Design and develop code to interface and control I/O peripherals, and to perform signal generation applications.
5. Analyze, design, and implement real-time embedded system 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	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	2	3	-	-	-	-	-	-	2	3	-
CO 2	3	3	2	2	3	-	-	-	1	-	-	2	3	1
CO 3	3	2	2	1	3	-	-	-	1	-	-	2	3	-
CO 4	3	3	3	2	3	-	-	1	2	2	3	3	3	2
CO 5	3	3	3	3	3	1	-	-	2	2	3	3	3	3

List of Experiments

1. Study the basic instruction set of the 8086 to develop Assembly Language programs.
2. Develop algorithms for arithmetic and branching operations using the 8086.
3. Develop algorithms for multiplication and division to perform signed and unsigned data operations.
4. Develop algorithms to perform single-byte and multi-byte binary and BCD addition and subtraction.
5. Develop algorithms to perform logical operations, string searching, and sorting operations.
6. Develop algorithms to perform code conversions.
7. Develop algorithms to use DOS function calls in system-level I/O operations for the 8086.
8. Develop code to interface and control traffic light signals using the 8086.
9. Develop code to interface a Digital-to-Analog Converter (DAC) using the 8086 for generating waveforms.
10. Develop code to interface and control a stepper motor using the 8086.

11. Develop code to interface 7-segment LED displays (Common Cathode/Common Anode) using the 8086.
12. Develop code for gating applications using 8253/8254 timers with the 8086 for waveform generation.
13. Develop code to interface a Real-Time Clock (RTC) using the 8086 to display date and time on an LCD.
14. Develop code to interface and control an elevator simulator using the 8086.

22EVI02

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	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	2	2	2	3	1	1	1	1	1	1	3
CO 2	2	2	2	2	3	2	2	1	1	2	2	3	3	1
CO 3	2	2	3	3	2	2	1	1	1	1	2	3	3	1
CO 4	2	2	2	2	1	2	2	1	3	2	1	1	1	3
CO 5	3	3	3	3	1	3	2	2	2	2	2	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

B.E. - ELECTRONICS ENGINEERING (VLSI DESIGN AND TECHNOLOGY)

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	22EVC13	Embedded Systems Design	3	-	-	3	40	60	3
2	22ECC15	Analog and Digital communications	3	-	-	3	40	60	3
3	22EVC14	System on chip	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	22EVC15	Embedded Systems Design Lab	-	-	2	3	50	50	1
8	22EVC16	System on Chip Lab	-	-	2	3	50	50	1
9	22ECC19	Analog and Digital communications Lab	-	-	2	3	50	50	1
10	22EVC17	Mini Project	-	-	2	-	50	-	1
11	22EVU02	Up-skill Certification Course- II	-				25	-	0.5
Total			**18**	**-**	**8**	**27**	**465**	**510**	**22.5**
Clock Hours Per Week: 26									

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

AICTE Model Curriculum with effect from AY 2026-27

B.E. - ELECTRONICS ENGINEERING (VLSI DESIGN AND TECHNOLOGY)

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	22EVE04	IC Packaging	22EVE06	Neuromorphic circuits
2	22ECE34	Linux and scripting languages	22EVE07	Advanced Computer Architecture
3	22ECE31	Design for Testability	22EVE08	High Power Circuit Design
4	22EVE05	Antennas and Microwave Circuits	22EVE09	Electromagnetic Interference and Compatibility

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

22EVC13

EMBEDDED SYSTEM DESIGN

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

Prerequisites: Digital Logic Design, Microprocessors and Microcontrollers

COURSE OBJECTIVES:

1. To provide foundational knowledge on the architecture, classification, and application of embedded systems, with emphasis on ARM processors.
2. To enable students to program and interface peripherals using ARM-based microcontrollers, specifically the LPC2148.
3. To introduce embedded system design methodologies, software development tools, debugging techniques, and real-world applications.

COURSE OUTCOMES:

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

1. Analyze the Embedded Systems and their design metrics and challenges.
2. Understand the ARM architecture, instruction set, and programming in both ARM and THUMB modes.
3. Develop embedded applications using ARM7 (LPC2148) microcontroller by interfacing peripherals
4. Explain and apply the embedded system design cycle, development tools, and software integration techniques.
5. Utilize debugging tools and methodologies to test and integrate embedded hardware and software.

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	PSO 1	PSO 2	PSO 3
CO 1	3	3	-	-	-	-	-	-	-	-	-	2	3	3
CO 2	3	2	2	-	-	-	-	-	-	-	-	2	3	3
CO 3	3	2	3	-	3	-	-	-	1	1	1	2	3	3
CO 4	3	2	2	2	3	-	-	-	1	2	2	2	3	3
CO 5	3	3	3	2	3	-	-	-	2	2	2	2	3	3

UNIT – I

Introduction to 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. Introduction to ARM processor, ARM design philosophy.

UNIT – II

ARM Processor Fundamentals: Register organization, 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. Introduction to ARM C Programming.

UNIT – III

ARM 7 Microcontroller (LPC2148)**:** Salient features of LPC 2148, Pin description of 2148, Architectural Overview. **ARM 7**(LPC2148) **Peripherals:** Description of General Purpose Input/Output (GPIO) ports, Pin control Block. Features, Pin description, Register description and operation of PLL, Interfacing: LED, Relay, Buzzer, LCD, DAC, DC motor. Communication protocols: Brief overview on I2C, SPI, and CAN.

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 systems. 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, RTOS services. Case Studies: Embedded system design for automatic vending machines and digital camera.

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. Steve Furber "ARM System On Chip Architecture" 2/e Pearson education, 2000.

SUGGESTED READINGs:

1. David E.Simon, "An Embedded software primer", Pearson Education,2004.
2. ARM 7 (LPC 214x) user manual from Philips semiconductors

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	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	2	1	1	1	1	1	-	2	3	2	2
CO 2	3	3	3	2	1	1	1	1	1	-	2	3	2	2
CO 3	3	3	3	2	1	1	1	1	1	-	2	3	2	2
CO 4	3	3	3	2	1	1	1	1	1	-	2	3	2	2
CO 5	3	3	3	2	1	1	1	1	1	-	2	3	2	2

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.

22EVC14

System on Chip

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	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	2	3	1	1	2	2	1	2	3	3	3
CO 2	3	3	2	3	3	1	1	3	2	2	2	3	3	3
CO 3	3	3	3	3	3	1	1	2	2	2	3	3	3	3
CO 4	3	3	3	3	3	1	1	2	2	2	2	3	3	3
CO 5	3	2	2	2	3	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.

22EVE04

IC Packaging

(Professional Elective-III)

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

Prerequisite(s): Student should have knowledge on Basic Electronics

COURSE OBJECTIVES:

1. To introduce the fundamental concepts, types, and hierarchical structure of IC packaging technologies.
2. To provide knowledge on interconnection techniques and packaging characteristics, including electrical and thermal aspects.
3. To enable understanding of the IC packaging design flow and the modeling techniques involved.

COURSE OUTCOMES (COs): After completing this course, students will be able to:

1. Understand the fundamentals and importance of IC packaging in modern electronics.
2. Understand the types, structure, and materials used in various IC packaging techniques.
3. Analyze electrical and thermal characteristics crucial to IC package design.
4. Demonstrate the design flow and thermal management strategies in IC packaging.
5. Evaluate reliability factors and explore recent trends in packaging 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	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	2	3	1	1	2	2	1	2	3	3	3
CO 2	3	3	2	3	3	1	1	3	2	2	2	3	3	3
CO 3	3	3	3	3	3	1	1	2	2	2	3	3	3	3
CO 4	3	3	3	3	3	1	1	2	2	2	2	3	3	3
CO 5	3	2	2	2	3	1	1	2	2	1	2	3	3	3

UNIT-I

Introduction to IC Packaging Technologies: IC Packaging definition, hierarchy of packaging, function of the package, package disciplines (electrical, mechanical, materials), package types- through-hole, surface-mount, ball grid array. Interconnection techniques: wire bonding, flip-chip, and solder bump technologies.

UNIT-II

Packaging Characteristics: Electrical characteristics – impedance and transmission line models stripline, microstrip, and buried stripline. Propagation delay models, Lattice diagrams for reflection analysis. Thermal characteristics - thermal transport modes Conduction, convection and radiation, newton's law of cooling.

UNIT-III

Packaging design flow: package modeling, IC modeling, wirebonding, dynamic manufacturing constraints, package interconnect and routing, manufacturing data creation.

UNIT-IV

Thermal Management in IC Packaging: Principles, Techniques for heat dissipation and cooling, Analyse thermal management strategies. Signal integrity challenges, Power integrity considerations and solutions.

UNIT -V

Reliability in IC Packaging: Factors affecting reliability, Testing and validation techniques for packaged ICs. Emerging trends in IC packaging technologies, Advanced materials and techniques.

TEXT BOOKS:

1. John H. Lau. Semiconductor Advanced Packaging. Springer, 2021.
2. King-Ning Tu, Chih Chen, Hung-Ming Chen. Electronic Packaging Science and Technology. John Wiley and Sons Inc., 2022

SUGGESTED READING:

1. Chen, Andrea. Semiconductor Packaging. CRC Press, 2016.
2. Chung, Deborah. Materials for Electronic Packaging. Elsevier, 1995

22ECE34

LINUX AND SCRIPTING LANGUAGES

(Professional Elective-III)

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	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	1	2	1	1	1	1	1	1	2	2	1
CO 2	1	2	2	1	2	1	1	1	1	1	1	2	3	1
CO 3	2	2	3	2	2	1	1	1	1	1	1	3	2	2
CO 4	2	1	2	2	3	1	1	1	1	1	1	3	2	3
CO 5	1	1	1	1	2	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.

22ECE31

DESIGN FOR TESTABILITY

(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 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	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	2	2	2	2	2	2	2	2	3	2	1
CO 2	3	3	3	1	1	2	1	2	2	1	1	3	2	1
CO 3	3	3	3	2	2	2	1	1	2	2	2	3	2	1
CO 4	3	3	3	1	2	1	2	2	1	2	1	3	2	1
CO 5	3	3	3	1	2	2	1	1	2	1	2	3	2	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.

22EVE05

ANTENNA AND MICROWAVE CIRCUITS

(Professional Elective-III)

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

Prerequisite(s): Electro Magnetic Waves and Transmission Lines, Network Analysis.

COURSE OBJECTIVES:

1. To understand the fundamental principles of antenna theory and arrays and pattern synthesis techniques
2. To familiarize students with antenna circuit modelling
3. To study the characteristics and S-parameter representation of microwave passive components
4. To analyse and design microwave active devices and circuits

COURSE OUTCOMES (COs): After completing this course, students will be able to:

1. Understand the basic concepts and parameters of antennas
2. Analyse and design various types of antennas and antenna arrays.
3. Design basic microwave circuits and match antenna systems for efficient performance
4. Apply transmission line and waveguide theory to microwave circuit analysis.
5. Use scattering parameters to evaluate microwave components.

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	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	1	3	2	–	2	–	2	–	3	2	3
CO 2	3	3	2	2	3	–	1	2	–	1	–	3	2	3
CO 3	3	3	3	2	3	1	1	2	2	2	1	3	2	3
CO 4	2	2	3	2	3	–	–	1	1	2	1	3	2	3
CO 5	2	2	2	1	2	2	2	2	1	2	1	3	2	3

UNIT I: Antenna Basics: Radiation mechanism, Antenna parameters: Radiation pattern, beam width, gain, directivity, efficiency, bandwidth, polarization, impedance, Types of antennas: Wire,aperture,array, reflectors, lens antennas, Radiation pattern measurement.

UNIT II: Antenna Types and Antenna arrays: Dipole, monopole, loop antennas,Yagi-Uda antenna, Horn and parabolic reflector antennas, Micro strip patch antennas,

Antenna arrays: Broadside and end-fire arrays, Array factor and beam forming, Concept of smart antennas,

UNIT III: Antenna Circuit Modelling: Equivalent circuit of an antenna, Impedance, reactance, and radiation resistance, Lumped vs. distributed modelling of antennas, Review of circuit elements at RF/microwave frequencies, Input impedance of antennas, Equivalent circuit models for dipole, monopole, and loop antennas.

UNIT IV: Microwave Fundamentals: Microwave frequency bands, Waveguides and cavity resonators, Scattering Parameters significance and Properties of S-matrix, Two-port and multi-port network analysis using S-parameters, Conversion between Z, Y, and S parameters, Impedance matching: Stub matching, quarter-wave transformer

UNIT V: Microwave Components: Directional couplers, Power dividers (e.g., Wilkinson), Magic Tee, Hybrid couplers, Circulators and Isolators, Phase shifters and attenuators, Design principles and scattering matrix analysis, Microwave filters.

TEXT BOOKS:

1. "Antennas and Wave Propagation" by John D. Kraus.
2. "Microwave Engineering" by David M. Pozar.
3. "Antennas and Propagation" by Balanis C.A.
4. "Microwave Devices and Circuits" by Samuel Y. Liao.
5. "RF Circuit Design" – Christopher Bowick.

SUGGESTED READING:

1. "Foundations for Microwave Engineering" by R.E. Collin.
2. "Microwave Circuits and Passive Devices" by M.L. Sisodia and G.S. Raghuvanshi.
3. IEEE Transactions on Antennas and Propagation.
4. Application Notes from Keysight, NI AWR, and Ansys.

22EVE06

NEUROMORPHIC CIRCUITS

(Professional Elective-IV)

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

Prerequisite: CMOS Analog IC Design

COURSE OBJECTIVES:

Th objective of the course is to

1. Introduce the students to neuromorphic analog circuits.
2. To identify various properties of these circuits suitable for neural networks.
3. To demonstrate the art of designing neural network based applications using neuromorphic circuits.

COURSE OUTCOMES:

The students will be able to

1. Classify various physical effects in MOS Transistors.
2. Design Basic Amplifiers and Time Domain MOS Circuits.
3. Design Current Mode Circuits with attention to second order sections.
4. Classify various signal aggregation circuits.
5. Develop Neuromorphic systems and Neuron Models using the analog 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	PSO 1	PSO 2	PSO 3
CO 1	3	3	-	3	-	-	-	-	2	-	-	2	1	2
CO 2	3	-	3	-	-	-	-	-	2	-	-	2	1	2
CO 3	3	-	3	-	-	-	-	-	2	-	-	2	1	2
CO 4	3	3	-	3	-	-	-	-	2	-	-	2	1	2
CO 5	3	-	3	-	-	-	-	-	2	-	-	2	1	2

UNIT-I

MOS Transistor Operation, Weak Inversion, Strong Inversion, Floating-Gate Circuits, Electron Tunneling, Hot-Electron Injection, Fundamental Adaptive Circuit.

UNIT-II

Transconductance Amplifiers, **Building Blocks:** Current Mirror, Differential Pair, Gain Stages, DCOperation, Time-Domain Circuits, Follower-Integrator, Differentiators.

UNIT-III

Second-Order Sections, Current-Mode Circuits, Translinear Principle, Current-Mode Circuits, Translinear Principle.

UNIT-IV

Signal-Aggregation Circuit Arrays, Centroid Circuits, Resistive Networks, Diffuser Circuits, Winner-Take-All Circuits, Delay Lines.

UNIT-V

Neuromorphic Systems, Electronic Cochlea, Auditory Localization,
Silicon Retinas: Voltage and Current Mode, Neuron Models. Address Event Communication, Motor Pattern Generation.

TEXTBOOKS:

1. Mead, *Analog VLSI and Neural Systems*, Addison Wesley, 1989.

SUGGESTED READINGS:

1. A. Moini, Vision Chips. Kluwer Academic Publishers, 2000
2. M. Mahowald and R. Douglas, "A silicon neuron," Nature, vol. 354, pp. 515–518, 1991.
3. S. Sands and M. Pflieger, 1999, http://www.neuro.com.

22EVE07

ADVANCED COMPUTER ARCHITECTURE

(Professional Elective-IV)

Instruction	3P Hour per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	1.5

Prerequisite(s): Student should have knowledge on Computer Architecture.

COURSE OBJECTIVES:

1. To introduce advanced concepts of modern processor architectures and their performance features.
2. To enable students to understand the memory hierarchy and multiprocessor systems.
3. To expose students to current trends such as multicore, GPU, and cloud computing systems.

COURSE OUTCOMES (COs): After completing this course, students will be able to:

1. Describe the operation of modern pipelined processors and ILP techniques.
2. Understand cache memory design and memory hierarchy optimization.
3. Explain the basics of multicore and multiprocessor systems.
4. Illustrate the concept of parallelism through GPU and SIMD architectures.
5. Summarize emerging trends in computing systems including cloud and edge architectures.

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	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	1	2	–	–	1	–	2	–	2	1	2
CO 2	3	3	2	2	2	–	1	1	–	1	–	2	2	2
CO 3	3	3	3	2	3	1	1	1	2	2	1	2	1	2
CO 4	2	2	3	2	3	–	–	1	1	2	1	2	2	2
CO 5	2	2	2	1	2	2	2	2	1	2	1	2	2	2

UNIT-I

Instruction-Level Parallelism (ILP): Review of pipelining, Data hazards and forwarding, Basics of ILP, Dynamic scheduling: Tomasulo's algorithm, Branch prediction (concept only)

UNIT-II

Memory Hierarchy and Cache Design: Memory hierarchy basics, Cache memory: types and mapping techniques, Cache misses and optimization techniques, Virtual memory overview, Introduction to TLB.

UNIT-III

Basics of Multicore and Multiprocessor Architectures: Introduction to multicore processors, Shared vs. distributed memory, Cache coherence: simplified MESI protocol, Interconnection networks (overview only), Case studies of dual/multi-core processors

UNIT-IV

Data-Level and Thread-Level Parallelism: SIMD and vector processing basics, GPU architecture overview, Concepts of CUDA/OpenCL (introductory only), Thread-level parallelism, Applications of parallel computing

UNIT-V

Recent Trends in Architecture: Introduction to cloud and edge computing, Basics of Warehouse-Scale Computers (WSC), RISC-V and open-source architectures (basic idea).

TEXT BOOKS:

1. J. L. Hennessy and D. A. Patterson, *Computer Architecture: A Quantitative Approach*, 6th ed. San Francisco, CA, USA: Morgan Kaufmann, 2019.
2. K. Hwang, *Advanced Computer Architecture: Parallelism, Scalability, Programmability*, New York, NY, USA: McGraw-Hill, 1993.

SUGGESTED READING:

4. D. A. Patterson and J. L. Hennessy, *Computer Organization and Design: The Hardware/Software Interface*, 5th ed. San Francisco, CA, USA: Morgan Kaufmann, 2014.
5. V. Rajaraman and T. Radhakrishnan, *Parallel Computers: Architecture and Programming*, New Delhi, India: PHI Learning, 2001.

22EVE08

HIGH POWER CIRCUIT DESIGN

(Professional Elective-IV)

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

Prerequisites: Power Electronics, Analog Electronics, Circuit Theory

COURSE OBJECTIVES: This course aims to:

1. To explain the design of power circuits to high currents and high voltages.
2. To discuss Switching behaviors of power semiconductor circuits
3. To explain the Power Conversion Topologies and Snubber Circuits and Protection
4. To explain the Design for thermal stability, safety, reliability, and manufacturability

COURSE OUTCOMES:

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

1. Design power circuits handling high voltage and/or high current.
2. Analyze switching behaviour in power semiconductors (IGBTs, MOSFETs, SiC/GaN).
3. Develop robust gate drive circuits.
4. Understand and apply thermal and EMI management techniques.
5. Design for safety, reliability, and manufacturability.

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	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	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	1	1	2	-	-	-	-	3	3	2
CO 4	3	3	2	1	1	-	2	-	-	-	-	3	3	2
CO 5	3	3	3	1	2	1	2	-	-	-	-	3	3	2

UNIT-I:

Introduction to High Power Circuits: "High Power" vs. "Low Power", Applications overview, Safety considerations, Power semiconductor devices: MOSFETs, IGBTs, SiC, GaN Device characteristics and limitations, Switching behaviour and losses.

UNIT-II:

Design Fundamentals: Gate driver design, Gate drive requirements, Isolated vs. non-isolated gate drivers, Turn-on/off techniques and protection, Thermal Design: Heat generation and dissipation, Heat sinks, thermal vias, fans, and liquid cooling, Thermal modelling and simulation.

UNIT-III:

PCB Layout and EMI/EMC for Power Electronics: High current traces and planes**,** parasitic inductance/capacitance**,** Creepage and clearance distances, Sources of EMI in switching circuits, Filtering and shielding, Layout strategies for EMI reduction

UNIT-IV:

Power Conversion Topologies and Snubber Circuits and Protection: Buck, Boost, Buck-Boost converters**,** Inverters, Full/Half Bridge topologies**,** Transformer-based isolated topologies, RC, RCD, and active snubbers, Overvoltage/overcurrent protection, Desaturation detection.

UNIT-V:

High Voltage, Power Design with SiC/GaN, Fault Detection and Protection Circuits: Isolation techniques, Design standards and testing, Measurement challenges, Advantages and challenges, Gate driving and PCB layout considerations, Efficiency and switching performance, Crowbar circuits, Redundant systems and fuses, Software-based monitoring, **applications** : Motor drives, EVs, solar inverters, UPS systems and battery chargers, Grid-tied systems

TEXT BOOK:

1. "Power Electronics: Converters, Applications, and Design" by Mohan, Undeland, and Robbins

Reference:

1. “High Power Electronics” by M.H. Rashid
2. Manufacturer datasheets (Infineon, Texas Instruments, Wolfspeed)
3. Application notes from STMicroelectronics, TI, and ON Semiconductor

22EVE09

ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

(Professional Elective –IV)

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

Prerequisite(s): Student should have knowledge on Computer Architecture.

COURSE OBJECTIVES:

1. To tutor the basics of EMI, EMC.
2. To instill knowledge on the EMI coupling mechanism and its mitigation techniques.
3. To impart comprehensive insight about the current EMC standards and about various measurement techniques.

COURSE OUTCOMES (COs):

After completing this course, students will be able to:

1. Familiarize with the fundamentals in the field of EMI / EMC.
2. Analyze coupling mechanisms and measurements.
3. Summarize Mitigation Techniques and working principles for measurements.
4. Analyze standards and regulations for EM radiation.
5. Evaluate the EMI Testing & Instrumentation.

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	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	1	2	–	–	1	–	2	–	2	2	2
CO 2	3	3	2	2	2	–	1	1	–	1	–	2	2	2
CO 3	3	3	3	2	3	1	1	1	2	2	1	2	2	2
CO 4	2	2	3	2	3	–	–	1	1	2	1	2	2	2
CO 5	2	2	2	1	2	2	2	2	1	2	1	2	2	2

UNIT-I

Basic Theory: Introduction to EMI and EMC, Intra and inter system EMI, Elements of Interference, Sources and Victims of EMI, Conducted and Radiated EMI emission and susceptibility, Case Histories, Radiation hazards to humans, Various issues of EMC, EMC Testing categories, EMC Engineering Application.

UNIT-II

Coupling Mechanism: Electromagnetic field sources and Coupling paths, coupling via the supply network, Common mode coupling, Differential mode coupling, Impedance coupling, Inductive and Capacitive coupling, Radiative coupling, Ground loop coupling, Cable related emissions and coupling, Transient sources, Automotive transients.

UNIT-III

EMI Mitigation Techniques: Working principle of Shielding and Murphy's Law, LF Magnetic shielding, Apertures and shielding effectiveness, Choice of Materials for H, E, and free space fields, Gasketting and sealing, PCB Level shielding, Principle of Grounding, Isolated grounds, Grounding strategies for Large systems, Grounding for mixed signal systems, Filter types and operation, Surge protection devices, Transient protection.

UNIT-IV

Standards And Regulation: Need for Standards, Generic/General Standards for Residential and Industrial environment, Basic Standards, Product Standards, National and International EMI Standardizing Organizations; IEC, ANSI, FCC, AS/NZS, CISPR, BSI, CENELEC, ACEC. Electro Magnetic Emission and susceptibility standards and specifications, MIL461E Standards.

UNIT -V

EMI Test Methods And Instrumentation: Fundamental considerations, EMI Shielding effectiveness tests, Open field test, TEM cell for immunity test, Shielded chamber , Shielded anechoic chamber, EMI test receivers, Spectrum analyzer, EMI test wave simulators, EMI coupling networks, Line impedance stabilization networks, Feed through capacitors, Antennas, Current probes, MIL -STD test methods, Civilian STD test methods.

TEXT BOOKS:

1. Clayton R Paul, Introduction to Electromagnetic Compatibility, John Wiley Sons, 2010

SUGGESTED READING:

1. V.P.Kodali, Engineering Electromagnetic Compatibility, 2 nd Ed., IEEE Press, 2000
2. Henry W. Ott, "Electromagnetic Compatibility Engineering", John Wiley & Sons Inc, New york, 2009.
3. Electromagnetic Interference and Compatibility IMPACT series, IIT Delhi
4. Daryl Gerke and William Kimmel, "EDN's Designer's Guide to Electromagnetic Compatibility", Elsevier Science & Technology Books, 2002
5. W Scott Bennett, "Control and Measurement of Unintentional Electromagnetic Radiation", John Wiley & Sons Inc., (Wiley Inter science Series) 1997.
6. Dr Kenneth L Kaiser, "The Electromagnetic Compatibility Handbook", CRC Press 2005.

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	PSO 1	PSO 2	PSO 3
CO 1	1	-	-	-	-	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	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	2	2	2	2	2	2	2	2	2
CO 2	1	1	2	1	2	2	2	1	2	2	2	2	2	2
CO 3	1	1	2	2	1	2	2	1	2	2	1	2	2	3
CO 4	2	1	2	2	1	2	2	1	2	2	2	2	2	3
CO 5	2	1	2	2	1	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	PSO 1	PSO 2	PSO 3
CO 1	2	2	-	-	-	-	-	-	-	-	-	3	2	2
CO 2	2	2	-	-	-	-	-	-	-	-	-	2	2	2
CO 3	2	2	1	-	-	-	-	-	-	-	-	2	2	3
CO 4	2	2	2	2	-	-	-	-	2	2	-	3	2	2
CO 5	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'suncertainty 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	PSO 1	PSO 2	PSO 3
CO 1	2	3	1	1	-	-	-	-	-	-	-	2	2	2
CO 2	3	2	1	2	-	-	-	-	-	-	-	2	2	2
CO 3	3	2	1	1	-	-	-	-	-	-	--	2	2	2
CO 4	3	3	1	2	-	-	-	-	-	-	-	2	2	2
CO 5	3	2	1	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	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	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	3	2	2	2	1	1	2	2	2	3
CO 2	3	-	-	-	3	2	2	2	1	1	2	2	2	3
CO 3	3	1	2	2	3	2	2	2	2	2	2	2	2	3
CO 4	3	1	1	2	3	2	2	2	2	2	2	2	2	3
CO 5	3	1	2	2	3	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

22EVC15

EMBEDDED SYSTEM DESIGN LAB

Instruction	2 Hours per week
Semester end Examination Duration	2 Hours
Semester end Examination	50 Marks
CIE	50 Marks
Credits	1

Prerequisites: Basic knowledge of Assembly and C programming

COURSE OBJECTIVES:

1. To provide hands-on experience with ARM7-based microcontroller (LPC2148) programming using assembly and C.
2. To develop practical skills in interfacing common peripherals such as LEDs, buzzers, switches, LCDs, DAC, ADC, and motors.
3. To enhance the ability to implement and test embedded programs using industry-standard tools like Keil IDE.

COURSE OUTCOMES:

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

1. Set up and use an ARM7 microcontroller development environment (LPC2148) using Keil IDE
2. Implement and verify ARM assembly programs for arithmetic, logical, shift, and memory operations.
3. Write embedded C programs to interface LEDs, switches, relays, and buzzers with the LPC2148 microcontroller.
4. Interface and control advanced I/O devices like LCDs, DACs, ADCs, and motors using ARM7 programming.
5. Design and debug real-time embedded applications by integrating multiple peripheral components and ensuring functional operation.

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	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	3	-	-	-	-	2	2	2	3	2
CO 2	3	2	-	-	2	-	-	-	-	-	-	2	3	2
CO 3	3	2	2	-	2	-	-	-	-	1	1	2	3	2
CO 4	3	2	3		2	-	-	-	-	1	1	2	3	2
CO 5	3	3	3	2	3	-	-	-	2	2	3	2	3	2

List of Experiments

I. Basic ARM 7 Programming using instruction set

1. Study and use of ARM 7 Microcontroller trainer and Keil IDE
2. Programs on Arithmetic and Logical operations
3. Programs on Barrel shifter operations
4. Programs on Load and Store operations
5. Program on MAC operations

II. ARM7 C programming on LPC2148:

6. LEDs Switches, Relay and Buzzer interfacing
7. LCD interfacing
8. Programming on chip DAC
9. Programming on chip ADC
10. DC Motor interfacing
11. 7-Segment display interfacing

SUGGESTED READING:

1. Philips semiconductors, "ARM 7 (LPC 214x) user manual", 2005.

22EVC16

System on Chip LAB

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

Prerequisite:
Familiar with using the Vivado IDE, Digital IC Design, Verilog HDL, Embedded C.

COURSE OBJECTIVES:

1. To build a simple IPs on FPGA
2. To demonstrate the development of ARM SOC on a FPGA
3. To demonstrate the procedure for Porting Operating System on an SOC

COURSE OUTCOMES:
The students will be able to

1. Demonstrate skills to effectively utilize Vivado IDE for building IPs and SoCs on FPGA.
2. Develop IP for digital modules like Seven Segment Driver, RTC etc using Verilog HDL.
3. Develop an ARM SoC with Operating System and Implement it on FPGA
4. Develop a working SoC Model by porting Operating System on an FPGA.
5. Develop Applications to run on 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	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	2	3	-	-	-	3	-	2	3	3	2
CO 2	3	3	3	3	3	-	-	-	3	-	-	3	3	2
CO 3	3	3	3	3	3	-	-	-	3	-	-	3	3	2
CO 4	3	3	3	3	3	2	2	2	3	2	2	3	3	2
CO 5	3	3	3	3	3	2	2	2	3	2	2	3	3	2

List of Experiments:

1. Introduction to the FPGA and ZedBoard.
2. Simulation and Synthesis using Vivado.
3. Driving the Seven Segment Display.
4. Counting the Seconds, Stopwatch.
5. Measuring Button Bounce, and Design A Debounce Circuit.
6. Creating an IP Component.
7. Building an ARM FPGA.
8. A Software Stopwatch.
9. Audio : I2S Receiver, I2S Transmitter and I2S Loopback
10. Embedded Linux – Hardware
11. Embedded Linux – PetaLinux
12. Embedded Linux – Controlling a SPI device
13. Debugging Linux Applications from SDK
14. Controlling a SPI device using the ZYNQ SPI controller

Activity:
Mini Project demonstrating the application of the SoC to provide a real time solution.

SUGGESTED READINGS:
Lab Manual of "SoC Design Lab"

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	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	2	2	3	3	3	3	2	3	3	3	1
CO 2	3	3	3	2	2	3	3	3	3	2	3	3	3	2
CO 3	3	3	3	2	2	3	3	3	3	2	3	3	3	2
CO 4	3	3	3	2	2	3	3	3	3	2	3	3	3	2
CO 5	3	3	3	2	2	3	3	3	3	2	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.

22EVC17

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	PSO 1	PSO 2	PSO 3
CO 1	2	3	2	2	1	2	1	3	1	2	3	3	3	2
CO 2	1	3	2	2	1	1	1	3	1	1	2	3	3	2
CO 3	1	2	1	2	2	1	1	3	1	1	1	3	2	1
CO 4	1	1	1	1	1	1	1	3	3	1	1	3	1	1
CO 5	1	1	1	1	1	1	1	3	3	1	1	3	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.

22EVU02

Up-skill Certification Course - II

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

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	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	2	2	3	3	3	1	1	3	3	2	3
CO 2	3	2	3	3	3	2	2	2	2	3	3	3	2	2
CO 3	3	3	3	2	2	3	1	2	1	2	2	3	3	2
CO 4	3	2	3	3	3	3	2	2	2	3	2	3	1	3
CO 5	3	3	3	3	2	2	2	2	2	3	3	3	2	2

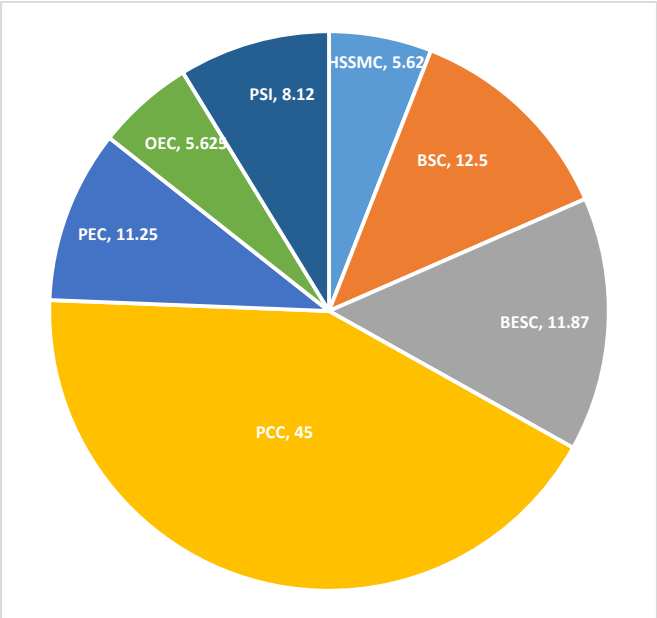
Course Structure with the credit weightage distribution and Scheme for eight semesters						
Name of the Program : B.E (ECE) R-22 (A) Regulation						
L-Lecture, T-Tutorial, P-Practical / Drawing / Project / Seminar						
S.no	**Curriculum Composition / Name of the Course**	**Semester**	**No. of Hours**			**Credits**
			L	T	P/D	
I. Humanities and Social Sciences including Management Courses (HSSMC) (09 Credits) 05.62%						
1	English	II	2	0	2	3
2	Employability Skills	IV	0	0	2	1
3	Engineering Economics and Accountancy	VII	3	0	0	3
4	Universal Human Values II: Understanding Harmony	IV	0	1	0	1
5	Community Engagement	I	0	0	2	1
II. Basic Science courses (BSC) (20 Credits) 12.5%						
1	Electromagnetic Theory and Quantum Mechanics	II	3	0	3	4.5
2	Chemistry	I	3	0	3	4.5
3	Calculus	I	3	1	0	4
4	Vector Calculus and Differential Equations	II	3	1	0	4
5	Complex Variables and Special functions	III	3	0	0	3
III. Basic Engineering Science Courses (BESC) (19 Credits) 11.87%						
1	Digital Fabrication Workshop	II	0	0	3	1.5
2	Engineering Graphics	II	0	1	3	2.5
4	Problem Solving and Programming using Python	I	2	1	3	4.5
5	Basic Electrical Engineering	I	2	1	2	4
6	Data Structures using C	III	3	0	2	4
7	Robotics and Drones Lab	I	0	1	3	2.5
IV. Professional CoreCourses (PCC) (76 Credits) 47.5% (The Programs which are offering PCC credits between 48 and 64, the difference credits shall be offered as Professional Elective Credits and Open Elective Credits in addition to the credits allotted under PSI categories and also, along with mandatory non-credit courses)						
V. Professional Elective Courses (PEC): Relevant to the chosen specialization/branch (18 Credits) 11.25% (Four to Six Professional Electives are to be offered by the respective department Board of Studies.)						
VI. Open Elective Courses (OEC): Electives from other technical and /or emerging subjects (9 Credits) 05.625% (Three to five open electives are to be offered by the other department Board of Studies) Note: The total number of credits of Serial No's. IV, V & VI should be 93.						
VII. Project work, Seminar & Internship in industry or elsewhere (PSI) (13Credits) 08.12%						
1	Mini Project	VI Semester	2 hours			1
2	Project Part-1	VII Semester	4 hrs. per week			2
3	Technical Seminar	VIII Semester	2 hrs. per week			1
4	Project Part-2	VIII Semester	8 hrs. Per week/180 hrs. Industry			4
5	Internship-I:MOOCs/Inter or Intra-Institutional Training /Internship	After II / During III Semester	3-4 Weeks/90 hrs.			2
6	Internship-II: Industrial Internship /Rural Internship	After IV / During V Semester	3-4 Weeks/90 hrs.			2
7	Upskill Certification Course - I	During winter vacation of II Year	--			0.5
8	Upskill Certification Course- II	During winter vacation of III Year	--			0.5
Total Credits						160
VIII. Mandatory Courses: Environmental Sciences (VII Sem), Indian Constitution and Fundamental Principles (IV Sem), Induction program (After orientation program - before start of I Semester). Induction Program is to be conducted for a period of 3 weeks.						
IX. Activity Points: (Mandatory) Communication, Team Work and Leadership skills: 60 to100 Points e-Portfolio						

R- 22 (A) Semester wise Curriculum components distribution

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20.5	19.5	24	20.5	26	22.5	19	08	**160**
No of hours	27	26	25	26	27	26	25	13	**194**

Sem / Cat code	I	II	III	IV	V	VI	VII	VIII	Credits offered
HSS	1	3	-	2	-	-	3	-	**9**
BSC	8.5	8.5	3	-	-	-	-	-	**20**
BESC	11	4	4	-	-	-	-	-	**19**
PCC	-	4	15	18	15	12	8	-	**72**
PEC	-	-	-	-	6	6	6	-	**18**
OEC	-	-	-	-	3	3	-	3	**9**
PSI	-	-	2	0.5	2	1.5	2	5	**13**
Mandatory Course(MC)	-	-	-	Non-Credit	-	-	Non-Credit	-	**Non-Credit**
Total	**20.5**	**19.5**	**24**	**20.5**	**26**	**22.5**	**19**	**08**	**160**

R- 22(A) Pie Chart



Course Type	No of Credits	% of Credits
HSSMC	9	5.62
BSC	20	12.5
BESC	19	11.87
PCC	72	45
PEC	18	11.25
OEC	9	5.625
PSI	13	8.12
TOTAL	160	100

Comparision of R22(A) Curriculum Composition with AICTE Model Curriculum

S.No	Credits Weightage Distribution	AICTE Model Curriculum 2013	Nos. Of Credits	% of Credits
1	Humanities and Social Sciences including Management Courses (HSSMC)	**15**	**9**	**5.62**
2	Basic Science courses (BSC)	**23**	**20**	**12.5**
3	Basic Engineering Science Courses (BESC)	**17**	**19**	**11.87**
4	Professional Core Courses (PCC)	**64**	**72**	**45**
5	Professional Elective Courses (PEC): Relevant to the chosen specialization/branch	**12**	**18**	**11.25**
6	Open Elective Courses (OEC): Electives from other technical and /or emerging subjects	**12**	**9**	**5.625**
7	Project work, Seminar & Internship in industry or elsewhere (PSI)	**18**	**13**	**8.12**
8	Mandatory Courses	**No Credits**	**No Credits**	**No Credits**
	Total	**161***	**160**	**160**