CARE

COLLEGE OF ENGINEERING

(An Autonomous Institution)

Approved by AICTE, New Delhi | Affiliated to Anna University, Chennai
Accredited by NAAC with 'A' Grade
#27, Thayanur, Tiruchirappalli - 620009

# Regulations 2024

# Undergraduate Degree

# B.E. / B. Tech./B.Des.

# Full Time Programmes

# Curriculum and Syllabus

**CARE COLLEGE OF ENGINEERING:: TIRUCHIRAPPALLI 620 009**
**(AN AUTONOMOUS INSTITUTION)**
**REGULATION 2024**
**CURRICULUM AND SYLLABUS FOR FIRST YEAR**
**CHOICE BASED CREDIT SYSTEM**

**B.E. ELECTRONICS AND COMMUNICATION ENGINEERING**

**SEMESTER I**

| S. No | Course Code | Course Title | Category | Periods per week | | | No of Contact Periods | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| **THEORY COURSES** | | | | | | | | |
| 1 | U24MA111 | Matrices and Calculus | BSC | 3 | 1 | 0 | 4 | 4 |
| 2 | U24GE111 | Problem solving using Python | ESC | 3 | 0 | 0 | 3 | 3 |
| 3 | U24HS111 | Heritage of Tamils | HSMC | 1 | 0 | 0 | 1 | 1 |
| **THEORY CUM PRACTICAL COURSES** | | | | | | | | |
| 4 | U24HS123 | Communicative English for Engineers | HSMC | 3 | 0 | 2 | 5 | 4 |
| 5 | U24PH113 | Engineering Physics | BSC | 3 | 0 | 2 | 5 | 4 |
| 6 | U24CY113 | Engineering Chemistry | BSC | 3 | 0 | 2 | 5 | 4 |
| **PRACTICAL COURSES** | | | | | | | | |
| 7 | U24GE122 | Problem solving using Python Laboratory | ESC | 0 | 0 | 4 | 4 | 2 |
| | | | **TOTAL** | **16** | **1** | **10** | **27** | **22** |

**SEMESTER II**

| S. No | Course Code | Course Title | Category | Periods per week | | | No of Contact Periods | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| **THEORY COURSES** | | | | | | | | |
| 1 | U24MA231 | Transforms and Complex Analysis | BSC | 3 | 1 | 0 | 4 | 4 |
| 2 | U24HS211 | Tamils and Technology | HSMC | 1 | 0 | 0 | 1 | 1 |
| **THEORY CUM PRACTICAL COURSES** | | | | | | | | |
| 3 | U24PH233 | Physics for Electronics Engineering | BSC | 3 | 0 | 2 | 5 | 4 |
| 4 | U24EC213 | Circuit Analysis | ESC | 3 | 0 | 2 | 5 | 4 |
| 5 | U24CS233 | Data Structures using C | ESC | 3 | 0 | 2 | 5 | 4 |
| 6 | U24HS223 | Technical English for Engineers | HSMC | 2 | 0 | 2 | 4 | 3 |
| **PRACTICAL COURSES** | | | | | | | | |
| 7 | U24EE232 | Engineering Practices for Circuit Branches | ESC | 0 | 0 | 4 | 4 | 2 |
| 8 | U24EM212 | Professional Development | EEC | 0 | 0 | 2 | 2 | 1 |
| | | | **TOTAL** | **15** | **1** | **14** | **30** | **23** |

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#27, Thayanur, Tiruchirappalli - 620009

## Department of Electronics and Communication Engineering

## Regulation 2024 Third Semester Curriculum

| Sl. No | Course Code | Course Name | Category | No. of periods/week | | | Total Periods | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1 | U24MA331 | Probability and Random Process | BSC | 3 | 1 | 0 | 4 | 4 |
| 2 | U24EC311 | Electromagnetic Fields | PCC | 3 | 1 | 0 | 4 | 4 |
| 3 | U24EC323 | Signals and Systems | PCC | 2 | 1 | 2 | 5 | 4 |
| 4 | U24EC333 | Electron Devices and Circuits | PCC | 3 | 0 | 2 | 5 | 4 |
| 5 | U24EC343 | Digital System Design | PCC | 3 | 0 | 2 | 5 | 4 |
| | | | **Total** | **14** | **3** | **6** | **23** | **20** |

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**Department of Electronics and Communication Engineering**
**R2024 Fourth Semester Curriculum**

| S. No | Course Code | Course Title | Category | Periods per week | | | No of Contact Periods | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1 | U24EC411 | Analog Integrated Circuits | PCC | 3 | 0 | 0 | 3 | 3 |
| 2 | U24EC421 | Transmission Lines and Waveguides | PCC | 3 | 1 | 0 | 4 | 4 |
| 3 | U24EC431 | Communication Systems | PCC | 3 | 0 | 0 | 3 | 3 |
| 4 | U24EC443 | Digital Signal Processing | PCC | 3 | 0 | 2 | 5 | 4 |
| 5 | U24EC453 | Internet of Things | PCC | 1 | 0 | 4 | 5 | 3 |
| 6 | U24EM411 | Aptitude and Reasoning – I | EEC | 1 | 0 | 0 | 1 | 1 |
| 7 | U24EC462 | Analog Integrated Circuits Laboratory | PCC | 0 | 0 | 4 | 4 | 2 |
| 8 | U24EC472 | Communication Systems Laboratory | PCC | 0 | 0 | 4 | 4 | 2 |
| 9 | U24EM422 | Soft Skill and Personality Development – I | EEC | 0 | 0 | 2 | 2 | 1 |
| | | | **Total** | **14** | **1** | **16** | **31** | **23** |

| U24MA111 | MATRICES AND CALCULUS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 4 |

**Course Objectives:**

- To develop the use of matrix algebra techniques those are needed to engineers for practical applications.
- To familiarize the students with differential calculus.
- To introduce the methods of solving linear and nonlinear ordinary differential equations.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.
- To acquaint the student with the concepts of vector calculus needed for problems in all engineering disciplines.

**UNIT I MATRICES** **9+3**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane

**UNIT II DIFFERENTIAL CALCULUS** **9+3**

Functions of single variable – Limit of the function- Continuity and Differentiability - Mean value Theorems - Partial derivatives - Total derivative - Taylor series (in one and two variables) - Maxima and Minima (in one and two variables).

**UNIT III ORDINARY DIFFERENTIAL EQUATION** **9+3**

Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients.

**UNIT IV INTEGRAL CALCULUS** **9+3**

Evaluation of definite and improper integrals - Change of order of integration - Double integrals in polar coordinates - Area enclosed by plane curves - Triple integrals.

**UNIT V VECTOR CALCULUS** **9+3**

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

**TOTAL: 60 PERIODS**

**Text Books**


1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 44th Edition, New Delhi, 2015.
2. Erwin Kreyszig. E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016


**Reference Books**


1. Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016
2. Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016.
3. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.

| Course Outcomes: At the end of the course, the students will be able to | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge level** |
| CO1 | Apply the matrix algebra methods for solving practical problems. | Applying |
| CO2 | Apply differential calculus tools in solving various Engineering problems. | Applying |
| CO3 | Apply various techniques in solving differential equations. | Applying |
| CO4 | Apply double and triple integration techniques in solving areas and volumes. | Applying |
| CO5 | Evaluate of line, surface and volume integrals using Gauss, Stokes and Green's Theorems. | Applying |

**CO-PO/PSO Mapping**

| **CO** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | | | | | | 2 | 2 | | 3 | | |
| **CO2** | 3 | 3 | 3 | | | | | | 2 | 2 | | 3 | | |
| **CO3** | 3 | 3 | 3 | | | | | | 2 | 2 | | 3 | | |
| **CO4** | 3 | 3 | 3 | | | | | | 2 | 2 | | 3 | | |
| **CO5** | 3 | 3 | 3 | | | | | | 2 | 2 | | 3 | | |
| **Avg.** | **3** | **3** | **3** | | | | | | **2** | **2** | | **3** | | |

**U24GE111 PROBLEM SOLVING USING PYTHON**

| **L** | **T** | **P** | **C** |
|---|---|---|---|
| **3** | **0** | **0** | **3** |

**Course Objectives:**

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To do input/output with files in Python.

**UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9**

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

**UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS 9**

Python interpreter and interactive mode, debugging; values and types: int, float, Boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

**UNIT III CONTROL FLOW, FUNCTIONS, STRINGS 9**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

**UNIT IV LISTS, TUPLES, DICTIONARIES 9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

**UNIT V FILES, MODULES, PACKAGES 9**

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file,

Voter's age validation, Marks range validation (0-100).

**TOTAL: 45 PERIODS**

**Text Books**


1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.


**Reference Books**


1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data, Third Edition, MIT Press, 2021
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5. https://www.python.org/
6. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.


| **Course Outcomes: At the end of the course, the students will be able to** | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge level** |
| CO1 | Develop algorithmic solutions to simple computational problems. | Applying |
| CO2 | Write simple python programs using the basic data types, expressions and Statements. | Applying |
| CO3 | Write simple Python programs using conditionals and loops for solving problems and decompose a Python program into functions. | Applying |
| CO4 | Represent compound data types using Python lists, tuples, dictionaries etc. | Applying |
| CO5 | Read and write data from/to files in Python programs. | Applying |

| **CO-PO/PSO Mapping** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| **CO1** | 2 | 2 | 1 | 2 | 1 | | | 2 | 3 | 3 | 2 | | | |
| **CO2** | 2 | 2 | 1 | 2 | 1 | | | 2 | 3 | 3 | 2 | | | |
| **CO3** | 2 | 2 | 1 | 2 | 1 | | | 2 | 3 | 3 | 2 | | | |
| **CO4** | 2 | 2 | 1 | 3 | 1 | | | 2 | 3 | 3 | 2 | | | |
| **CO5** | 2 | 2 | 1 | 3 | 1 | | | 2 | 3 | 3 | 2 | | | |
| **Avg.** | **2** | **2** | **1** | **2** | **1** | | | **2** | **3** | **3** | **2** | | | |

## U24HS111 தமிழர் மரபு / HERITAGE OF TAMILS

| **L** | **T** | **P** | **C** |
|---|---|---|---|
| **1** | **0** | **0** | **1** |

**Course Objectives:**

- Recognize Tamil literature and its significance in Tamil culture.
- Introduce the Tamils' rich artistic and cultural legacy.
- Familiarize the different types of folk and martial arts that are unique to Tamil Nadu.
- Acquaint the concept of Thinai in Tamil literature and culture.
- Comprehend the significance of Tamil in developing Indian culture.

**UNIT I LANGUAGE AND LITERATURE** **3**

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

**UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3**

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

**UNIT III FOLK AND MARTIAL ARTS 3**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

**UNIT IV THINAI CONCEPT OF TAMILS 3**

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

**UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3**

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

**TOTAL: 15 PERIODS**

**Text Books**


1. Social Life of Tamils (Dr. K.K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V. Subatamanian, Dr. K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M. Valarmathi) (Published by: International Institute of Tamil Studies).
5. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author).
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
8. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book.


| **Course Outcomes: At the end of the course, the students will be able to** | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge level** |
| CO1 | Describe the various types of Tamil Literature. | Understanding |
| CO2 | Discuss about Tamil Arts and Sculpture. | Understanding |
| CO3 | Explain the Tamil Folks and Martial Arts. | Understanding |
| CO4 | Summarize the Thinai Concepts of Tamil. | Understanding |
| CO5 | Review the contribution of Tamil Culture to Indian Culture and National Movements. | Understanding |

| **CO-PO/PSO Mapping** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | | | | | | 2 | | 2 | 2 | 3 | | | | |
| CO2 | | | | | | 2 | | 2 | 2 | 3 | | | | |
| CO3 | | | | | | 2 | | 2 | 2 | 3 | | | | |
| CO4 | | | | | | 2 | | 2 | 2 | 3 | | | | |
| CO5 | | | | | | 2 | | 2 | 2 | 3 | | | | |
| **Avg.** | | | | | | **2** | | **2** | **2** | **3** | | | | |

| U24HS123 | COMMUNICATIVE ENGLISH FOR ENGINEERS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 4 |

**Course Objectives:**

To improve the communicative competence of learners

- To learn to use basic grammatical structures in suitable contexts.
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text.
- To help learners use language effectively in both informal and professional contexts.
- To develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.

**UNIT I INTRODUCTION TO EFFECTIVE COMMUNICATION 1**

What is effective communication? (Explain using activities) Why is communication critical for excellence during study, research and work? What are the seven C's of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the course focus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skills to get the best out of this course?

**UNIT I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 8**

Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Wh / Yes or No / and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

**UNIT II NARRATION AND SUMMATION 9**

Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing; Short Report on an event (field trip etc.) Grammar –Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.

**UNIT III DESCRIPTION OF A PROCESS / PRODUCT 9**

Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).

**UNIT IV CLASSIFICATION AND RECOMMENDATIONS 9**

Reading – Newspaper articles; Journal reports –and Non-Verbal Communication (tables, pie charts etc.). Writing – Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non-verbal (chart, graph etc., to verbal mode) Grammar – Articles; Pronouns - Possessive & Relative pronouns. Vocabulary - Collocations; Fixed / Semi fixed expressions.

**UNIT V EXPRESSION 9**

Reading – Reading editorials; and Opinion Blogs; Writing – Essay Writing (Descriptive or narrative), Dialogue-writing. Grammar – Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions – Content vs Function words.

**TOTAL: 45 PERIODS**

| Sl. No. | Practical – List of experiments: |
|---|---|
| 1 | Listening comprehension |
| 2 | Telephone conversation & Introductions (listening & speaking) |
| 3 | Mock Interviews |
| 4 | Narrating personal experiences |

| Sl. No. | Practical – List of experiments: |
|---|---|
| 5 | Short Oral Presentations |
| 6 | Advertising a product |
| 7 | Situational conversation – 3 in a team |
| 8 | Creating educational videos |
| 9 | Group discussion |
| 10 | ICT based presentations |

**TOTAL: 30 PERIODS**

**Text Books**


1. Communication Book, Portfolio Penguin, 2018. Authored by Mikael Krogerus, Roman Tschäppeler. ISBN-13: 978-0241982280.
2. Communicative English for Engineers and Professionals, Pearson Education India, 2010. Authored by Bhatnagar Nitin, ISBN: 9788131732045, 8131732045
3. English for Science & Technology, Cambridge University Press, 2021. Authored by Dr.Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.


**Reference Books**


1. Technical Communication – Principles and Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. English For Technical Communication (With CD) By AyshaViswamohan, McGraw Hill Education, ISBN: 0070264244, 2008.
3. How to win at Interviews & Group Discussions, Abhishek Publications, 2014. Authored by D.S. Cheema, ISBN: 9788182475175, 8182475171.


| **Course Outcomes: At the end of the course, the students will be able to** | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge level** |
| CO1 | Explain different points of view during discussions. | Applying |
| CO2 | Prepare for formal ICT based presentations and video creation. | Applying |
| CO3 | Construct English sentences in both formal and informal contexts. | Applying |
| CO4 | Interpret technical texts, audio materials and visual representation. | Understanding |
| CO5 | Write letters, definitions, descriptions, narrations and essays on various topics. | Applying |

| **CO-PO/PSO Mapping** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| CO2 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| CO3 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| CO4 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| CO5 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| **Avg.** | | | | | | | | **1** | **2** | **3** | | **3** | | |

**U24PH113** **ENGINEERING PHYSICS** **L T P C**
**3 0 2 4**

**Course Objectives:**

- To make the students effectively to achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves, optics and its applications.
- To introduce the basics knowledge of lasers and fibre optics.
- Equipping the students to successfully understand the importance of quantum mechanics.
- To make the students understand the basics of crystal structure and its importance in studying materials properties.

**UNIT I MECHANICS** **9**

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM

Rotation of rigid bodies: Rotational kinematics – Theorems of M.I. –moment of inertia of continuous bodies – torque – rotational dynamics of rigid bodies — gyroscope - torsional pendulum – double pendulum

**UNIT II ELECTROMAGNETIC WAVES AND OPTICS 9**

Maxwell's equations - wave equation; Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - Producing electromagnetic waves - Cell-phone reception. Reflection and refraction of light waves - interference –Michelson interferometer –Theory of air wedge and experiment.

**UNIT III LASERS AND FIBRE OPTICS 9**

Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO2 laser, semiconductor laser –Basic applications of lasers in industry.
Fiber optics: Principle, Numerical aperture and acceptance angle –types of optical fibers (material, refractive index, mode)- fibre optic communication- losses associated with optical fibers- fibre optic sensors: pressure and displacement- medical endoscope.

**UNIT IV QUANTUM MECHANICS 9**

Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization – particle in a infinite potential well: 1D- particle in a infinite potential well:2D and 3D Boxes (Qualitative).

**UNIT V CRYSTAL PHYSICS 9**

Crystal structures: Crystal structures: BCC, FCC and HCP – crystal imperfections- edge and screw dislocations – grain and twin boundaries - Burgers vector and elastic strain energy- Slip systems, plastic deformation of materials and Miller indices –distance between successive planes – crystalline and non-crystalline material.

**TOTAL: 45 PERIODS**

| Sl. No. | Practical – List of experiments (Any Seven experiments) |
|---|---|
| 1 | Determination of rigidity modulus – Torsion pendulum |
| 2 | Determination of Young's modulus by non-uniform bending method |
| 3 | Determination of wavelength using Laser. |
| 4 | Determination of Numerical aperture and acceptance angle in an optical fiber. |
| 5 | Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer |
| 6 | Determination of thickness of a thin wire – Air wedge method |
| 7 | Determination of band gap of a semiconductor |
| 8 | Determination of Young's modulus by uniform bending method. |
| 9 | Compact disc- Determination of width of the groove using laser. |
| 10 | Simple harmonic oscillations of cantilever. |
| 11 | Spectrometer - Determination of wavelength of Mercury Spectrum using diffraction grating. |
| 12 | Michelson's interferometer -Determine the wave length of monochromatic light. |
| 13 | Melde's Experiment - Determine the Frequency of a tuning fork. |

**TOTAL: 30 PERIODS**

**Text Books**


1. D. Kleppner and R. Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2. E.M. Purcell and D.J. Morin, Electricity and Magnetism, Cambridge Univ. Press, 2013.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw- Hill (Indian Edition), 2017.


**Reference Books**


1. Gaur R K and Gupta S L, "Engineering Physics", Dhanpat Rai Publications, 2018.
2. Charles Kittel, "Introduction to Solid State Physics", Wiley India Pvt. Ltd, 7th ed., 2017.
3. D. K. Mynbaev and Lowell L. Scheiner, Fiber Optic Communication Technology, 2011,1st Edition, Pearson, USA.

| Course Outcomes: At the end of the course, the students will be able to | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge level** |
| CO1 | Apply the principles of mechanics to solve problems. | Applying |
| CO2 | Apply the knowledge of the Maxwell's equations for electromagnetic waves and optics. | Applying |
| CO3 | Apply the knowledge on the concepts of laser and their applications in fiber optics. | Applying |
| CO4 | Apply quantum mechanical principles towards the formation of energy bands. | Applying |
| CO5 | Describe the basics of crystals, their structures and defects. | Understanding |

**CO-PO/PSO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | | 2 | | | 1 | 2 | 2 | | 3 | | |
| CO2 | 3 | 3 | 2 | | 2 | | | 1 | 2 | 2 | | 3 | | |
| CO3 | 3 | 3 | 2 | | 2 | | | 1 | 2 | 2 | | 3 | | |
| CO4 | 3 | 3 | 2 | | 2 | | | 1 | 2 | 2 | | 3 | | |
| CO5 | 3 | 3 | 2 | | 2 | | | 1 | 2 | 2 | | 3 | | |
| **Avg.** | **3** | **3** | **2** | | **2** | | | **1** | **2** | **2** | | **3** | | |

**U24CY113** **ENGINEERING CHEMISTRY**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 2 | 4 |

**Course Objectives:**

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

**UNIT I WATER AND ITS TREATMENT** **9**

**Water:** Sources and impurities, Water quality parameters - color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic.

**Municipal water treatment:** primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water-Reverse Osmosis.

**Boiler troubles** - Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming & foaming.

**Treatment of boiler feed water:** Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process.

**UNIT II NANOCHEMISTRY** **9**

Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic);

**Types of nanomaterials:** Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. **Preparation of nanomaterials:** sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. **Applications of nanomaterials** in medicine, agriculture, energy, electronics and catalysis.

**UNIT III PHASE RULE AND COMPOSITES** **9**

**Phase rule:** Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process.

**Composites:** Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). **Nano Composites:** Properties and applications of Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

**UNIT IV FUELS AND COMBUSTION** **9**

**Fuels:** Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel.

**Combustion of fuels:** Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method.

**UNIT V ENERGY SOURCES AND STORAGE DEVICES** **9**

**Nuclear energy**: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of Silicon (si) Solar cell, Wind energy, Geo thermal energy.

**Batteries:** Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion battery; Electric vehicles - working principles; Fuel cells: $H_2$-$O_2$ fuel cell, microbial fuel cell; Super capacitors: Storage principle, types and examples.

**TOTAL: 45 PERIODS**

| **Sl. No**. | **Practical – List of experiments** |
|---|---|
| 1 | Determination of types and amount of alkalinity in a water sample. - Split the first experiment into two. |
| 2 | Determination of total, temporary & permanent hardness of water by EDTA method. |
| 3 | Determination of DO content of water sample by Winkler's method. |
| 4 | Determination of chloride content of water sample by Argentometric method. |
| 5 | Determination of strength of given hydrochloric acid using pH meter. |
| 6. | Determination of strength of acids in a mixture of acids using conductivity meter. |
| 7. | Conductometric titration of barium chloride against sodium sulphate (precipitation titration) |
| 8. | Conductometric titration of strong acid vs strong base. |
| 9. | Estimation of iron content of the given solution using potentiometer. |
| 10. | Estimation of sodium /potassium present in water using a flame photometer. |

**TOTAL: 30 PERIODS**

**Text Books:**


1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.


**Reference Books:**


1. Mary Francisca. L.J, Engineering Chemistry-I, 1, 2004.
2. O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.


| **Course Outcomes: At the end of the course, the students will be able to** | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge level** |
| CO1 | Describe the water treatment processes and calculate the quality parameters of different types in Water Samples and Apply the appropriate method to find the PH, conductance and potential values of various solutions | Understanding |
| CO2 | Apply the concepts of nano science in Engineering Applications. | Applying |
| CO3 | Apply the knowledge of phase rule and composites for material selection requirements | Applying |
| CO4 | Identify the types of fuels and calculate the calorific value, explosive range for engineering processes. | Understanding |
| CO5 | Apply suitable energy resources for Engineering sectors. | Applying |

| CO-PO/PSO Mapping | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 3 | | | | | 1 | | | 1 | 2 | | 2 | | |
| CO2 | 3 | | | | | 1 | | | 1 | 2 | | 2 | | |
| CO3 | 3 | | | | | 1 | | | 1 | 2 | | 2 | | |
| CO4 | 3 | | | | | 1 | | | 1 | 2 | | 2 | | |
| CO5 | 3 | | | | | 1 | | | 1 | 2 | | 2 | | |
| **Avg.** | **3** | | | | | **1** | | | **1** | **2** | | **2** | | |

**U24GE122 PROBLEM SOLVING USING PYTHON LABORATORY**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

**Course Objectives:**

- To learn about Variables, Operators available and how to write loops and decision statements in Python.
- To learn and Implement programs using non recursive and recursive functions.
- To Learn and execute a program using different Data Types - String, List, advance List, Dictionary, Tuple, Sets, Python Modules and packages.
- To learn how to read and write files in Python and also learn to use exception handling in Python applications for error handling.
- To build a mini project using fundamental programming constructs like variables, conditional logic, looping, and function and other required modules.

| Sl. No. | Practical – List of experiments |
|---|---|
| 1 | Environment Setup and execute Basic Exercise to learn about Variables, Operators available in python. |
| 2 | Execute programs using Python Control Flow -Python Loops and Control Statements |
| 3 | Implement programs using String and array in python. |
| 4 | Write functions and pass arguments [Non-Recursive, Recursive] in Python |
| 5 | Execute program to learn different Data Types in python- String, List, advance List, Dictionary, Tuple, Sets |
| 6 | Learn and execute programs using Python Modules and packages. |
| 7 | Execute program using Python Directory and Files Management. |
| 8 | Implement program to learn about python exception handling |
| 9 | Mini project [ Group project- demo and presentation] |

**TOTAL: 60 PERIODS**

**Text Books**


1. Allen B. Downey, “Think Python: How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.
2. Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and Programming”, 1st Edition, BCS Learning & Development Limited, 2017.


**Reference Books**


1. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data, Third Edition, MIT Press , 2021
4. Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.
5. https://www.python.org/
6. Martin C. Brown, “Python: The Complete Reference”, 4th Edition, Mc-Graw Hill, 2018.


| Course Outcomes: At the end of the course, the students will be able to | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge level** |
| CO1 | Understand and make use of Variables, Operators available and how to write | Applying |

| Course Outcomes: At the end of the course, the students will be able to | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge level** |
| | loops and decision statements in Python. | |
| CO2 | Execute programs to implement non recursive and recursive functions in python. | Applying |
| CO3 | Write Python Programs using core data structures like array, string, Lists, Set, Dictionaries and use Tuples. | Applying |
| CO4 | Use and carry out examples to handle File Systems and exception handling in Python. | Applying |
| CO5 | Deconstruct exemplary applications in Python. | Analysing |

| CO-PO/PSO Mapping | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 2 | 2 | 1 | 2 | 1 | | | 2 | 1 | 2 | 2 | | 2 | 2 |
| CO2 | 2 | 2 | 1 | 2 | 1 | | | 2 | 1 | 2 | 2 | | 2 | 2 |
| CO3 | 2 | 2 | 1 | 2 | 1 | | | 2 | 1 | 2 | 2 | | 2 | 2 |
| CO4 | 2 | 2 | 1 | 3 | 1 | | | 2 | 1 | 2 | 2 | | 2 | 2 |
| CO5 | 2 | 2 | 1 | 3 | 1 | 1 | 1 | 2 | 1 | 3 | 2 | 1 | 2 | 2 |
| **Avg.** | **2** | **2** | **1** | **3** | **1** | **1** | **1** | **2** | **1** | **3** | **2** | **1** | **2** | **2** |

**U24MA231 TRANSFORMS AND COMPLEX ANALYSIS**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**Course Objectives:**

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier transform techniques used in a wide variety of situations.
- To make the student appreciate the purpose of using transforms to create a new domain which makes it easier to handle the problem that is being investigated.
- To develop Z transform techniques for discrete time Systems.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence in application areas.

**UNIT I FOURIER SERIES** **9+3**

Dirichlet's conditions — General Fourier series — Odd and even functions — Half range sine series — Half range cosine series — Complex form of Fourier series — Parseval's identity — Harmonic analysis.

**UNIT II FOURIER TRANSFORMS** **9+3**

Statement of Fourier integral theorem — Fourier sine and cosine transforms — Properties — Transforms of simple functions — Convolution theorem — Parseval's identity.

**UNIT III LAPLACE TRANSFORM** **9+3**

Sufficient condition for existence –Transform of elementary functions –Basic properties –Derivatives and integrals of transforms -Transforms of unit step function and impulse functions –Transform of periodic functions. Inverse Laplace transform -Statement of Convolution theorem –Initial and final value theorems– Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

**UNIT IV Z — TRANSFORMS AND DIFFERENCE EQUATIONS** **9+3**

Z-transforms — Elementary properties — Inverse Z-transform (using partial fraction and residues) — Initial and final value theorems — Convolution theorem — Formation of difference equations — Solution of difference equations using Z — transform.

**UNIT V COMPLEX ANALYSIS** **9+3**

Analytic functions, Cauchy's integral theorem, Cauchy's integral formula, Taylor and Laurent series, residue theorem.

**TOTAL: 60 PERIODS**

**Text Books**

1. Grewal B.S., “Higher Engineering Mathematics", 44thEdition, Khanna Publishers, New Delhi, 2018.
2. Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2018.

**Reference Books**

1. Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2021.
3. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.

| **Course Outcomes: At the end of the course, the students will be able to** | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge level** |
| CO1 | Determine periodic function using Fourier series analysis which plays a vital role in engineering applications. | Applying |
| CO2 | Calculate the Fourier Sine and Cosine transform. | Applying |
| CO3 | Apply the Laplace and inverse Laplace transformations for different types of functions. | Applying |
| CO4 | Apply Z-transforms for solving linear ODEs. | Applying |
| CO5 | Apply residue theorem to integrate complex functions. | Applying |

| **CO – PO/PSO Mapping** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| **CO1** | 3 | 3 | 3 | | | | | | 2 | 2 | | 3 | | |
| **CO2** | 3 | 3 | 3 | | | | | | 2 | 2 | | 3 | | |
| **CO3** | 3 | 3 | 3 | | | | | | 2 | 2 | | 3 | | |
| **CO4** | 3 | 3 | 3 | | | | | | 2 | 2 | | 3 | | |
| **CO5** | 3 | 3 | 3 | | | | | | 2 | 2 | | 3 | | |
| **Avg.** | **3** | **3** | **3** | | | | | | **2** | **2** | | **3** | | |

**U24HS211** **தமிழரும் தொழில்நுட்பமும் / TAMILS AND TECHNOLOGY**

| **L** | **T** | **P** | **C** |
|---|---|---|---|
| **1** | **0** | **0** | **1** |

**Course Objectives:**

- To facilitate the student to understand weaving and technology of sangam age.
- To create an awareness on structural design of Tamils during sangam age.
- To help students to distinguish between all the levels of manufacturing technology in ancient period.
- To understand the ancient knowledge of agriculture and irrigation technology.
- To enable the students to understand the digitalization of Tamil Language.

**UNIT I WEAVING AND CERAMIC TECHNOLOGY** **3**

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

**UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY** **3**

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

**UNIT III MANUFACTURING TECHNOLOGY** **3**

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and goldCoins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

**UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY** **3**

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

**UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING** **3**

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

**TOTAL: 15 PERIODS**

**Text Books**

1. Social Life of Tamils (Dr. K.K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr. S.V.S ubatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies).
5. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by: The Author).
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
8. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

| **Course Outcomes: At the end of the course, the students will be able to** | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge level** |
| CO1 | Review the Weaving and Ceramic Technology during Tamil Sangam Age. | Understanding |
| CO2 | Describe the Construction Technology and various Architecture during Tamil Sangam Age. | Understanding |
| CO3 | Discuss the Manufacturing Technology with Archaeological Evidences. | Understanding |
| CO4 | Explain the Agriculture and Irrigation Technology during Tamil Sangam Age. | Understanding |
| CO5 | Describe Tamil Software and Digitalization Tamil Literatures. | Understanding |

| **CO-PO/PSO Mapping** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | | | 2 | | | 2 | | 2 | 1 | 3 | | | | |
| CO2 | | | 2 | | | 2 | | 2 | 1 | 3 | | | | |
| CO3 | | | 2 | | | 2 | | 2 | 1 | 3 | | | | |
| CO4 | | | 2 | | | 2 | | 2 | 1 | 3 | | | | |
| CO5 | | | 2 | | | 2 | | 2 | 1 | 3 | | | | |
| **Avg.** | | | **2** | | | **2** | | **2** | **1** | **3** | | | | |

**U24PH233** **PHYSICS FOR ELECTRONICS ENGINEERING**

| **L** | **T** | **P** | **C** |
|---|---|---|---|
| **3** | **0** | **2** | **4** |

**Course Objectives:**

- Ascertain about the basic of semiconductor physics.
- Illustrate concepts of semiconductor devices and applications of diodes.
- Analyzing and creating ideas about transistors and applying advanced circuit analysis techniques to solve complex electrical circuits.
- Apply optical properties of materials to the optoelectronic devices.
- Interpret the quantum physics and its applications in Nano devices.

**UNIT I SEMICONDUCTOR PHYSICS** **9**

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors – Carrier concentration in P-type semiconductors – Variation of carrier concentration with temperature — Carrier transport in Semiconductor: drift and diffusion

**UNIT II SEMICONDUCTOR DEVICES** **9**

Semiconductor Basics – PN Junction Diodes – Forward and Reverse Biasing – Reverse Saturation Current – Diode current components – Cut-in voltage – VI Characteristics. Rectification – Half-wave – Full-wave and Bridge – Filters. Zener Diodes -Shunt voltage regulator – Regulator Design.

**UNIT III TRANSISTORS** **9**

Transistors – BJTs – PNP and NPN transistors – Effects – Transistor Currents – Amplifying action of a transistor. Transistor Characteristics – CE configuration – Biasing – Quiescent point – Load line – Biasing – Fixed base bias – Small Signal Model of BJT.

Field Effect Transistors – MOSFET – Enhancement and Depletion Modes – Regions of Operation. MOSFET Characteristics – MOSFET Amplifier – MOSFET as a switch.

**UNIT IV OPTOELECTRONIC DEVICES** **9**

Classification of optical materials –light detectors and solar cells – light emitting diode – laser diode - optical processes in organic semiconductor devices –LCD - excitonic state – Varactor Diodes – Schottky Diodes.

**UNIT V NANO DEVICES** **9**

Introduction - quantum confinement – quantum structures: quantum wells, wires and dots — band gap of nanomaterials. Tunnelling – Single electron phenomena: Coulomb blockade – resonant tunnelling diode – single electron transistor – Optics in quantum structures – quantum well laser.

**TOTAL: 45 PERIODS**

| **Sl. No.** | **Practical – List of experiments** |
|---|---|
| 1 | Characteristics of PN Junction Diode |
| 2 | Zener diode characteristics |
| 3 | FET Characteristics |
| 4 | Transistor - Common Base input - output Characteristics |
| 5 | Transistor- Common Emitter input-output Characteristics. |
| 6 | Compact disc- Determination of width of the narrow beam using laser. |
| 7 | Determination of particle size using laser source. |

**TOTAL: 30PERIODS**

**Text Books**


1. Charles K. Alexander & Mathew N.O.Sadiku, "Fundamentals of Electric Circuits", McGraw-Hill, 2nd Edition, 2003.
2. S.O. Kasap. Principles of Electronic Materials and Devices, McGraw Hill Education (Indian Edition), 2020.
3. Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Education (Indian Edition), 2019.
4. G.W. Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.


**Reference Books**


1. Robert.L. Boylestead, "Introductory Circuit Analysis", Pearson Education India, 12th Edition, 2014. David Bell, "Fundamentals of Electric Circuits", Oxford University press, 7thEdition, 2009.
2. Allan H.Robbins, Wilhelm C. Miller, “Circuit Analysis Theory and Practice", Cengage Learning, Fifth Edition, 1st Indian Reprint 2013.
3. R.F. Pierret. Semiconductor Device Fundamentals. Pearson (Indian Edition), 2006.

| Course Outcomes: At the end of the course, the students will be able to | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge level** |
| CO1 | Acquire knowledge on the concepts of semiconductor physics | Understand |
| CO2 | Apply the knowledge of semiconductor devices and diodes. | Applying |
| CO3 | Apply knowledge of the transistor devices and its applications. | Applying |
| CO4 | Apply knowledge of the optoelectronic devices. | Applying |
| CO5 | Acquire knowledge about the optical properties and its application in finding the thickness of the particles. | Applying |

**CO-PO/PSO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | | | 2 | | | | 2 | 2 | | 2 | | |
| CO2 | 3 | 1 | | | 2 | | | | 2 | 2 | | 2 | | |
| CO3 | 3 | 1 | | | 2 | | | | 2 | 2 | | 2 | | |
| CO4 | 3 | 1 | | | 2 | | | | 2 | 2 | | 2 | | |
| CO5 | 3 | 1 | | | 2 | | | | 2 | 2 | | 2 | | |
| **Avg.** | **3** | **1** | | | **2** | | | | **2** | **2** | | **2** | | |

**U24EC213** **CIRCUIT ANALYSIS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 2 | 4 |

**Course Objectives:**

- To apply the basic concepts of circuit analysis in Kirchoff's laws for the DC and AC circuits.
- To compute suitable network theorems and analyze AC and DC circuits.
- To design steady state response of any R, L and C circuits.
- To analyze the transient response for any RC, RL and RLC circuits and frequency response of parallel and series resonance circuits.
- To determine relationship of various two port network.

**UNIT I DC CIRCUIT ANALYSIS** **9**

Basic Components of electric Circuits, Charge, current, Voltage and Power, Voltage and Current Sources, Ohms Law, Kirchoff's Current Law, Kirchoff's voltage law, The single Node – Pair Circuit, series and Parallel Connected Independent Sources, Resistors in Series and Parallel, voltage and current division, Nodal analysis, Mesh analysis.

**UNIT II NETWORK THEOREM AND DUALITY** **9**

Useful Circuit Analysis techniques – Linearity and superposition, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer, Delta-Wye Conversion. Duals, Dual circuits. Analysis using dependent current sources and voltage sources.

**UNIT III SINUSOIDAL STEADY STATE ANALYSIS** **9**

Sinusoidal Steady – State analysis, Characteristics of Sinusoids, The Complex Forcing Function, The Phasor, Phasor relationship for R, L, and C, impedance and Admittance, Nodal and Mesh Analysis, Phasor Diagrams, AC Circuit Power Analysis, Instantaneous Power, Average Power, apparent Power and Power Factor, Complex Power.

**UNIT IV TRANSIENTS AND RESONANCE IN RLC CIRCUITS** **9**

Basic RL and RC Circuits, The Source- Free RL Circuit, The Source-Free RC Circuit, The Unit-Step Function, Driven RL Circuits, Driven RC Circuits, RLC Circuits, Frequency Response, Parallel Resonance, Series Resonance, Quality Factor.

**UNIT V COUPLED CIRCUITS** **9**

Introduction, Magnetically Coupled Circuits, Faraday's law of Electromagnetic Induction, Self-Inductance and Mutual Inductance, Conductively Coupled Circuit - Equivalent T Circuit, Equivalent π Circuit, Linear Transformer, Ideal Transformer.

**TOTAL: 45 PERIODS**

**Sl. No. List of experiments:**

1 Verification of KVL and KCL
2 Verification of Thevenin Theorems.
3 Verification of Norton's Theorems.
4 Verification of Superposition Theorem
5 Verification of Maximum Power Transfer
6 Frequency response of series resonance circuits
7 Frequency response of parallel resonance circuits

**TOTAL: 30 PERIODS**

**Text Books**


1. Hayt Jack Kemmerly, Steven Durbin, "Engineering Circuit Analysis", McGraw Hill education, 9th Edition, 2018.
2. Charles K. Alexander & Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Mc Graw- Hill, 2nd Edition, 2003.
3. Joseph Edminister and Mahmood Nahvi, ―Electric Circuits, Schaum's Outline Series, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.


**Reference Books**


1. Robert.L. Boylestead, "Introductory Circuit Analysis", Pearson Education India, 12th Edition, 2014. David Bell, "Fundamentals of Electric Circuits", Oxford University press, 7thEdition, 2009.
2. John O Mallay, Schaum's Outlines "Basic Circuit Analysis", The Mc Graw Hill companies, 2nd Edition, 2011.
3. Allan H. Robbins, Wilhelm C. Miller, "Circuit Analysis Theory and Practice", Cengage Learning, Fifth Edition, 1st Indian Reprint 2013.


| **Course Outcomes: At the end of the course, the students will be able to** | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge level** |
| CO1 | Apply the basic concepts of circuit analysis in Kirchoff's laws for the DC and AC circuits. | Applying |
| CO2 | Compute suitable network theorems and analyze AC and DC circuits | Applying |
| CO3 | Design steady state response of any R, L and C circuits | Applying |
| CO4 | Analyze the transient response for any RC, RL and RLC circuits and frequency response of parallel and series resonance circuits. | Applying |
| CO5 | Determine relationship of various two port network | Applying |

| **CO-PO/PSO Mapping** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| **CO1** | 3 | 2 | 1 | 1 | | | | 1 | | 1 | | | | |
| **CO2** | 3 | 3 | 2 | 2 | | | | 1 | | 1 | | | | |
| **CO3** | 3 | 3 | 3 | 3 | | | | 1 | | 1 | | | | |
| **CO4** | 3 | 3 | 3 | 3 | | | | 1 | | 1 | | | | |
| **CO5** | 3 | 3 | 3 | 2 | | | | 1 | | 1 | | | | |
| **Avg.** | **3** | **2.8** | **2.4** | **2.2** | | | | **1** | | **1** | | | | |

**U24CS233** **DATA STRUCTURES USING C**

| **L** | **T** | **P** | **C** |
|---|---|---|---|
| **3** | **0** | **2** | **4** |

**Course Objectives:**

- To introduce the basics of C programming language.
- To learn the concepts of advanced features of C.
- To understand the concepts of ADTs and linear data structures.
- To know the concepts of non-linear data structure and hashing.
- To familiarize the concepts of sorting and searching techniques.

**UNIT I C PROGRAMMING FUNDAMENTALS** **9**

Data Types – Variables – Operations – Expressions and Statements – Conditional Statements – Functions – Recursive Functions – Arrays – Single and Multi-Dimensional Arrays.

**UNIT II C PROGRAMMING - ADVANCED FEATURES** **9**

Enumerated Data Types – Pointers: Pointers to Variables, Arrays and Functions – Structures – Union – File Handling – Preprocessor Directives.

**UNIT III LINEAR DATA STRUCTURES** **9**

Abstract Data Types (ADTs) – List ADT – Array-Based Implementation – Linked List – Doubly Linked Lists – Circular Linked List – Stack ADT – Implementation of Stack – Applications – Queue ADT – Priority Queues – Queue Implementation – Applications.

**UNIT IV NON-LINEAR DATA STRUCTURES** **9**

Trees – Binary Trees – Tree Traversals – Expression Trees – Binary Search Tree – Hashing - Hash Functions – Separate Chaining – Open Addressing – Linear Probing– Quadratic Probing – Double Hashing – Rehashing.

**UNIT V SORTING AND SEARCHING TECHNIQUES** **9**

Insertion Sort – Quick Sort – Heap Sort – Merge Sort –Linear Search – Binary Search.

**TOTAL: 45 PERIODS**

| Sl. No. | Practical – List of experiments |
|---|---|
| 1 | Practice of C programming using statements, expressions, decision making and iterative statements |
| 2 | Practice of C programming using Functions and Arrays |
| 3 | Implement C programs using Pointers and Structures |
| 4 | Implement C programs using Files |
| 5 | Array implementation of List ADT |
| 6 | Array implementation of Stack and Queue ADTs |
| 7 | Linked list implementation of List, Stack and Queue ADTs |
| 8 | Implementation of Binary Trees and operations of Binary Trees |
| 9 | Implementation of Binary Search Trees |
| 10 | Implementation of searching techniques |
| 11 | Implementation of Sorting algorithms: Insertion Sort, Quick Sort, Merge Sort |
| 12 | Implementation of Hashing – any two collision techniques |

**TOTAL: 30 PERIODS**

**Text Books**


1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Second Edition, Pearson Education, 1997.
2. Reema Thareja, “Programming in C”, Second Edition, Oxford University Press, 2016.


**Reference Books**


1. Brian W. Kernighan, Rob Pike, “The Practice of Programming”, Pearson Education, 1999.
2. Paul J. Deitel, Harvey Deitel, “C How to Program”, Seventh Edition, Pearson Education, 2013.
3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education,1983.
4. Ellis Horowitz, Sartaj Sahni and Susan Anderson, “Fundamentals of Data Structures”, Galgotia, 2008.

| Course Outcomes: At the end of the course, the students will be able to | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge level** |
| CO1 | Develop C programs for any real world/technical application | Applying |
| CO2 | Apply advanced features of C in solving problems | Applying |
| CO3 | Write functions to implement linear and non–linear data structure operations. | Applying |
| CO4 | Suggest and use appropriate linear/non–linear data structure operations for solving a given problem | Applying |
| CO5 | Appropriately use sort and search algorithms for a given application. | Applying |

| CO-PO/PSO Mapping | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| **CO1** | 2 | 3 | 1 | 2 | 2 | 1 | 1 | | 1 | 2 | 1 | 3 | | |
| **CO2** | 1 | 2 | 1 | 2 | 2 | | | | 1 | 1 | 1 | 2 | | |
| **CO3** | 2 | 3 | 1 | 2 | 3 | | | | 1 | 1 | 1 | 2 | | |
| **CO4** | 2 | 1 | | 1 | 1 | | | | 2 | 1 | 1 | 2 | | |
| **CO5** | 1 | 2 | 1 | 2 | 2 | 1 | 1 | | 1 | 2 | 1 | 3 | | |
| **Avg.** | **1.6** | **2.2** | **1** | **1.8** | **2** | **1** | **1** | | **1.2** | **1.4** | **1** | **2.4** | | |

**U24HS223 TECHNICAL ENGLISH FOR ENGINEERS**

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 2 | 3 |

**Course Objectives:**

- To engage learners in meaningful language activities to improve their LSRW skills.
- To enhance learners' awareness of general rules of writing for specific audiences.
- To help learners understand the purpose, audience, contexts of different types of writing.
- To develop analytical thinking skills for problem solving in communicative contexts.
- To demonstrate an understanding of job applications and interviews for internship and placements.

**UNIT I MAKING COMPARISONS** **6**

Reading - Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette - Compare and Contrast Essay; Grammar – Mixed Tenses, Prepositional phrases.

**UNIT II EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING** **6**

Reading - Reading longer technical texts– Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints. Grammar - Active Passive Voice transformations, Infinitive and Gerunds.

**UNIT III PROBLEM SOLVING** **6**

Reading - Case Studies, excerpts from literary texts, news reports etc. Writing – Letter to the Editor, Checklists, Problem solution essay / Argumentative Essay. Grammar – Error correction; If conditional sentences.

**UNIT IV REPORTING OF EVENTS AND RESEARCH** **6**

Reading –Newspaper articles; Writing – Proposal writing - Picture description - Accident Report, Survey Report. Grammar – Reported Speech, Modals Vocabulary – Conjunctions- use of prepositions.

**UNIT V THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY** **6**

Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses.

**TOTAL: 30 PERIODS**

| Sl. No. | Practical – List of experiments |
|---|---|
| 1 | Role Play Exercises Based on Workplace Contexts |
| 2 | Understanding lexical items via movie clippings – Individual task |
| 3 | Discussing news stories |

4 Dialogues (with cue cards)-Understanding common technology terms
5 Pronunciation, Intonation, Stress and Rhythm (Level 1)
6 Pronunciation, Intonation, Stress and Rhythm (Level 2)
7 Public Speech: Talking about self in a Professional Setting, Introduction of Speakers, Vote of thanks - 3 in a team
8 Writing a short article (Can be compiled as a magazine)
9 Verbal ability exercises for competitive examinations
10 Visume

**TOTAL: 30 PERIODS**

**Text Books**

1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.
2. English for Science & Technology Cambridge University Press 2021 Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.
3. Better English Pronunciation, (2005), J.D. O'Connor, Second Edition, ISBN-13:978-0521682589.

**Reference Books**

1. Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi.
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.
3. A Modern Approach to Verbal & Non-Verbal Reasoning - Includes Latest Questions and their Solutions, Revised Edition, R.S. Aggarwal, January 2018.

| **Course Outcomes: At the end of the course, the students will be able to** | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge level** |
| CO1 | Articulate English with proper pronunciation, intonation, stress and rhythm. | Applying |
| CO2 | Develop verbal ability skills for attending competitive examinations. | Applying |
| CO3 | Employ speaking and writing skills in professional contexts. | Applying |
| CO4 | Write effective resumes in the context of job search. | Applying |
| CO5 | Interpret the denotative and connotative meanings of technical texts. | Understanding |

| **CO-PO/PSO Mapping** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| CO2 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| CO3 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| CO4 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| CO5 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| **Avg.** | | | | | | | | **1** | **2** | **3** | | **3** | | |

**U24CE232 ENGINEERING PRACTICES FOR CIRCUIT BRANCHES**

| **L** | **T** | **P** | **C** |
|---|---|---|---|
| **0** | **0** | **4** | **2** |

**Course Objectives:**

- To gain practical experience in characterizing electronic devices
- To solder and test simple electronic circuits on PCB
- To verify KVL and KCL using series and parallel circuits
- To perform various electrical joints in common household electrical wire work.
- To measure of electrical quantities in different electrical circuits

**ELECTRONIC ENGINEERING PRACTICES**

1 Study of Electronic Components and Equipment
2 Resistor Value using Colour coding

3 Generation of AC signal using Function Generator and Measurement of its parameter using CRO / DSO
4 Study of logic gates - AND, OR, NOT, NOR, NAND and XOR
5 Soldering simple electronic circuits and checking continuity.
6 Verification of KVL and KCL using series and parallel circuits
7 Controlling smart devices using Mobile phone
8 Study of troubleshooting steps in Mobile Repairing

**ELECTRICAL ENGINEERING PRACTICES**

1 Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2 Fluorescent lamp wiring.
3 Stair case wiring
4 Measurement of electrical quantities – voltage, current, power and power factor in RLC circuit.
5 Measurement of energy using a single-phase energy meter.
6 Measurement of resistance to earth of electrical equipment.

| **Course Outcome Statement** | | |
|---|---|---|
| **CO** | **At the end of the course, the students will be able to** | **Knowledge Level** |
| **CO1** | Analyze the characteristics of basic electronic devices | Applying |
| **CO2** | Perform simple electronic circuits on PCB | Applying |
| **CO3** | Solve KVL and KCL using series and parallel circuits | Applying |
| **CO4** | Perform various electrical joints in common household electrical wire work. | Applying |
| **CO5** | Calculate electrical quantities in different electrical circuits | Applying |

| **CO-PO/PSO Mapping** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| **CO1** | 3 | 3 | | | | | | 2 | 3 | 2 | | 2 | | |
| **CO2** | 3 | 2 | 2 | | | | | 2 | 3 | 2 | | 2 | | |
| **CO3** | 3 | 3 | 3 | | | | | 2 | 3 | 2 | | | | |
| **CO4** | 3 | 2 | | | | 2 | | 2 | 3 | 2 | | 3 | | |
| **CO5** | 3 | 2 | 2 | | | 2 | | 2 | 3 | 2 | | 3 | | |
| **Avg.** | **3** | **2.4** | **2.3** | | | **2** | | **2** | **3** | **2** | | **2.5** | | |

**U24EM212** **PROFESSIONAL DEVELOPMENT** **L T P C**
**0 0 2 1**

**Course Objectives:**

- To be proficient in important Microsoft Office tools: MS WORD, EXCEL, POWERPOINT.
- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and overall utility value of content.
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered
- To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations

| **Sl. No** | **List of exercises** |
|---|---|
| 1 | **MS WORD: (10 Periods)**<br>Create and format a document<br>Working with tables<br>Working with Bullets and Lists<br>Working with styles, shapes, smart art, charts<br>Inserting objects, charts and importing objects from other office tools |

| | |
|---|---|
| | Creating and Using document templates<br>Inserting equations, symbols and special characters<br>Working with Table of contents and References, citations<br>Insert and review comments<br>Create bookmarks, hyperlinks, endnotes footnote<br>Viewing document in different modes<br>Working with document protection and security<br>Inspect document for accessibility |
| 2 | **MS EXCEL: 10 Periods**<br>Create worksheets, insert and format data<br>Work with different types of data: text, currency, date, numeric etc.<br>Split, validate, consolidate, Convert data<br>Sort and filter data<br>Perform calculations and use functions:<br>(Statistical, Logical, Mathematical, date, Time etc.,)<br>Work with Lookup and reference formulae<br>Create and Work with different types of charts<br>Use pivot tables to summarize and analyse data<br>Perform data analysis using own formulae and functions<br>Combine data from multiple worksheets using own formulae and built-in functions to generate results<br>Export data and sheets to other file formats<br>Working with macros<br>Protecting data and Securing the workbook |
| 3 | **MS POWERPOINT: 10 Periods**<br>Select slide templates, layout and themes<br>Formatting slide content and using bullets and numbering<br>Insert and format images, smart art, tables, charts<br>Using Slide master, notes and handout master<br>Working with animation and transitions<br>Organize and Group slides<br>Import or create and use media objects: audio, video, animation<br>Perform slideshow recording and Record narration and create presentable videos |
| | **Total: 30 Hours** |

| **Course Outcomes: At the end of the course, the students will be able** | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge Level** |
| CO1 | Create quality documents, by structuring and organizing content for their day to day technical and academic requirements using MS Word | Applying |
| CO2 | Perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding using MS Excel | Applying |
| CO3 | Create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects using MS Power Point | Applying |
| CO4 | Prepare an effective report using MS word and MS Excell on any subject content | Applying |
| CO5 | Present the report using MS Power Point | Applying |

| CO-PO/PSO Mapping | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | | | | | | | | | 2 | 2 | | 2 | | |
| CO2 | | | | | | | | | 2 | 2 | | 2 | | |
| CO3 | | | | | | | | | 2 | 2 | | 2 | | |
| CO4 | | | | | | | | | 2 | 2 | | 2 | | |
| CO5 | | | | | | | | | 2 | 2 | | 2 | | |
| **Avg.** | | | | | | | | | **2** | **2** | | **2** | | |

**B.E. Electronics and Communication Engineering**
**R2024 Third Semester Syllabus**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **U24MA331** | **PROBABILITY AND RANDOM PROCESSES** | **3** | **1** | **0** | **4** |

**Course Objectives:**

- To provide necessary basic concepts in probability and random processes with applications to random signals, linear systems in communication engineering.
- To understand the basic concepts of probability, one and two dimensional random variables and to introduce some standard distributions commonly used in engineering to real life phenomenon.
- To understand the basic concepts of random processes which are widely used in IT fields.
- To understand the concept of correlation and spectral densities.
- To understand the significance of linear systems with random inputs.

**UNIT I PROBABILITY AND RANDOM VARIABLES 9+3**

Probability – Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions- Functions of a random variable.

**UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 9+3**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables.

**UNIT III RANDOM PROCESSES 9+3**

Classification – Stationary process: SSS process and WSS process – Markov process - Markov chain - Poisson process

**UNIT IV CORRELATION AND SPECTRAL DENSITIES 9+3**

Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties.

**UNIT V LINEAR SYSTEMS WITH RANDOM INPUTS 9+3**

Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.

**TOTAL: 60 PERIODS**

**Text Books**

1. Ibe, O.C.," Fundamentals of Applied Probability and Random Processes ", 1st Indian Reprint, Elsevier, 2010.
2. Peebles, P.Z., "Probability, Random Variables and Random Signal Principles ", Tata McGraw Hill, 4th Edition, New Delhi, 2002.
3. M.B.K .Moorthy, K. Subramani, A. Santha, "Probability and Random Processes",7thEdition,Scitech Publications(INDIA)Pvt.Ltd.,2015.
4. T. Veerarajan, "Probability, Statistics and Random Process",3rdedition, Tata McGraw Hill Publishing Company limited, 2008.

**Reference Books**

1. Stark. H. and Woods. J.W., "Probability and Random Processes with Applications to Signal Processing ", Pearson Education, Asia, 3rdEdition, 2002.
2. Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", Wiley India Pvt. Ltd., Bangalore, 2ndEdition, 2012.
3. Cooper. G.R., McGillem. C.D., "Probabilistic Methods of Signal and System Analysis", Oxford University Press, New Delhi, 3rdIndian Edition, 2012.
4. Miller. S.L. and Childers. D.G., "Probability and Random Processes with Applications to Signal Processing and Communications ", Academic Press, 2004.

**Course Outcomes**

| CO | At the end of the course, the students will be able to | Knowledge level |
|---|---|---|
| CO1 | Apply the basic knowledge of the probability concepts. | Applying |
| CO2 | Apply the basic concepts on two dimensional random variables. | Applying |
| CO3 | Apply the concept random processes in engineering disciplines. | Applying |
| CO4 | Apply the concept of correlation and spectral densities in engineering fields. | Applying |
| CO5 | Apply the appropriate formula for the input system of a transfer function to get the auto correlation function and mean square value of the output. | Applying |

**CO-PO/PSO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | | | | | 2 | 2 | | 3 |
| CO2 | 3 | 3 | 3 | | | | | 2 | 2 | | 3 |
| CO3 | 3 | 3 | 3 | | | | | 2 | 2 | | 3 |
| CO4 | 3 | 3 | 3 | | | | | 2 | 2 | | 3 |
| CO5 | 3 | 3 | 3 | | | | | 2 | 2 | | 3 |
| **Avg.** | **3** | **3** | **3** | | | | | **2** | **2** | | **3** |

**CO-PO/PSO Mapping:** 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

**U24EC311 Electromagnetic Fields**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**Course Objective:**

- To develop Proficiency in Vector Analysis for Electromagnetic Applications
- To gain a Comprehensive Understanding of Electrostatics and Electric Fields
- To explore the Fundamentals of Magnetostatics and Magnetic Fields
- To examine the Role of Time-Varying Fields and Maxwell's Equations in Electromagnetics
- To analyze Wave Propagation and Electromagnetic Power in Different Media

**Unit I INTRODUCTION TO VECTOR ANALYSIS 9+3**

The Electromagnetic Model, Units and constants, Review of vector algebra- Cartesian Coordinates, Cylindrical Coordinates and Spherical Coordinates-Line, surface and volume

integrals, Gradient of a Scalar Field, Divergence of a Vector Field, Divergence Theorem, Curl of a Vector Field, Stokes's Theorem, Two Null Identities, Helmholtz's Theorem

Unit II **Static Electric Fields** **9+3**

Electrostatics in Free Space, Coulomb's Law, Gauss's Law and Applications, Electric Potential, Conductors in Static Electric Field, Dielectrics in Static Electric Field, Electric Flux Density and Dielectric Constant, Boundary Conditions for Electrostatic Fields, Capacitance and Parallel, cylindrical and spherical capacitors, Electrostatic Energy and Forces, Poisson's and Laplace's **equations,** Current Density and Ohm's Law, Electromotive Force and Kirchhoff's Voltage Law, Equation of Continuity and Kirchhoff's Current Law

Unit III **Static Magnetic Fields** **9+3**

Fundamental Postulates of Magnetostatics in Free Space, Lorentz force equation, Ampere's law, Vector Magnetic Potential, The Biot-Savart Law and Applications, The Magnetic Dipole, Magnetic Field Intensity and Relative Permeability, Magnetic Circuits, Behavior of Magnetic Materials, Boundary Conditions for Magnetostatic Fields, Inductances and Inductors, Magnetic Energy, Magnetic Forces and Torques

**Unit IV TIME-VARYING FIELDS AND MAXWELL'S EQUATIONS** **9+3**

Faraday's Law of Electromagnetic Induction, Maxwell's Equations – Differential and Integral Form of Maxwell's Equations, Potential Functions, Electromagnetic Boundary Conditions, Wave Equations and Their Solutions, Time-Harmonic Fields

**Unit V PLANE ELECTROMAGNETIC WAVES** **9+3**

Plane Waves in Lossless Media, Plane Waves in Lossy Media, Group Velocity, Flow of Electromagnetic Power and the Poynting Vector, Normal Incidence at a Plane Conducting Boundary, Oblique Incidence at a Plane Conducting Boundary, Normal Incidence at a Plane Dielectric Boundary.

**Total Periods:60**

**Text Books**

1 David K. Cheng, “Field and Wave Electromagnetics”, Second Edition, Pearson New International Edition, 2014.

2 John Kraus and Daniel Fleisch, “Electromagnetics with Applications”, Fifth Edition, McGraw Hill Education (India Edition),July 2017.

**Reference Books**

1 M.N.O. Sadiku and S.V. Kulkarni, Principles of electromagnetics, 6th ed., Oxford(Asian Edition), 2015

2 Edward C. Jordon (Author), Keith G. Balmain (Author), Electromagnetic Waves and Radiating Systems, Second Edition, Pearson Education, 2015

3 W.H. Hayt and J.A. Buck, “Engineering electromagnetics”, 9th ed., McGraw-Hill (India), 2020

**Course Outcomes**

| **At the end of the course, the students will be able to** | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge Level** |
| CO1 | Apply vector calculus operations and related theorems to solve problems in electromagnetic theory. | Applying |
| CO2 | Analyze the behavior of electrostatic fields and their interactions with materials in static conditions. | Analyzing |

| | | |
|---|---|---|
| CO3 | Evaluate magnetic fields and energy using fundamental postulates of magnetostatics and related laws. | Evaluating |
| CO4 | Explain Maxwell's equations and their applications in solving electromagnetic wave equations. | Applying |
| CO5 | Infer the behavior of electromagnetic waves during propagation and interaction with various boundaries | Analyzing |

**CO-PO/PSO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 3 | 2 | | 2 | 2 | 2 | | 2 | 2 | 2 |
| CO2 | 3 | 3 | 2 | 3 | 2 | | 2 | 2 | 2 | | 2 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 3 | 2 | | 2 | 2 | 2 | | 2 | 2 | 2 |
| CO4 | 3 | 3 | 2 | 3 | 2 | | 2 | 2 | 2 | | 2 | 2 | 2 |
| CO5 | 3 | 3 | 2 | 3 | 2 | | 2 | 2 | 2 | | 2 | 2 | 2 |
| **Avg.** | **3** | **3** | **2** | **3** | **2** | | **2** | **2** | **2** | | **2** | **2** | **2** |

**CO-PO/PSO Mapping:** 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

**U24EC323** **Signals and Systems** **L T P C**
**2 1 2 4**

**Course Objective:**

- Understanding the fundamental characteristics of signals and systems.
- Analysis of Continuous Time Signals using Fourier Representation.
- Analysis of Discrete Time Signals using Fourier Transform and Z Transform Representation.
- Understanding the Characteristics of LTI-CT Systems.
- Understanding the Characteristics of LTI-DT Systems.

**UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS (9)**

Standard signals-Step, Ramp, Impulse, Real and complex exponentials and Sinusoids-Classification of signals-Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals. Classification of systems-CT systems and DT systems-Static and Dynamic Systems, Time-variant & Time-invariant, Linear & Nonlinear, Causal & Non-causal, Stable & Unstable systems, Invertible and Invertible systems.

**UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS (9)**

Fourier series-Continuous Time Fourier series-Trigonometric or Quadrature Fourier series -Fourier series and properties-Fourier Transform and properties-Laplace Transforms and properties

**UNIT III ANALYSIS OF DISCRETE TIME SIGNALS (9)**

Fourier Transform of discrete time signals (DTFT)-Properties of DTFT-Z Transform and Properties.

**UNIT IV LINEAR TIME INVARIANT - CONTINUOUS TIME SYSTEMS (9)**

Convolution integrals-Impulse Response and Properties of Systems-Differential Equation- Fourier and Laplace transforms in Analysis of CT systems.

**UNIT V LINEAR TIME INVARIANT - DISCRETE TIME SYSTEMS (9)**

Convolution sum-Impulse response-Difference equations-Discrete Fourier Transform-Z Transform Analysis DT systems-Recursive & Non-Recursive systems.

**Total Periods: 45**

**List of Experiments**

| Sl. No | List of Experiments |
|---|---|
| **Simulation using MATLAB** | |
| 1 | Study of MATLAB and Its Features |
| 2 | Study of Basic MATLAB Commands and Functions |
| 3 | Basic MATLAB Programming |
| 4 | Simulation of Various Real-Time Signal Generations for Communication |
| 5 | Simulation and Fourier Series Analysis of Square Waves for Signal Processing and Communication Systems |
| 6 | Simulation of Fourier Transform and Spectral Analysis for Signal Processing: Magnitude and Phase Spectrum Visualization |
| 7 | Simulation of Z-Transform for Discrete-Time System Analysis and Digital Control Applications |
| 8 | Simulation of Impulse and Step Responses for System Behaviour Analysis from Difference Equations |
| 9 | Simulation of Linear Convolution for Signal Interaction and System Response Analysis |

**Total Periods: 30**

**Total Periods: 75**

**Text Books**

1 Oppenheim, Willsky and Hamid, “Signals and Systems”, 2nd Edition, Pearson Education, New Delhi, 2015.(Units I - V).
2 Simon Haykin, Barry Van Veen, “Signals and Systems”, 2nd Edition, Wiley, 2020

**Reference Books**

1 M. J. Roberts, “Signals and Systems Analysis using Transform methods and MATLAB”, McGraw- Hill Education, 2018.
2 B. P. Lathi, “Principles of Linear Systems and Signals”, 2nd Edition, Oxford, 2009.
3 John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.

**Course Outcomes**

| **At the end of the course, the students will be able to** | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge Level** |
| CO1 | Estimate the basic elementary signals & determine the Fourier series for Continuous Time Signals. | Analyzing |
| CO2 | Calculate Fourier Transform and Laplace Transform in continuous Time Signals | Applying |
| CO3 | Determine Fourier Transform and Z Transform in Discrete Time Signals | Applying |
| CO4 | Solve Linear Time Invariant Continuous Signals using Fourier Transform and Laplace Transform | Applying |
| CO5 | Solve Linear Time Invariant Discrete Signals using Z Transform | Applying |

**CO-PO/PSO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | | 2 | 2 | 2 | | 2 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | | 2 | 2 | 2 | | 2 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | | 2 | 2 | 2 | | 2 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | | 2 | 2 | 2 | | 2 | 2 | 2 |
| CO5 | 3 | 2 | 3 | 3 | 3 | | 2 | 2 | 2 | | 2 | 2 | 2 |
| **Avg.** | **3** | **3** | **3** | **3** | **3** | | **2** | **2** | **2** | | **2** | **2** | **2** |

**CO-PO/PSO Mapping:** 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

**U24EC333 ELECTRONIC DEVICES & CIRCUITS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 2 | 4 |

**Course Objective:**

- Describe a strong basis for building the Analog Electronic Circuits.
- Analyze the Low Frequency and High frequency Small Signal amplifier.
- Provide insights into multistage amplifiers and Differential amplifiers.
- Equip students with the ability to analyze and design feedback amplifiers & Oscillators
- Explain Photo Electronic Devices and Regulated Power Supplies.

**Unit I: SPECIAL DIODES & APPLICATIONS (9)**

Special Diodes: Backward Diode, p-i-n photo Diode, Tunnel diode, Gunn Diode, IMPATT Diode-Avalanche Photodiode - Applications: Clipper, Clamper & Voltage Multipliers.

**Unit II: AMPLIFIERS (9)**

BJT small signal model: Analysis of CE, CB, CC amplifiers- Gain and frequency response – MOSFET small signal model: Analysis of CS, CG and Source follower – Gain and frequency response

**Unit III: MULTISTAGE AMPLIFIERS & DIFFERENTIAL AMPLIFIER (9)**

Cascade Amplifier, Cascode Amplifier, Differential Amplifier - Common mode and Differential Mode analysis -Tuned Amplifier -Neutralization Methods- Power Amplifier - Class A, Class B, Class AB & Class C.

**Unit IV: FEEDBACK AMPLIFIER & OSCILLATOR (9)**

Advantages of negative feedback – VoPltage / Current, Series / Shunt feedback Amplifiers – positive feedback–Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

**Unit V: PHOTOELECTRIC DEVICES (9)**

Photo emissivity - Photoelectric Theory - Photo Tubes - Applications of Photo devices – Multiplier Phototubes - Photoconductivity - The Semiconductor Photodiode- Multiple Junction Photodiodes - The Photovoltaic Effect.

**Total Periods:45**

**Sl. No List of Experiments**

1 Characteristics of Voltage Multipliers.
2 MOSFET Drain Current and Transfer Characteristics.
3 Characteristics of Diode-Clipper Circuits.

**Simulation using Multisim NS 12**

4 Gain & Frequency response of CE Amplifier.
5 Gain & Frequency response of CS Amplifier.
6 Cascade Amplifier Frequency response.

7 Wien bridge oscillator Frequency response
8 Current shunt Feedback Amplifier-Feedback on frequency response.
9 Simulation of Photo-Diode characteristics using MULTISIM 12.

**Total Periods: 30**
**Total Periods:75**

**Text Books**

1 Jacob Millman & Christos C.Halkias, "Electronic Devices and Circuits" ,4th Edition, October 2022.
2 David A. Bell, "Electronic Devices and Circuits", Oxford Higher Education Press, 5th Edition, 2022.
3 Robert L. Boylestad and Louis Nasheresky, " Electronic Devices and Circuit Theory", 11th Edition , Person Education, 2018.

**Reference Books**

1 Adel.S. Sedra , Kenneth C.Smith, "Microelectronic Circuits: Theory and Applications", oxford university, Pearson Education, 6th Edition, 2017.
2 Donald A. Neamen, "Electronic circuit Analysis and Design", Tata McGraw Hill, 3rd Edition, 2010.

**Course Outcomes**

| **At the end of the course, the students will be able to** | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge Level** |
| CO1 | Experiment the structure and working operation of basic electronic devices. | Applying |
| CO2 | Design and Analysis of Low frequency & High frequency small signal amplifiers. | Analyzing |
| CO3 | Analyze the response of Multistage Amplifiers and Differential amplifiers. | Analyzing |
| CO4 | Examine the behaviour of feedback amplifiers and oscillators. | Analyzing |
| CO5 | Develop photo electronic devices. | Applying |

**CO-PO/PSO Mapping**

| **CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | | 2 | 2 | | | 2 | 2 | 2 |
| CO2 | 3 | 2 | 2 | 3 | 2 | | 2 | 2 | | | 2 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 2 | | 2 | 2 | | | 2 | 2 | 2 |
| CO4 | 3 | 3 | 2 | 3 | 2 | | 2 | 2 | | | 2 | 2 | 2 |
| CO5 | 3 | 2 | 3 | 2 | 2 | | 2 | 2 | | | 2 | 2 | 2 |
| **Avg.** | **3** | **2.6** | **2.6** | **2.6** | **2** | | **2** | **2** | | | **2** | **2** | **2** |

**CO-PO/PSO Mapping:** 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

| U24EC343 | DIGITAL SYSTEMS DESIGN | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 4 |

**Course Objective:**

- Develop a strong foundation in number systems and Boolean algebra
- Enable students to design and implement combinational logic circuits
- Provide insights into synchronous sequential circuits
- Equip students with the ability to analyze and design asynchronous sequential circuits
- Explore logic families and programmable logic devices

**Unit I: NUMBER SYSTEMS AND BOOLEAN ALGEBRA (9)**

Boolean algebra- theorems, Logic expression minimization, sum of product and product of sum simplification, canonical forms min term and max term, Simplification of Boolean expressions using Karnaugh map, Implementation of Boolean expressions using universal gates.

**Unit II: COMBINATIONAL LOGIC CIRCUITS (9)**

Combinational circuits Introduction, Half and Full Adders, Binary Adder – Carry look ahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Multiplexer, Demultiplexer, Implementation of logic functions using multiplexer, Parity Generator/Checker, Code-Converters.

**Unit III: SYNCHRONOUS SEQUENTIAL CIRCUITS (9)**

Latches, Flip flops – SR, T, D, JK, Master Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – Design of Moore and Mealy models, state minimization, state assignment – Design of synchronous Counters, Ripple Counters, Ring Counters, Shift registers.

**Unit IV: ASYNCHRONOUS SEQUENTIAL CIRCUITS (9)**

Introduction to Asynchronous Sequential Circuits - Fundamental mode and pulse mode sequential circuits, Stable and Unstable States, State Reduction, Races and Cycles, Race-Free State Assignments, Hazards in Asynchronous Circuits - Design of hazard-free circuits, Essential Hazards.

**Unit V: LOGIC FAMILIES AND PROGRAMMABLE LOGIC DEVICES (9)**

Introduction to Logic Families, Key Characteristics of Logic Families, Logic Family Types- RTL ,TTL,ECL, CMOS, Comparison of Logic families, Low power Design considerations in logic families, Applications of Logic Families in Automotive and IoT. Implementation of Logic Circuits - Combinational logic and sequential logic design using standard ICs, Introduction to Programmable Logic Devices - Types and applications: PROM, PLA, and PAL, Basic Memory Concepts - Static ROM, PROM, EPROM and EEPROM, Introduction to HDL.

**Total Periods:45**

**List of Experiments**

| Sl. No | List of Experiments |
|---|---|
| 1 | Verification of Boolean theorems |
| 2 | Design of adders. |
| 3 | Design of subtractors. |
| 4 | Design of code converters. |
| 5 | Design of Multiplexers. |
| 6 | Design of Demultiplexers. |
| 7 | Design of Encoders. |
| 8 | Design of Decoders. |
| 9 | Design of Magnitude Comparators |
| 10 | Parity Checker and Generator |

11 Design and implementation of counters using flip-flops
12 Design and implementation of shift registers
13 Simulation of Half adder using Verilog HDL
14 Simulation of Full adder using Verilog HDL

**Total Periods: 30**
**Total Periods: 75**

**Text Books**

1 M. Morris Mano and Michael D. Ciletti, 'Digital Design', Pearson, 7th Edition, 2024.

**Reference Books**

1 M. Morris Mano, '"Digital Logic and Computer Design", 2024
2 William Kleitz, "Digital Electronics: A Practical Approach with VHDL", (8th Edition) 2024
3 "Digital Systems: Principles and Applications" (13th Edition) by Ronald J. Tocci, Neal S. Widmer, and Gregory L. Moss 2024

**Course Outcomes**

| **At the end of the course, the students will be able to** | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge Level** |
| CO1 | Experiment the conversion of number systems and Boolean algebra theorems | Applying |
| CO2 | Design combinational logic circuits, including adders, multiplexers, and encoders | Applying |
| CO3 | Construct synchronous sequential circuits and State machines using Moore and Mealy models | Applying |
| CO4 | Examine the behavior of asynchronous sequential circuits to identify races, hazards, and stable states | Applying |
| CO5 | Evaluate different logic families and programmable logic devices for circuit design | Applying |

**CO-PO/PSO Mapping**

| **CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 2 | - | 2 | 2 | 2 | - | 2 | 3 | 2 |
| CO2 | 3 | 2 | 3 | 2 | 2 | - | 2 | 2 | 2 | - | 2 | 3 | 2 |
| CO3 | 3 | 2 | 2 | 2 | 2 | - | 2 | 2 | 2 | - | 2 | 3 | 2 |
| CO4 | 3 | 2 | 2 | 2 | 2 | - | 2 | 2 | 2 | - | 2 | 3 | 2 |
| CO5 | 3 | 2 | 2 | 2 | 2 | - | 2 | 2 | 2 | - | 2 | 3 | 2 |
| **Avg.** | **3** | **2.2** | **2.4** | **2** | **2** | **-** | **2** | **2** | **2** | **-** | **2** | **3** | **2** |

**CO-PO/PSO Mapping:** 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

**R2024 Electronics and Communication Engineering**
**Fourth Semester Syllabus**

| U24EC411 | ANALOG INTEGRATED CIRCUITS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

The student should be made to:

- Apply the basic concepts of operational amplifiers to analyze their functional characteristics.
- Demonstrate the practical applications of operational amplifiers in analog circuits.
- Analyze the operation of analog multipliers and phase-locked loops (PLLs) in system design.
- Implement the applications of A/D and D/A converters in signal processing.
- Analyze the performance of special function ICs for various electronic applications.

**Detailed Syllabus**

| Unit No., Title and detailed syllabus |
|---|
| **UNIT I BASICS OF OPERATIONAL AMPLIFIERS 9**<br>Basic information about Op-amps: Symbol, Power Supply Connection - Ideal Operational Amplifier - Inverting Amplifier - Non-Inverting Amplifier - Voltage Follower - Differential Amplifier - Op-amp: Block Diagram, DC characteristics : Input Bias Current –Input offset current – input offset voltage, AC characteristics: Frequency response, Frequency Compensation, Slew rate - open and closed loop configurations. |
| **UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9**<br>Basic Op-amp Applications - Scale Changer/Inverter, Summing Amplifier, Subtractor, Differentiator, Integrator, Comparators, Instrumentation amplifier, Log and Antilog amplifier. V-to-I and I-to-V converters, Op-amp Circuit using diode: HWR- FWR – Peak Detector – clipper - Sample and Hold circuit, Schmitt trigger |
| **UNIT III ANALOG MULTIPLIER AND PLL 9**<br>Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, Operational Transconductance Amplifier (OTA), Analog multiplier ICs and their applications, PLL: basic principles, analysis, Voltage controlled oscillator, Monolithic PLL IC 565, PLL Application |
| **UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 9**<br>Basic DAC techniques - weighted resistor type, R-2R Ladder type, inverted R-2R Ladder DAC, A/D Converter - Flash type, Counter Type A/D converter, Servo Tracking A/D Converter, Successive Approximation type – Integrated type of ADC -Single Slope type, Dual Slope type, DAC/ADC Specifications. |
| **UNIT V SPECIAL FUNCTION ICS 9**<br>Timer IC 555 - Functional Description, Monostable operation, Astable Multivibrator, IC Voltage regulators: fixed voltage series regulator - IC 723 general purpose regulator - Switching regulator, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fibre optic IC. |

**TOTAL= 45 PERIODS**

**Text Books**

| | |
|---|---|
| 1 | Roy Choudhry D and Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 4th Edition, 2018. |
| 2 | Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", Tata McGraw-Hill, 4th Edition, 2015. |

**References**

| | |
|---|---|
| 1 | Ramakant A Gayakwad, "Op-Amp and Linear ICs", Prentice Hall I Pearson Education, 4th Edition, 2021. |
| 2 | Salivahanan S and Kanchana Bhaskaran VS, "Linear Integrated Circuits", Tata McGraw Hill, 3rd Edition, 2018 |
| 3 | IIT Madras, Prof. Aniruddhan S & Nagendra Krishnapura, "Analog IC Design" ,https://nptel.ac.in/courses/108106105?utm_source |
| 4 | IIT Madras, Prof. Shanti Pavan, "Analog Electronic Circuits" , https://nptel.ac.in/courses/108106188?utm_source |

**Course Outcomes**

| **At the end of the course, the students will be able to** | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge Level** |
| CO1 | Apply the basic concepts of operational amplifiers to analyze their functional characteristics. | Applying |
| CO2 | Demonstrate the practical applications of operational amplifiers in analog circuits. | Applying |
| CO3 | Analyze the operation of analog multipliers and phase-locked loops (PLLs) in system design. | Analyzing |
| CO4 | Implement the applications of A/D and D/A converters in signal processing. | Applying |
| CO5 | Analyze the performance of special function ICs for various electronic applications. | Analyzing |

**CO-PO/PSO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | | | | 2 | 2 | | | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 | | | 2 | 2 | | 2 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | | | | 2 | 2 | | | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | | | | 2 | 2 | | | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | | | | 2 | 2 | | | 3 | 3 |
| **Avg.** | **3** | **3** | **3** | **3** | **3** | | | **2** | **2** | | **2** | **3** | **3** |

**For CO-PO/PSO Mapping:** 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

| U24EC421 | TRANSMISSION LINES AND WAVEGUIDES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 4 |

**COURSE OBJECTIVE:**

The student should be made to:

- Analyze the transmission line equations and their solutions to study propagation, reflection, and distortion phenomena.
- Evaluate high-frequency transmission line characteristics such as standing waves, VSWR, and input impedance under various terminations.
- Analyze impedance matching networks using quarter-wave transformers, stubs, and Smith chart methods for maximum power transfer.
- Analyze passive filter networks (constant-k and m-derived) to achieve desired frequency-selective characteristics.
- Analyze electromagnetic wave propagation in waveguides and develop solutions for TE, TM and TEM modes.

**Detailed Syllabus**

**UNIT I TRANSMISSION LINE THEORY** **12**

General theory of Transmission lines – the transmission line – general solution – The infinite line – Wavelength, velocity of propagation – Waveform distortion – the distortion-less line – Loading and different methods of loading – Line not terminated in Z0 – Reflection coefficient – calculation of current, voltage, power delivered and efficiency of transmission – Input and transfer impedance – Open and short circuited lines – reflection factor and reflection loss.

**UNIT II HIGH FREQUENCY TRANSMISSION LINES** **12**

Transmission line equations at radio frequencies – Line of Zero dissipation – Voltage and current on the dissipation-less line, Standing Waves, Nodes, Standing Wave Ratio – Input impedance of the dissipation-less line – Open and short circuited lines – Power and impedance measurement on lines – Reflection losses – Measurement of VSWR and wavelength.

**UNIT III IMPEDANCE MATCHING IN HIGH FREQUENCY LINES** **12**

Impedance matching: Quarter wave transformer – Impedance matching by stubs – Single stub and double stub matching – Smith chart – Solutions of problems using Smith chart – Single and double stub matching using Smith chart.

**UNIT IV PASSIVE FILTERS** **12**

Characteristic impedance of symmetrical networks – filter fundamentals, Design of filters: Constant K – Low Pass, High Pass, Band Pass, Band Elimination, m- derived sections – low pass, high pass composite filters.

**UNIT V WAVE GUIDES** **12**

General Wave behaviours along uniform Guiding structures, Transverse Electromagnetic waves, Transverse Magnetic waves, Transverse Electric waves, TM and TE waves between parallel plates, TM and TE waves in Rectangular wave guides, Bessel's differential equation and Bessel function, TM and TE waves in Circular wave guides, Rectangular and circular cavity Resonators.

**Total Periods: 60**

**Text Books**

| | |
|---|---|
| 1 | David M. Pozar, "Microwave Engineering",4th Edition (2011). |
| 2 | Constantine A. Balanis, "Advanced Engineering Electromagnetics",3rd Edition (2024). |

**References:**

| | |
|---|---|
| 1 | Robert E. Collin, "Foundations for Microwave Engineering",2nd Edition (1992). |
| 2 | G. L. Matthaei, Leo Young, E. M. T. Jones,Microwave Filters, Impedance-Matching Networks, and Coupling Structures, Reprint of 1964 / 1980 editions (Artech House). |
| 3 | NPTEL: Advances in UHV Transmission and Distribution,- https://onlinecourses.nptel.ac.in/noc25_ee141/preview |
| 4 | NPTEL: Microwave Engineering & Transmission Line Theory-Introduction to Electromagnetic Theory-https://onlinecourses.nptel.ac.in/noc25_ph41/preview |

**Course Outcomes**

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

| CO | Course Outcome Statement | Knowledge Level |
|---|---|---|
| CO1 | Analyze the behavior of transmission lines under matched and mismatched conditions, including reflection losses and efficiency. | Analyzing |
| CO2 | Evaluate input impedance, power transfer, and VSWR in high-frequency transmission lines. | Evaluating |
| CO3 | Analyze the impedance matching networks using single/double stub techniques and Smith chart. | Analyzing |
| CO4 | Analyze the passive filters (low-pass, high-pass, band-pass, band-stop) and composite filters. | Analyzing |
| CO5 | Analyze the TE, TM, and TEM wave propagation in rectangular and circular waveguides and cavity resonators for microwave applications. | Analyzing |

**CO-PO/PSO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | | | | | 2 | 2 | | 2 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | | | | | 2 | 2 | | 2 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | | | | 2 | 2 | | 2 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | | | | | 2 | 2 | | 2 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | | | | | 2 | 2 | | 2 | 3 | 3 |
| **Avg.** | **3** | **3** | **3** | **3** | | | | **2** | **2** | | **2** | **3** | **3** |

**For CO-PO/PSO Mapping:** 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

| U24EC431 | COMMUNICATION SYSTEMS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

The student should be made to:

- Apply various modulation techniques to generate analog signals.
- Implement noise models for communication systems and their effects on signal transmission and reception.
- Illustrate pulse modulation techniques and their performance in digital communication systems.
- Analyze various digital modulation schemes for the effectiveness under varying channel conditions
- Evaluate various source and error control coding methods to enhance reliability and efficiency in digital communication systems

**Detailed Syllabus**

| Unit No., Title and detailed syllabus |
|---|
| **Unit I: ANALOG MODULATION** **9**<br>Amplitude Modulation Systems-Switching modulator, Envelop detector, DSB- Ring modulator , Coherent detection, Costas Receiver, Quadrature carrier multiplexing , SSB and VSB modulations. Super heterodyne Receiver, Practical AM communication systems Angle Modulation, Representation of FM and PM signals, Generation of FM Signals – Direct method, indirect method, Demodulation of FM Signals. |
| **Unit II: SAMPLING & NOISE MODELLING** **9**<br>Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De-emphasis, Threshold effect in angle modulation. Low pass sampling – Aliasing- Signal Reconstruction-Quantization - Uniform & non-uniform quantization - quantization noise - Nyquist criterion- Logarithmic Companding. |
| **Unit III: PULSE MODULATION AND LINE CODING TECHNIQUES** **9**<br>Pulse Modulation Techniques - PAM, PPM, PWM, Pulse code Modulation, Noise considerations in PCM ,Differential pulse code modulation, Adaptive Differential Pulse Code Modulation, Delta modulation, Adaptive Delta Modulation, Line Coding Techniques. |
| **Unit IV: DIGITAL MODULATION SCHEME** **9**<br>Generation, detection and BER analysis of coherent BPSK, BFSK, QPSK, QAM - Carrier Synchronization - Structure of Non coherent Receivers - Generation and detection of BFSK and DPSK. |
| **Unit V: SOURCE AND ERROR CONTROL CODING** **9**<br>Entropy, Source encoding theorem, Shannon fano coding, Huffman coding, mutual information, channel capacity, Channel coding theorem - Linear Block Codes - Hamming codes - Cyclic codes - Convolutional codes and Viterbi decoding. |

**Total Periods: 45**

**Text Books**

| | |
|---|---|
| 1 | Simon Haykin; Michael Moher; Ganesh Prasad; Kiran Kumar Gurrala; Sateesh Kumar Awasthi; Shravan Kuma, "Introduction to Analog and Digital Communications, 2nd Edition, An Indian Adaptation Paperback- 6 January 2023. |
| 2 | B.P.Lathi, "Modern Digital and Analog Communication Systems", 6th Edition, Oxford University Press, 2025. |

**References**

| | |
|---|---|
| 1 | George Kennedy, Bernard Davis, "Kennedy's Electronic Communication Systems (SIE)", 6th edition, 2017. |
| 2 | B.Sklar, "Digital Communications Fundamentals and Applications", 3rd Edition Pearson Education 2021. |
| 3 | IIT Kanpur- Prof. Aditya Jagannatham, "Principles of Communication Systems", https://nptel.ac.in/courses/108104091 |
| 4 | IIT Guwahati- "Simulation of communication Systems using MATLAB"- https://nptel.ac.in/courses/108103191 |

**Course Outcomes**

| **At the end of the course, the students will be able to** | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge Level** |
| CO1 | Apply various modulation techniques to generate analog signals. | Applying |
| CO2 | Implement noise models for communication systems and their effects on signal transmission and reception. | Evaluating |
| CO3 | Illustrate pulse modulation techniques and their performance in digital communication systems. | Applying |
| CO4 | Analyze various digital modulation schemes for the effectiveness under varying channel conditions | Analyzing |
| CO5 | Evaluate various source and error control coding methods to enhance reliability and efficiency in digital communication systems | Evaluating |

**CO-PO/PSO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | | | | | 2 | 2 | | 2 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | | | | | 2 | 2 | | 2 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | | | | | 2 | 2 | | 2 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | | | | | 2 | 2 | | 2 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | | | | | 2 | 2 | | 2 | 3 | 3 |
| **Avg.** | **3** | **3** | **3** | | | | | **2** | **2** | | **2** | **3** | **3** |

**For CO-PO/PSO Mapping:** 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

| U24EC443 | DIGITAL SIGNAL PROCESSING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 4 |

**COURSE OBJECTIVE:**

- The student should be made to:
- Apply the Discrete Fourier Transform (DFT), analyze its properties, and implement its application to linear filtering.
- Examine the characteristics of digital filters, design and implement digital IIR filters, and apply them to suppress undesirable signals in specified frequency bands.
- Analyze the characteristics of digital filters, design and implement digital FIR filters, and apply them to remove unwanted signals across various frequency bands.
- Evaluate the effects of finite precision representation on the performance of digital filters.
- Analyze adaptive filters and apply them in communication engineering scenarios for noise cancellation and signal enhancement.

**Detailed Syllabus**

| Unit No., Title and detailed syllabus | |
|---|---|
| **Unit I:DISCRETE FOURIER TRANSFORM** | **9** |
| Review of Signals & Systems-Discrete Fourier transform (DFT) - deriving DFT from DTFT-Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT).Linear filtering using DFT. Filtering long data sequences – overlap save and overlap-add method. | |
| **Unit II:INFINITE IMPULSE RESPONSE FILTERS** | **9** |
| Characteristics of commonly used analog filters - Butterworth filters, Chebyshev Type-I filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency transformation in the analog domain. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations. | |
| **Unit III:FINITE IMPULSE RESPONSE FILTERS** | **9** |
| Analyze FIR filters - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations. | |
| **Unit IV:FINITE WORD LENGTH EFFECTS** | **9** |
| Fixed point and floating point number representation - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error – product quantization error - overflow error - limit cycle oscillations due to product quantization and summation. | |
| **Unit V:DSP PROCESSORS** | **9** |
| Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor-DSP Architecture Fixed and Floating point architecture - principles, Instruction Set, Addressing Modes. | |

**List of Experiments**

| Sl. No | List of Experiments |
|---|---|
| **Using MATLAB :** | |
| 1 | Apply the Discrete Fourier Transform (DFT) to analyze Decimation-In-Time FFT and Decimation-In-Frequency FFT. |
| 2 | Compute the spectrum of the signal for the following techniques using the FFT method.<br>i) Spectrum of single Sinusoid<br>ii) Sum of two Sinusoid<br>iii) Resolution<br>iv) Picket Fence effect and<br>v) Spectral Leakage |
| 3 | Implement the program for computing block convolution using overlap save method and overlap Add method. |
| 4 | Analyze signals using Auto correlation and cross correlation techniques to detect the stability test. |
| 5 | Design and evaluate FIR filter realizations using Butterworth and Chebhyshev types and widowing methods. |
| 6 | Design and implement IIR filters using Butterworth and Chebhyshev types. |
| 7 | Explore and apply multirate signal processing through convolution and m-fold decimation by polyphase decomposition. |
| 8 | Implement and assess PSD Estimator and Periodogram Estimation. |
| **TMS320C54X Processor Experiments:** | |
| 9 | Analyze DSP processor architecture to evaluate its role in accelerating real-time audio and video processing applications, such as mobile communication and multimedia devices. |
| 10 | Synthesize and apply standard test signals to simulate biomedical, speech, and radar environments, enabling validation of DSP system performance under practical conditions. |
| 11 | Implement and evaluate multiply–accumulate (MAC) operations with addressing techniques . |
| | **Total Periods: 75** |

**Text Books**

| | |
|---|---|
| 1 | John G. Proakis & Dimitris G.Manolakis, ―Digital Signal Processing – Principles, Algorithms & Applications, Fifth Edition, Pearson Education / Prentice Hall, 2021. |
| 2 | Maurice Bellanger-Digital Signal Processing: Theory and Practice, Tenth Edition, Wiley Publications,2024 |

**References**

| | |
|---|---|
| 1 | P. P. Vaidyanathan-Signals, Systems, and Signal Processing-1st Edition (2024),Cambridge University Press. |
| 2 | Andreas Antoniou- Digital Filters: Analysis, Design, and Signal Processing Applications,2nd Revised Edition,Mcgraw-Hill,2018. |

| | |
|---|---|
| 3 | IIT Delhi- Prof. S.C. Dutta Roy, "Digital Signal Processing Introduction"- https://nptel.ac.in/courses/117102060 |
| 4 | IIT Bombay- Prof. V. M. Gadre, "Digital Signal Processing and its Applications"- https://onlinecourses.nptel.ac.in/noc24_ee16/preview |

**Course Outcomes**

| **At the end of the course, the students will be able to** | | |
|---|---|---|
| CO | **Course Outcome Statement** | **Knowledge Level** |
| CO1 | Apply DFT for the analysis of digital signals and systems. | Applying |
| CO2 | Examine the characteristics of IIR Filters. | Analyzing |
| CO3 | Analyze FIR Filter structures. | Analyzing |
| CO4 | Compute the effects of finite representation on digital filters. | Applying |
| CO5 | Estimate Multi-Rate Signal Processing. | Evaluating |

**CO-PO/PSO Mapping**

| **CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | | | 2 | 2 | 2 | 2 | 2 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | | | 2 | 2 | 2 | 2 | 2 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | | | 2 | 2 | 2 | 2 | 2 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | | | 2 | 2 | 2 | 2 | 2 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | | 2 | 2 | 2 | 2 | 2 | 3 | 3 |
| **Avg.** | **3** | **3** | **3** | **3** | **3** | | **2** | **2** | **2** | **2** | **2** | **3** | **3** |

**For CO-PO/PSO Mapping:** 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

| U24EC453 | INTERNET OF THINGS | L | T | P | C |
|---|---|---|---|---|---|
| | | 1 | 0 | 4 | 3 |

**COURSE OBJECTIVE:**

The student should be made to:

- Analyze the architecture, components, and characteristics of IoT systems and their applications.
- Examine the hardware and software features of Arduino and Raspberry Pi for IoT-based implementations.
- Evaluate the operation and interfacing of various sensors used in IoT environments.
- Analyze and implement sensor integration using Arduino and Raspberry Pi with appropriate communication protocols.
- Analyze real-time IoT case studies and assess the potential of IoT solutions in various application domains

**Detailed Syllabus**

| Unit No., Title and detailed syllabus | |
|---|---|
| **Unit I: INTRODUCTION TO IOT & ARDUINO**<br>Introduction to IoT – Fundamentals and characteristics of IoT - IoT architecture and components - Applications and challenges of IoT - Introduction to Arduino board and features - Arduino programming environment and basic syntax. | **3** |
| **Unit II: RASPBERRY PI**<br>Introduction to Raspberry Pi board and models - Hardware architecture and GPIO pins - Installing and configuring Raspbian OS - Basics of Python programming for Raspberry Pi - Interfacing input/output devices with Raspberry Pi. | **3** |
| **Unit III: SENSORS**<br>Introduction and need for sensors in IoT - Classification of sensors – active and passive - - Analog and digital sensors – working principles - Ultrasonic sensor: operation and interfacing - Temperature and humidity sensor: operation and interfacing. | **3** |
| **Unit IV: SENSOR INTEGRATION AND CLOUD PLATFORM**<br>Sensor data acquisition using Arduino & Raspberry Pi - Data communication protocols – MQTT & HTTP - IoT cloud platforms Overview: ThingSpeak, Blynk, AWS IoT - Uploading sensor data to cloud - Real-time monitoring and data visualization. | **3** |
| **Unit V: CASE STUDIES**<br>Smart home automation using IoT - Smart city applications and traffic monitoring - IoT-based environmental monitoring system - Smart agriculture and irrigation system - Industrial IoT applications - Future trends and challenges in IoT. | **3** |

**List of Experiments**

| Sl. No | List of Experiments |
|---|---|
| 1 | Develop a program on the Arduino platform to control an LED. |
| 2 | Control an LED or relay using Python on Raspberry Pi. |
| 3 | Interfacing sensors with Arduino. |
| 4 | Interfacing sensors with Raspberry Pi. |

| | |
|---|---|
| 5 | Setup a cloud platform to log the data. |
| 6 | **Mini Projects: Design an IOT based system.**<br>1. Smart Home Automation using IoT<br>2. IoT-based Smart Agriculture System<br>3. IoT-based Environmental Monitoring System<br>4. IoT-based Smart Parking System<br>5. IoT-based Industrial Application System<br>6. IoT-based EV Charging & Fleet Monitoring System |
| | **Total Periods: 75** |

**Text Books**

| | |
|---|---|
| 1 | Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-On Approach", Universities Press / VPT Publication, 2nd Edition, 2021. |
| 2 | Bharat Bhushan, "Internet of Things: Technologies and Applications for a New Age of Intelligence", Elsevier Publication,2nd Edition, 2024 |

**References**

| | |
|---|---|
| 1 | Peter Waher, " Mastering the Internet of Things: Design and Deploy Solutions Using IoT Platforms" ,Packt Publishing,2nd Edition, 2023 |
| 2 | David Hanes et al., "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press, First Edition 2022. |
| 3 | IIT Kharagpur- Prof.Sudip Misra, " Introduction to Internet of Things"- https://nptel.ac.in/courses/106105166 |
| 4 | IIT Patna- Prof. Sanjoy Kumar Parida , "Components and Applications of Internet of Things" - https://onlinecourses.swayam2.ac.in/arp19_ap52/preview |

**Course Outcomes**

| **At the end of the course, the students will be able to** | | |
|---|---|---|
| **CO** | **Course outcome Statement** | **Knowledge Level** |
| CO1 | Analyze an IoT system architecture by integrating hardware and software components for real-world applications. | Analyzing |
| CO2 | Create IoT devices with Raspberry Pi and Python Programming. | Creating |
| CO3 | Integrate multiple sensors with Arduino and Raspberry Pi using appropriate communication protocols to create functional IoT prototypes. | Evaluating |
| CO4 | Develop cloud-enabled IoT systems for real-time data monitoring and visualization. | Creating |
| CO5 | Design IoT-based solutions for domains such as smart homes, agriculture, industries, and environment monitoring. | Creating |

**CO-PO/PSO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | | | 2 | 3 | 3 | | 2 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 |
| **Avg.** | **3** | **3** | **3** | **3** | **3** | **3** | **2** | **3** | **3** | **3** | **2** | **3** | **3** |

**For CO-PO/PSO Mapping:** 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

| U24EM411 | APTITUDE AND REASONING – I | L | T | P | C |
|---|---|---|---|---|---|
| | | 1 | 0 | 0 | 1 |

**Course Objective:**

- Enhance analytical and logical reasoning skills to solve problems efficiently.
- Strengthen understanding of basic arithmetic, algebra, geometry, and data interpretation.
- Train students to approach problems systematically and apply suitable techniques.
- Foster quick thinking and reduce error rates through practice and time-bound exercises.

**Syllabus**

| Topic titles | No of periods |
|---|---|
| **Quantitative aptitude**<br>• Numbers: Number series, arithmetic progression, geometric progression<br>• HCF and LCM: Highest common factor – split method, division method, Least Common Multiples – prime factor method, division method.<br>• Simplification – BODMAS rule<br>• Average and Percentage<br>• Simple and Compound Interest<br>• Profit, loss and discounts<br>• Ratio and proportion: Ratio – compound ratio, inverse ratio. Proportion – direct proportion, inverse proportion<br>• Mixture and alligation: Mixture, alligation, mean concentration<br>• Problems based on ages<br>• Partnerships: Simple partnership, compound partnership | 20 |
| **Reasoning:**<br>• Number series and letter series<br>• Odd one out<br>• Coding and decoding<br>• Missing characters/numbers and analogies<br>• Blood relations problems<br>• Direction sense tests<br>• Sequencing and ranking test | 10 |

**References**


| | |
|---|---|
| 1 | R.V. Praveen, "Quantitative Aptitude and Reasoning", 3rd Edition , Eastern Economy Edition, PHI Learning, New Delhi, 2016 |
| 2 | Dr. R.S. Aggarwal, " Quantitative Aptitude", S Chand Publishing, New Delhi 2017 |
| 3 | Dr. R.S. Aggarwal, "A Modern Approach to Verbal & Non-Verbal Reasoning", S Chand Publishing, New Delhi 2017 |
| 4 | https://www.indiabix.com/ |
| 5 | https://www.geeksforgeeks.org/ |
| 6 | https://faceprep.in/ |
| 7 | https://prepinsta.com/ |

| | |
|---|---|
| 8 | https://www.javatpoint.com/ |

**Course Outcomes**

| At the end of the course, the students will be able to | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge Level** |
| CO1 | Solve quantitative aptitude problems involving arithmetic, algebra, percentages, ratios, etc., using logical approaches. | Applying |
| CO2 | Analyze problems and apply reasoning strategies such as deduction, inference, and pattern recognition. | Analysing |
| CO3 | Solve problems in simple and compound interest, profit, loss and discount | Applying |
| CO4 | Solve problems based on ages and partnership | Applying |
| CO5 | Demonstrate improved performance in time-bound aptitude tests through consistent practice. | Applying |

**CO-PO/PSO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | | | | | | | 2 | 1 | | 2 | | |
| **CO2** | | | | | | | | 2 | 1 | | 2 | | |
| **CO3** | | | | | | | | 2 | 1 | | 2 | | |
| **CO4** | | | | | | | | 2 | 1 | | 2 | | |
| **CO5** | | | | | | | | 2 | 1 | | 2 | | |
| **Avg.** | | | | | | | | 2 | 1 | | 2 | | |

**For CO-PO/PSO Mapping:**3 – Substantial (High), 2– Moderate (Medium), 1– Slight (Low)

| U24EC462 | ANALOG INTEGRATED CIRCUITS LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |

**COURSE OBJECTIVE:**

The student should be made to:

- Demonstrate the characteristics of amplifiers and filters using operational amplifiers.
- Analyze the characteristics of multivibrators through circuit evaluation.
- Implement wave-shaping circuits using ICs for practical applications.
- Evaluate the functionality of special function ICs in electronic systems.
- Apply PSPICE software for circuit design and verification

**List of Experiments**

| Sl. No. | List of Experiments |
|---|---|
| 1. | Design and test Inverting, Non-Inverting and Differential Amplifiers. |
| 2 | Develop an instrumentation amplifier to measure the output. |
| 3 | Implement an integrator circuit to generate a triangular wave from a square wave, and a differentiator to detect sharp edges in pulse signals. |
| 4 | Design a low-pass filter to remove high-frequency noise from an audio input, and a high-pass filter to pass only treble sounds. |
| 5 | Design and implement Astable and Monostable Multivibrators. |
| 6 | Apply a Schmitt Trigger to convert a noisy sine wave into a clean digital square wave |
| 7 | Design a regulated 5V DC power supply to operate digital ICs. |
| 8 | Construct an R-2R ladder DAC to generate a staircase waveform for simple digital-to-analog conversion. |
| **Simulation Experiments:** | |
| 1 | Measurement and verification of Inverting, Non-Inverting and Differential Amplifiers. |
| 2 | Implementation of Integrator and Differentiator |
| 3 | Determine the cutoff frequency by measuring output amplitude at different input frequencies. |
| 4 | Measure the output frequency of Astable and Monostable Multivibrators. |
| 5 | Record the Output voltage of Schmitt Trigger and note the hysteresis effect. |
| **Total Periods: 60 Periods** | |

**Text Books**

| | |
|---|---|
| 1 | Roy Choudhry D and Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 4th Edition, 2018. |
| 2 | Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", Tata McGraw-Hill, 4th Edition, 2015. |

**References**

| | |
|---|---|
| 1 | Ramakant A Gayakwad, "Op-Amp and Linear ICs", Prentice Hall I Pearson Education, 4th Edition, 2015 |
| 2 | Salivahanan S and Kanchana Bhaskaran VS, "Linear Integrated Circuits", Tata McGraw Hill, 2nd Edition, 61h Reprint, 2010. |
| 3 | IIT Madras- Prof. Nagendra Krishnapura- "Analog Integrated Circuit Design" - - http://www.digimat.in/nptel/courses/video/117106030/L28.html |


**Course Outcomes**

| At the end of the course, the students will be able to | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge Level** |
| CO1 | Analyze the characteristics of amplifiers and filters using operational amplifiers. | Analyzing |
| CO2 | Analyze the characteristics of multivibrators through circuit evaluation. | Analyzing |
| CO3 | Implement wave-shaping circuits using ICs for practical applications. | Applying |
| CO4 | Evaluate the functionality of special function ICs in electronic systems. | Evaluating |
| CO5 | Apply PSPICE software for circuit design and verification. | Applying |

**CO-PO/PSO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | | | 2 | 2 | 2 | | | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | | | 2 | 2 | 2 | | | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | | | 2 | 2 | 2 | | 2 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | | | 2 | 2 | 2 | | 2 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 |
| **Avg.** | **3** | **3** | **3** | **3** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **3** | **3** |

**For CO-PO/PSO Mapping:** 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

| U24EC472 | COMMUNICATION SYSTEMS LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |

**COURSE OBJECTIVE:**

The student should be made to:

- Demonstrate AM and FM modulation and demodulation techniques.
- Illustrate the effects of sampling and Time Division Multiplexing (TDM).
- Apply the concepts of Pulse Code Modulation (PCM) and digital modulation.
- Simulate various digital modulation schemes using appropriate tools.
- Implement equalization algorithms and error control coding schemes.

**List of Experiments**

| Sl. No | List of Experiments |
|---|---|
| 1 | Apply the concept of Amplitude modulation and process by using envelope detection for recovering the original message. |
| 2 | Apply the FM modulation and demodulation technique to transmit and retrieve the information signal. |
| 3 | Implementing the pre-emphasis and de-emphasis circuit to improve the signal-to-noise ratio. |
| 4 | Apply the sampling theorem for continuous-time signals. |
| 5 | Demonstrate the multiplexing of multiple signals using TDM technique. |
| 6 | Demonstrate the encoding and decoding of an analog signal using PCM. |
| 7 | Apply a modulation and demodulation method using PAM. |
| 8 | Apply a modulation and demodulation method using PWM and PPM. |
| **Simulation Experiments:** | |
| 9 | Implement ASK, PSK and FSK modulation and demodulation schemes for digital data transmission. |
| 10 | Demonstrate the simulation of DPSK, QPSK, and QAM modulated signals. |
| 11 | Implement a linear block coding scheme and its error detection capability. |
| 12 | Apply cyclic coding techniques for error correction in a digital system |
| **Total Periods: 60** | |

**Text Books**

| | |
|---|---|
| 1 | Simon Haykin; Michael Moher; Ganesh Prasad; Kiran Kumar Gurrala; Sateesh Kumar Awasthi; Shravan Kuma, "Introduction to Analog and Digital Communications, 2nd Edition, An Indian Adaptation Paperback- 6 January 2023. |
| 2 | B.P.Lathi, "Modern Digital and Analog Communication Systems", 6th Edition, Oxford University Press, 2025. |

**References**


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|---|---|
| 1 | George Kennedy, Bernard Davis, "Kennedy's Electronic Communication Systems (SIE)", 6th edition, 2017. |
| 2 | B.Sklar, "Digital Communications Fundamentals and Applications", 3rd Edition Pearson Education 2021. |
| 3 | IIT Kanpur- Prof. Aditya Jagannatham, "Principles of Communication Systems", https://nptel.ac.in/courses/108104091 |
| 4 | IIT Guwahati- "Simulation of communication Systems using MATLAB"- https://nptel.ac.in/courses/108103191 |


**Course Outcomes**

| At the end of the course, the students will be able to | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge Level** |
| CO1 | Demonstrate the process of AM and FM modulation and demodulation in communication systems. | Applying |
| CO2 | Illustrate the practical effects of sampling and Time Division Multiplexing. | Applying |
| CO3 | Apply the principles of Pulse Code Modulation and digital modulation techniques. | Applying |
| CO4 | Simulate digital modulation schemes using appropriate simulation tools. | Applying |
| CO5 | Implement equalization algorithms and error control coding schemes in digital communication systems. | Applying |

**CO-PO/PSO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | | | | 2 | 2 | 2 | | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | | | | 2 | 2 | 2 | | | 3 | 3 |
| **CO3** | 3 | 3 | 3 | | | | 2 | 2 | 2 | | | 3 | 3 |
| **CO4** | 3 | 3 | 3 | | 3 | | 2 | 2 | 2 | | | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | | 2 | 2 | 2 | 2 | 3 | | 3 | 3 |
| **Avg.** | **3** | **3** | **3** | **3** | **3** | **2** | **2** | **2** | **2** | **3** | **3** | **3** | **3** |

**For CO-PO/PSO Mapping:** 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

| U24EM422 | SOFT SKILLS AND PERSONALITY DEVELOPMENT – I | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |

**Course Objective:**

- To understand and interpret human perception and behavior, enhancing interpersonal awareness.
- To enhance self-management, including habit formation, stress regulation, and personal productivity
- Develop conflict-resolution skills, aiming for win-win outcomes through structured strategies.
- Strengthen communication abilities—active listening, telephone etiquette, and overcoming listening barriers.

**List of Exercises**

| Sl. No. | List of Exercises |
|---|---|
| 1 | Introduction: A New Approach to Learning, Planning and Goal-Setting |
| 2 | Human Perceptions: Understanding People |
| 3 | Aiming for Excellence: Developing Potential and Self-Actualisation |
| 4 | Self-Management Skills- Time management & Self-motivation |
| 5 | Self-Management Skills- Stress management & Adaptability |
| 6 | Conflict Resolution Skills |
| 7 | Using The Zeigarnik Effect for Productivity and Personal Growth, Forming Habits of Success |
| 8 | Communication: Significance of Listening, Active Listening, Barriers to Active Listening |
| 9 | Telephone Communication: Basic Telephone Skills, Advanced Telephone Skills , Essential Telephone Skills |
| 10 | Profile Building |
| | **Total Periods: 30** |

**Text Books**

| | |
|---|---|
| 1 | Dorch, Patricia. What Are Soft Skills? New York: Execu Dress Publisher, 2013. |
| 2 | Kamin, Maxine. Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders. Washington, DC: Pfeiffer & Company, 2013. |

**Reference Books**

| | |
|---|---|
| 1 | Klaus, Peggy, Jane Rohman & Molly Hamaker. The Hard Truth about Soft Skills. London: HarperCollins E-books, 2007. |
| 2 | Petes S. J., Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw-Hill Education, 2011. |

**Course Outcomes**

| At the end of the course, the students will be able to | | |
|---|---|---|
| **CO** | **Course Outcome Statement** | **Knowledge Level** |
| CO1 | Develop an actionable growth plan aligning self-development with objectives. | Applying |
| CO2 | Analyze the habit loop; design personal interventions to break bad habits. | Analysing |
| CO3 | Analyze examples of interpersonal conflict, propose dual solutions using conflict-model frameworks. | Analysing |
| CO4 | Apply stress-management strategies: reframing, planning, relaxation exercises. | Applying |
| CO5 | Apply techniques to rectify the barriers in active listening | Applying |

**CO-PO/PSO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | | | | | | | 1 | 2 | | 2 | | |
| **CO2** | | | | | | | | 1 | 2 | | 2 | | |
| **CO3** | | | | | | | | 1 | 2 | | 2 | | |
| **CO4** | | | | | | | | 1 | 2 | | 2 | | |
| **CO5** | | | | | | | | 1 | 2 | | 2 | | |
| **Avg.** | | | | | | | | 1 | 2 | | 2 | | |

**For CO-PO/PSO Mapping:** 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)