JEPPIAAR INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

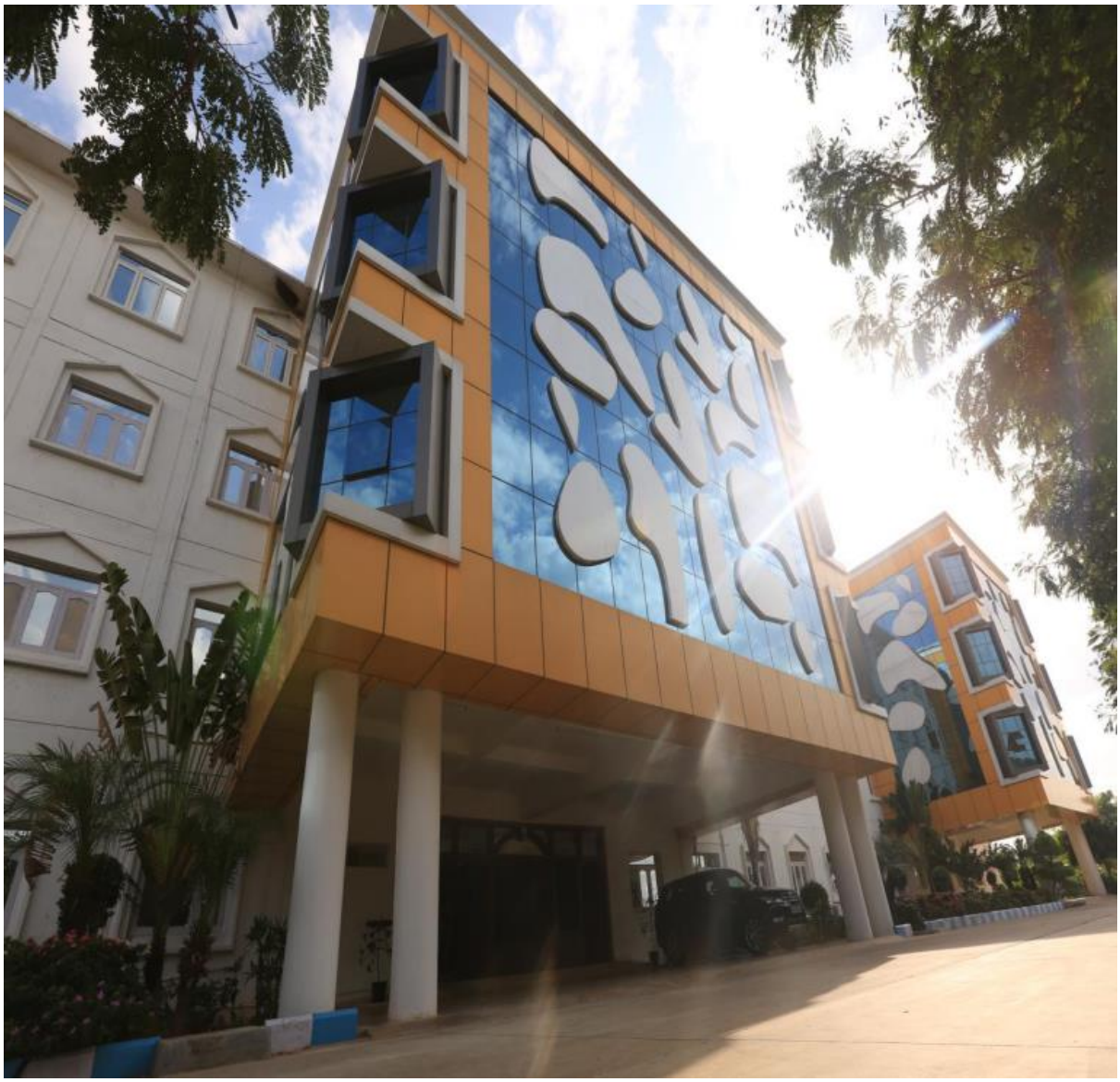
Self-Belief | Self Discipline | Self Respect

Kunnam, Sunguvarchatram, Sriperumbudur-631604

# DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

## AUTONOMOUS SYLLABUS

## REGULATION 2024



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# DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

## AUTONOMOUS CURRICULUM & SYLLABUS R2024

## CHOICE BASED CREDIT SYSTEM

# VISION AND MISSION OF THE INSTITUTION

## VISION

- Jeppiaar Institute of Technology aspires to provide technical education in futuristic technologies with the perspective of innovative, industrial, and social applications for the betterment of humanity.

## MISSION

- To produce competent and disciplined high-quality professionals with the practical skills necessary to excel as innovative professionals and entrepreneurs for the benefit of society.
- To improve the quality of education through excellence in teaching and learning, research, leadership, and by promoting the principles of scientific analysis, and creative thinking.
- To provide excellent infrastructure, serene, and stimulating environment that is most conducive to learning.
- To strive for productive partnership between the Industry and the Institute for research and development in the emerging fields and creating opportunities for employability.
- To serve the global community by instilling ethics, values, and life skills among the students needed to enrich their lives.

# VISION AND MISSION OF THE DEPARTMENT

## VISION

- To enhance and impart futuristic and innovative technological education for the excellence of Electronics and Communication Engineering with new ideas and innovation to meet industrial expectation and social needs with ethical and global awareness reinforced by an efficiency through research platform for the advancement of humanity.

## MISSION

- M1: To produce competent and high-quality professional Engineers in the field of Electronics and Communication Engineering for the benefit of the society globally.
- M2: To provide a conducive infrastructure and environment for faculty and students with enhanced laboratories, to create high quality professionals.
- M3: To provide Prerequisite Skills in multidisciplinary areas for the needs of Industries, higher education and research establishments and entrepreneurship.
- M4: To handle Socio Economic Challenges of Society by Imparting Human Values and Ethical Responsibilities. Imparting Human Values and Ethical Responsibilities to handle Socio Economic Challenges of Society.

## PROGRAMME EDUCATIONAL OBJECTIVES

- PEO 1: Graduate Engineers will have knowledge and skills required for employment and an advantage platform for lifelong learning process.
- PEO 2: Graduate Engineers will be provided with futuristic education along with the perspective research and application based on global requirements.

- ❖ PEO 3: Graduate Engineers will have effective communication skills and work in multidisciplinary team.

- ❖ PEO 4: Graduate Engineers will develop entrepreneurship skills and practice the profession with integrity, leadership, ethics and social responsibility.

**PROGRAM OUTCOMES**

**Engineering Graduates will be able to:**

1. **Engineering knowledge:** (K3) Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** (K4) Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** (K4) Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** (K5) Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** (K3, K5, K6) Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** (A3) Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** (A2) Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** (A3) Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** (A3) Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** (A3) Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** (A3) Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** (A2) Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**PROGRAM SPECIFIC OUTCOMES**

**PSO 1:** Ability to develop and utilize novel, compact and power efficient coherent theoretical and practical methodologies in the field of analog and digital electronics.

**PSO 2:** Ability to implement analog, digital and hybrid communication Protocol to aspect the challenges in the field of Telecommunication and Networking.

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# DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

## AUTONOMOUS CURRICULUM R2024 (CBCS)

| SEMESTER - I | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **S.No** | **Course Code** | **Course Title** | **Category** | **Periods** | | | **Credits** | **CIE** | **SEE** | **TOTAL** |
| | | | | L | T | P | | | | |
| 1 | AIP001 | Induction Programme | - | - | - | - | 0 | - | - | - |
| **THEORY** | | | | | | | | | | |
| 2 | AMA101 | Matrices and Calculus | BS | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 3 | AEC101 | Basic Electrical Engineering | ES | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 4 | AEC102 | Semiconductor Devices | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 5 | ACS102 | Python Programming | ES | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 6 | AMC101 | Employment Enhancement Skills | MC | 2 | 0 | 0 | 0 | - | - | 100 |
| 7 | AMC102 | Professional Ethics and Human Values | MC | 2 | 0 | 0 | 0 | - | - | 100 |
| **PRACTICALS** | | | | | | | | | | |
| 8 | AEC301 | Basic Electrical Engineering Laboratory | ES | 0 | 0 | 4 | 2 | 60 | 40 | 100 |
| 9 | ACS301 | Python Programming Laboratory | ES | 0 | 0 | 4 | 2 | 60 | 40 | 100 |
| 10 | AHS301 | Communication Skills and Technical Writing | HS | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 11 | AEEC301 | Mini Project/Professional Practices | EEC | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| | | | **Total** | 16 | 1 | 12 | 19 | | | |

| SEMESTER - II | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **S.No** | **Course Code** | **Course Title** | **Category** | **Periods** | | | **Credits** | **CIE** | **SEE** | **TOTAL** |
| | | | | **L** | **T** | **P** | | | | |
| **THEORY** | | | | | | | | | | |
| 1 | AMA103 | Mathematics for Electronics Engineers | BS | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 2 | APH101 | Computational Physics | BS | 3 | 0 | 0 | 3 | 40 | 60 | 100 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 | AAI101 | Introduction to Data Science | ES | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 4 | AEC104 | Electronic Circuits | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 5 | AEC105 | Digital Electronics | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 6 | AHS101 | Language Enhancement | HS | 1 | 0 | 0 | 1 | 40 | 60 | 100 |
| 7 | AMC103 | Indian Constitution | MC | 2 | 0 | 0 | 0 | - | - | 100 |
| **PRACTICALS** | | | | | | | | | | |
| 8 | AEC303 | Electronic Circuits Laboratory | PC | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 9 | AEC304 | Digital Electronics Laboratory | PC | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 10 | APH301 | Computational Physics Laboratory | BS | 0 | 0 | 4 | 2 | 60 | 40 | 100 |
| 11 | AMC301 | Yoga and Happy Living | MC | 0 | 0 | 3 | 0 | - | - | 100 |
| 12 | AEEC302 | Mini Project/Professional Practices | EEC | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| | | | **Total** | 18 | 1 | 13 | 22 | | | |

**SEMESTER - III**

| S.No | Course Code | Course Title | Category | Periods | | | Credits | CIE | SEE | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | | | |
| **THEORY** | | | | | | | | | | |
| 1 | AMA104 | Transforms and Partial Differential Equations | BS | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 2 | AEC106 | Signals and Systems | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 3 | AEC107 | Control Systems | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 4 | AEC108 | Electromagnetic Fields | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 5 | AEC109 | Microprocessor and Microcontroller | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 6 | AEC110 | Analog and Digital Communication | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 7 | AMC104 | Environmental Engineering and Sustainability | MC | 2 | 0 | 0 | 0 | - | - | 100 |
| **PRACTICALS** | | | | | | | | | | |
| 8 | AHS302 | Soft Skills I | HS | 0 | 0 | 2 | 0 | 60 | 40 | 100 |
| 9 | AEC305 | Microprocessor and Microcontroller Laboratory | PC | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 10 | AEC306 | Analog and Digital Communication Laboratory | PC | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 11 | AEEC303 | Mini Project/Professional Practices | EEC | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| | | | **Total** | 20 | 1 | 8 | 22 | | | |

| SEMESTER - IV | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **S.No** | **Course Code** | **Course Title** | **Category** | **Periods** | | | **Credits** | **CIE** | **SEE** | **TOTAL** |
| | | | | **L** | **T** | **P** | | | | |
| **THEORY** | | | | | | | | | | |
| 1 | AEC111 | Embedded Systems and IoT Design | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 2 | AEC112 | Digital Signal Processing | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 3 | AEC113 | Transmission Lines and RF Systems | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 4 | AEC114 | Linear Integrated Circuits | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **PRACTICALS** | | | | | | | | | | |
| 5 | AHS303 | Soft Skills II | HS | 0 | 0 | 2 | 0 | 60 | 40 | 100 |
| 6 | AEC307 | Embedded Systems and IoT Design Laboratory | PC | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 7 | AEC308 | Digital Signal Processing Laboratory | PC | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 8 | AEC309 | Linear Integrated Circuits Laboratory | PC | 0 | 0 | 4 | 2 | 60 | 40 | 100 |
| 9 | AEEC304 | Mini Project/Professional Practices/Internship | EEC | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| | | | **Total** | 12 | 0 | 12 | 17 | | | |

| SEMESTER - V | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **S.No** | **Course Code** | **Course Title** | **Category** | **Periods** | | | **Credits** | **CIE** | **SEE** | **TOTAL** |
| | | | | **L** | **T** | **P** | | | | |
| **THEORY** | | | | | | | | | | |
| 1 | AEC115 | VLSI Design | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 2 | AEC116 | Antennas and Wave Propagation | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 3 | | Professional Elective 1 | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **PRACTICALS** | | | | | | | | | | |
| 4 | AEC310 | VLSI Design Laboratory | PC | 0 | 0 | 4 | 2 | 60 | 40 | 100 |
| 5 | AEEC305 | Mini Project/Professional Practices | EEC | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| | | | **Total** | 9 | 0 | 6 | 12 | | | |

| SEMESTER - VI | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **S.No** | **Course Code** | **Course Title** | **Category** | **Periods** | | | **Credits** | **CIE** | **SEE** | **TOTAL** |
| | | | | **L** | **T** | **P** | | | | |
| **THEORY** | | | | | | | | | | |
| 1 | AEC117 | Wireless Communication | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | | Professional Elective 2 | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 3 | | Professional Elective 3 | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 4 | | Open Elective 1 | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **PRACTICALS** | | | | | | | | | | |
| 5 | AEEC306 | Mini Project/Professional Practices/Internship | EEC | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| | | | **Total** | 12 | 0 | 2 | 13 | | | |

**SEMESTER - VII**

| S.No | Course Code | Course Title | Category | Periods | | | Credits | CIE | SEE | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | | | |
| **THEORY** | | | | | | | | | | |
| 1 | AEC118 | Computer Vision | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 2 | | Professional Elective 4 | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 3 | | Professional Elective 5 | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 4 | | Open Elective 2 | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 5 | | Open Elective 3 | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **PRACTICALS** | | | | | | | | | | |
| 6 | AEC311 | Computer Vision Laboratory | PC | 0 | 0 | 4 | 2 | 60 | 40 | 100 |
| 7 | AEC312 | Project I | EEC | 0 | 0 | 10 | 5 | 60 | 40 | 100 |
| 8 | AEEC307 | Internship/Professional Practices | EEC | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| | | | **Total** | 15 | 0 | 16 | 23 | | | |

**SEMESTER - VIII**

| S.No | Course Code | Course Title | Category | Periods | | | Credits | CIE | SEE | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | | | |
| **THEORY** | | | | | | | | | | |
| 1 | | Professional Elective 6 | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 2 | | Professional Elective 7 | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **PRACTICALS** | | | | | | | | | | |
| 3 | AEC313 | Project II | EEC | 0 | 0 | 10 | 5 | 60 | 40 | 100 |
| 4 | AEEC307 | Internship/Professional Practices | EEC | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| | | | **Total** | 6 | 0 | 12 | 12 | | | |

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# DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

## AUTONOMOUS SYLLABUS R2024

## CHOICE BASED CREDIT SYSTEM

# SEM – I

| AMA101 - MATRICES AND CALCULUS | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **1** | **BS** | **3** | **1** | **0** | **4** |
| Preamble | ➢ Introduce the matrix techniques and to explain the nature of the matrix.<br>➢ Provide the necessary basic concepts of a few numerical methods and give procedures for solving numerically different kinds of problems occurring in Engineering and Technology.<br>➢ Familiarize the students with differential calculus.<br>➢ Understand techniques of calculus which are applied in the Engineering problems.<br>➢ Acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications | | | | | | |
| **Unit 1** | **MATRICES** | | | | | | **9+3** |
| Matrices - Eigen values and eigenvectors - Diagonalization of matrices using orthogonal transformation – Cayley Hamilton Theorem (without proof) - Quadratic forms - Reduction to canonical form using orthogonal transformation | | | | | | | |
| **Unit 2** | **SOLUTION OF LINEAR SYSTEM OF EQUATIONS AND EIGENVALUE PROBLEMS** | | | | | | **9+3** |
| Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Gauss Seidel iterative method - Matrix Inversion by Gauss Jordan method - Eigen values of a matrix by Power method – Jacobi method. | | | | | | | |
| **Unit 3** | **DIFFERENTIAL CALCULUS** | | | | | | **9+3** |
| Limit of a function-Continuity-Derivatives-Differentiation rules (sum, product, quotient, chain rules)-Implicit Differentiation-Logarithmic Differentiation-Applications: Maxima and Minima of functions of one variable | | | | | | | |
| **Unit 4** | **INTEGRAL CALCULUS** | | | | | | **9+3** |
| Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions – Improper integrals. | | | | | | | |
| **Unit 5** | **MULTIPLE INTEGRALS** | | | | | | **9+3** |
| Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids –Change of variables in double and triple integrals – Applications: Moments and centres of mass, moment of inertia. | | | | | | | |
| | | | | | | | **Total: 60** |
| **TEXTBOOKS** | | | | | | | |
| 1 | Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43rd Edition, 2014. | | | | | | |
| 2 | Erwin Kreyszig ," Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016 | | | | | | |
| 3 | Grewal. B.S., and Grewal. J.S., Numerical methods in Engineering and Science, Khanna Publishers, 9th Edition, New Delhi, 2001. | | | | | | |
| **REFERENCES** | | | | | | | |

| | |
|---|---|
| 1 | Ramana. B.V., " Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2018. |
| 2 | N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008 |

| **COURSEOUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Demonstrate the matrix techniques in solving the related problems in engineering and technology. | K4 |
| CO2 | Apply matrix methods to solve system of linear equations | K3 |
| CO3 | Apply differential calculus tools in solving various application problems | K3 |
| CO4 | Apply different methods of integration in solving practical problems. | K3 |
| CO5 | Evaluate multiple integrals to conduct investigations of complex problems | K5 |

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

## AEC101 - BASIC ELECTRICAL ENGINEERING

| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| | | **1** | **ES** | **3** | **0** | **0** | **3** |

| | |
|---|---|
| Preamble | This course provides the foundation for understanding various aspects of electrical engineering. From the basics of circuit theory to the AC, DC Machines, this subject delves into the heart of electrical systems. |

| **Unit – I** | **DC ELECTRICAL CIRCUITS** | **9** |
|---|---|---|

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state)

| **Unit – II** | **AC ELECTRICAL CIRCUITS** | **9** |
|---|---|---|

Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only)

| **Unit – III** | **DC ELECTRICAL MACHINES** | **9** |
|---|---|---|

Construction and Working principle- DC Separately and Self-excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications.

| Unit – IV | AC ELECTRICAL MACHINES | 9 |
|---|---|---|
| Construction, Working principle and Applications of Transformer, Three phase Alternator, Synchronous motor and Three Phase Induction Motor. | | |
| **Unit – V** | **MEASUREMENTS AND INSTRUMENTATION** | **9** |
| Functional elements of an instrument, Standards and calibration, Operating Principle, types -Moving Coil and Moving Iron meters, Measurement of three-phase power, Energy Meter, Instrument Transformers-CT and PT, DSO- Block diagram- Data acquisition. | | |
| | | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | S.K.Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, Second Edition, 2017. |
| 2. | S. Salivahanan, "Basic Electrical Engineering", McGraw Hill Education, First Edition, 2018 |

**REFERENCES:**

| | |
|---|---|
| 1. | Kothari DP and I.J Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw Hill Education, 2019. |
| 2. | Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Compute the DC electric circuit parameters for simple problems. | K4 |
| CO2 | Compute the AC electric circuit parameters for simple problems. | K4 |
| CO3 | Explain the working principle and applications of DC electrical machines. | K2 |
| CO4 | Explain the working principle and applications of AC electrical machines. | K2 |
| CO5 | Explain the operating principles of measuring instruments | K2 |

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

## AEC102 - SEMICONDUCTOR DEVICES

| Programme & Branch | BE & ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | 1 | PC | 3 | 0 | 0 | 3 |

| Preamble | The goal is to develop a solid understanding of the device concepts that will be needed in a broad range of areas from semiconductor to circuit (analog, digital and VLSI) design and engineering. | |
|---|---|---|
| **Unit – I** | **Electrons and Holes in Silicon** | **9** |
| Energy bands in Silicon, n-Type and p-Type silicon, Carrier Transport in Silicon, Basic Equation for Device Operation. | | |
| **Unit – II** | **P-N Junctions** | **9** |
| Energy–band Diagrams for a p-n diode, Abrupt Junction, The Diode Equation, Current-Voltage Characteristics, Time-dependent and Switching Characteristics, Diffusion Capacitance. | | |

| Unit – III | Fundamentals of BJT | 9 |
|---|---|---|
| NPN, PNP, Junctions, Input and Output Characteristics of Common Emitter, Common Base, Common Collector Amplifiers. | | |
| **Unit – IV** | **JFET** | **9** |
| Basic Concepts, Device Characteristics: Input/Output Characteristics, transfer characteristics, Transconductance, Pinch off Voltage. | | |
| **Unit – V** | **Fundamentals of MOSFETs** | **9** |
| Basic MOSFET Operation, Current-voltage relationship, Transconductance, Cut-off frequency and CMOS Technology, Special diodes and transistors LED, Avalanche Photodiode, PIN, LASERs, MISFETs, MESFETs. | | |
| | | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | Donald Neamen, "Semiconductor Physics and Devices", McGraw Hill Pvt Ltd, Fourth Edition, 2011. |
| 2. | Nandhitha Das Gupta and Amitava Das Gupta "Semiconductor Devices: Modeling and Technology" Prentice Hall of India Pvt Ltd, Fourth Edition, 2004. |

**REFERENCES:**

| | |
|---|---|
| 1. | Adel S. Sedra and Kenneth C.Smith, "Microelectronic Circuits", Oxford University Press, Sixth Edition, 2009. |
| 2. | Simon M.Sze and Kwok K.Ng, "Physics of Semiconductor Devices", John wiley & sons, 3rd edition, 2006. |
| 3. | Yuan Taur and Tak H.Ning, "Fundamentals of Modern VLSI Devices",Second Edition, Cambridge university Press, 2009. |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Apply the fundamental principle of electron and holes in silicon to study the parameters of semiconductor materials. | K3 |
| CO2 | Describe the relationship between electron transport properties and the operation of semiconductor devices like Diode, Bipolar Junction Transistors, and Field Effect transistors. | K2 |
| CO3 | Investigate the different configurations of BJTs | K3 |
| CO4 | Gain knowledge in the advanced development of JFET and its operation. | K2 |
| CO5 | Learn about semiconductor devices | K2 |

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

| ACS102 - PYTHON PROGRAMMING |
|---|
| |

| Programme & Branch | BE& ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | 1 | ES | 3 | 0 | 0 | 3 |

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

| Unit 1 | BASICS OF PYTHON PROGRAMMING | 9 |
|---|---|---|

Overview of programming language- Python history-Interactive mode – script mode-Tokens:Literal-Keyword-Delimiter-Identifier-Data types: Integer-Floating-Complex-Boolean-String-Indentation-Input operation-Comments

| Unit 2 | CONTROL STRUCTURE, OPERATORS AND FUNCTIONS | 9 |
|---|---|---|

Statements: if, if-else, nested if, if –elif - Iterative statements: while, for, Nested loops, else in loops, break, continue and pass statements. Operators: Arithmetic-Membership-Identity-Bitwise Functions: Types, parameters, arguments: positional arguments, keyword arguments, parameters with default values, functions with arbitrary arguments, Scope of variables: Local and global scope, Recursion

| Unit 3 | COLLECTIONS, STRINGS AND REGULAR EXPRESSIONS | 9 |
|---|---|---|

List: Create Access, Negative Indices, Slicing, Splitting, List Methods, and comprehensions Tuples: Create, Indexing and Slicing, Operations on tuples. Dictionary: Create, add, traversing and replace values, operations on dictionaries. Sets: Create and operations on set. Strings: Formatting, Comparison, Slicing, Splitting, Stripping, Negative indices, String functions. Regular expression: Matching the patterns, Search and replace

| Unit 4 | FILE HANDLING AND EXCEPTIONS | 9 |
|---|---|---|

Files: Open, Read, Write, Append, Tell, Seek and Close. Errors and Exceptions: Syntax Errors, Exceptions, Handling Exceptions, Raising Exceptions, Exception Chaining, User defined Exceptions, Defining Clean-Up actions

| Unit 5 | NUMPY, PANDAS, MATPLOTLIB | 9 |
|---|---|---|

Introduction - Basics of NumPy - N-dimensional Array in NumPy – Methods and Properties - Basics of SciPy - Broadcasting in NumPy Array Operations - Array Indexing in NumPy, Pandas - Introduction - Series - Data Frame - Matplotlib - Basics - Figures and Axes - Method subplot() - Axis container

**Total: 45**

**TEXTBOOKS**

| | |
|---|---|
| 1 | Ashok Namdev Kamthane, Amit Ashok Kamthane "Programming and Problem Solving with Python" , 2nd edition , Mc Graw Hill |
| 2 | Dr,R,NageswaraRao, "Core Python Programming",3rd edition, Deam tech Publisher |

**REFERENCES**

| | |
|---|---|
| 1 | Paul Dietel, Harvey Deitel, "Python for Programmers", Pearson |
| 2 | Reema Thareja," Problem Solving and programming with Python, Oxford University Press |

| COURSEOUTCOMES: | Bloom's Taxonomy |
|---|---|

| At the end of the course, learners will be able to | | Level |
|---|---|---|
| CO1 | Develop algorithmic solutions to simple computational problems. | K3 |
| CO2 | Develop and execute simple Python programs. | K3 |
| CO3 | Write simple Python programs using conditionals and loops for solving problems. | K2 |
| CO4 | Decompose a Python program into functions. | K3 |
| CO5 | Represent compound data using Python lists, tuples, dictionaries etc. | K3 |

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

| AMC101 - EMPLOYMENT ENCHANCEMENT SKILLS | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Programme & Branch** | **BE& ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **1** | **MC** | **2** | **0** | **0** | **0** |
| Preamble | | | | | | | |
| **Unit 1** | **RESUME WRITING** | | | | | | **6** |
| Resume: Objective; Formats; Meticulous & Attention to Detail; Organizing Information; Highlight skills; Mistakes to avoid; Qualification & Skill; SWOT Analysis; Assignment – Draft Resume & Corrections | | | | | | | |
| **Unit 2** | **INTERVIEW SKILLS** | | | | | | **6** |
| Types of Interviews; Preparation – Company, Role, Brush up Concepts, Technical Strengths; Strengths & Weakness; Importance of Grooming; Interview Questions – HR & Technical; Non Verbal Communication; Negotiation Skills; How to start/end an interview; Group Discussion; Assignment – Preparation for "Tell me about yourself", Mock Interviews. | | | | | | | |
| **Unit 3** | **PROFESSIONAL ETIQUETTES** | | | | | | **6** |
| Workplace Etiquette – Global & Local; Culture Sensitivity; Gender Sensitivity; Communication Netiquettes – Phone, Email, Social Media; Avoid Gossip; How to be personable yet be professional. Meetings: Types of meetings; Agenda; Schedule & Participants; Materials required; Minutes of Meeting. | | | | | | | |
| **Unit 4** | **PRESENTATION SKILLS** | | | | | | **6** |
| What is a Presentation; Develop an effective slide; Know your Slides; Know your Audience; Barriers in Presentation; Time Management; Listening to the silent audience; Question & Answer session; Feedback. | | | | | | | |
| **Unit 5** | **COMMUNICATION AT WORKPLACE** | | | | | | **6** |
| Language & Communication; Types of Communication – Internal & External, Formal & Informal; | | | | | | | |

| | |
|---|---|
| Direction of Communication Flow – Downward, Upward, Lateral, Diagonal; Team Work; Emotional Intelligence | |
| | **Total: 30** |
| **TEXTBOOKS** | |
| 1 | "Soft Skills & Employability Skills" by Sabina Pillai&Agna Fernandez |
| 2 | "Soft Skills" by Meenakshi Raman &ShaliniUpadhyay |
| 3 | "Campus Recruitment" by Ramanadhan Ramesh Babu, Israel Battu, Akash R Bhutada&Vijaya Lakshmi Krishnan |
| **REFERENCES** | |
| 1 | "Personality Development & Soft Skills (Old Edition)" by Barun K Mitra |
| 2 | "Soft Skills Training: A Workbook to develop Skills for Employment" by Frederick H Wentz |
| 3 | "Ten Soft Skills You Need to Advance Your Career(Andre Keys Book 9)" by Lisa Smith |
| 4 | "Get Your First Job: A Companion For Getting Your First Job – A Guide to Employability Skills & Career Planning" by AJ Balasubramanian & Dr J Sadakkadulla |

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

| **AMC102 - PROFESSIONAL ETHICS AND HUMAN VALUES** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE& ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **1** | **MC** | **2** | **0** | **0** | **0** |
| Preamble | ➢ To create an awareness on Engineering Ethics and Human Values.<br>➢ To understand social responsibility of an engineer.<br>➢ To appreciate ethical dilemma while discharging duties in professional life. | | | | | | |
| **Unit 1** | **HUMAN VALUES** | | | | | | **2** |
| Morals, Values and Ethics – Integrity – Work Ethic – Honesty – Courage –Empathy – Self-Confidence – Character | | | | | | | |
| **Unit 2** | **ENGINEERING ETHICS** | | | | | | **4** |
| Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories. Valuing Time – Co-operation – Commitment | | | | | | | |

| Unit 3 | ENGINEERING AS SOCIAL EXPERIMENTATION | 3 |
|---|---|---|
| Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study | | |
| **Unit 4** | **SAFETY, RESPONSIBILITIES AND RIGHTS** | **3** |
| Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and chernobyl case studies | | |
| **Unit 5** | **GLOBAL ISSUES** | **3** |
| Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership | | |
| | | **Total: 15** |

| **TEXTBOOKS** | |
|---|---|
| 1 | Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 1996 |
| 2 | Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004 |
| **REFERENCES** | |
| 1 | Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint now available). |
| 2 | Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000 (Indian Reprint now available). |
| 3 | John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003. |
| 4 | Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001. |

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

| **AEC301 - BASIC ELECTRICAL ENGINEERING LABORATORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **1** | **ES** | **0** | **0** | **4** | **2** |
| **Preamble** | To provide hands on training to the students in:<br>➢ Soldering and testing simple electronic circuits.<br>➢ Assembling and testing simple electronic components on PCB. | | | | | | |

| | |
|---|---|
| | ➢ Study of basic electrical and digital equipment. |
| **List of Exercises / Experiments:** | |
| 1. | Soldering simple electronic circuits and checking continuity. |
| 2. | Assembling and testing electronic components on a small PCB. |
| 3. | Study of electronic components and equipments. a. Resistor Color coding using digital multi-meter. b. Assembling electronic components on breadboard. |
| 4. | Measurement of electrical quantities-voltage current, power & power factor in RLC circuit |
| 5. | Verification of KVL, KCL |
| 6. | Verification of Thevenin, Norton, Superposition Theorem |
| 7. | Fluorescent lamp wiring |
| 8. | Staircase wiring |
| 9. | Study of iron box wiring and working |
| 10. | Assembly and dismantle of computer/ laptop. |
| | **Total: 60** |
| **REFERENCES/MANUAL/SOFTWARE:** | |
| 1. | Laboratory Manual |

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB. | K3 |
| CO2 | Demonstrate the wiring of various electrical joints in common household electrical wire work. | K3 |
| CO3 | Verify theorems for Electrical devices | K2 |
| CO4 | Understand the working of basic electrical devices | K2 |
| CO5 | Apply basic electrical concepts to implement basic electrical circuits. | K3 |

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

| **ACS301 - PYTHON PROGRAMMING LABORATORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE& ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **1** | **ES** | **0** | **0** | **4** | **2** |
| Preamble | ➢ To understand the problem-solving approaches.<br>➢ To learn the basic programming constructs in Python. | | | | | | |

| | |
|---|---|
| | ➢ To practice various computing strategies for Python-based solutions to real world problems.<br>➢ To use Python data structures - lists, tuples, dictionaries.<br>➢ To do input/output with files in Python. |

**LIST OF EXPERIMENTS**

1. Identification and solving of simple real life or scientific or technical problems and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3 Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4.Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5.Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7.Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8.Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9.Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10.Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11.Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

**Total: 60**

| **COURSEOUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Develop algorithmic solutions to simple computational problems | K3 |
| CO2 | Develop and execute simple Python programs. | K3 |
| CO3 | Implement programs in Python using conditionals and loops for solving problems. | K3 |
| CO4 | Deploy functions to decompose a Python program. | K3 |
| CO5 | Process compound data using Python data structures. | K3 |

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

| **AHS301 - COMMUNICATION SKILLS AND TECHNICAL WRITING** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE& ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **1** | **HS** | **0** | **0** | **2** | **1** |

| | |
|---|---|
| Preamble | ➢ Impart a thorough understanding of the principles underlying effective technical communication.<br>➢ Develop the skills necessary to tailor technical communication to diverse audience needs.<br>➢ Enhance proficiency in using language techniques and understanding genres related to technical communication.<br>➢ Equip students with the ability to utilize technological tools to improve technical communication practices.<br>➢ Foster an awareness of ethical considerations and global perspectives in technical communication. |

| **Unit 1** | **PRINCIPLES OF TECHNICAL COMMUNICATION** | **12** |
|---|---|---|

Listening -Brief video snippets of conversational moments from movies and short documentaries
Speaking- Presenting oneself, introducing others, inviting people, and explaining places.
Reading - Short passages that need understanding include inference and critical analysis.
Writing-Finishing missing phrases and constructing suggestions based on supplied information.
Grammar- Who-Questions and Yes/No Questions - Parts of Speech. Vocabulary development: prefixes, suffixes, articles, countable and uncountable nouns.

| **Unit 2** | **AUDIENCE-CENTERED COMMUNICATION** | **12** |
|---|---|---|

Listening: Deep Listening - Talk Shows and Debates.
Reading: In depth Reading: Scanning Passages
Speaking: Describe current issues, happenings, etc.
Writing: Instructions, Recommendations, Note Taking, and Paragraph Writing
Grammar: Continuous tenses, prepositions and articles
Vocabulary: Phrasal verbs and one-word substitutes

| **Unit 3** | **LANGUAGE TECHNIQUES AND GENRES IN TECHNICAL COMMUNICATION** | **12** |
|---|---|---|

Listening: Listening to lectures, podcasts, audio books.
Reading: Interpretation of Tables, Charts and Graphs
Speaking: SWOT Analysis on oneself and Narrating incidents
Writing: Formal Letter Writing, Covering Letter and Memos.
Grammar: Perfect Tenses and Discourse Markers
Vocabulary: Nouns, usage of keywords

| Unit 4 | TECHNOLOGICAL TOOLS USED IN COMMUNICATION | 12 |
|---|---|---|

Listening: Instructional videos, webinars on personal branding and networking and TED talks
Reading: Manuals, Research papers or articles, Graphic narratives, AI tools used in reading
Speaking: Participating in and conducting mock virtual meetings, focusing on presentation skills and etiquette. Mock networking events and Elevator Pitch
Writing: E-Mails, drafting formal messages in social media handles, and Usage of AI prompts.
Grammar: Adjectives, Verbs and Adverbs.

| Unit 5 | ETHICAL AND GLOBAL PERSPECTIVES IN TECHNICAL COMMUNICATION | 12 |
|---|---|---|

Listening: Podcasts, documentaries and webinars on digital ethics and cybersecurity.
Reading: Articles on fundamental ethical principles and case studies.
Speaking: Cultural sensitivity and representation ross-cultural communication strategies Mock meetings to practice global collaboration.
Writing: Case study analysis reports on legal and ethical responsibilities. Proposals for implementing sustainable communication practices.
Grammar: Reported Speech, Idioms and phrases and Loan words

**Total: 60**

**TEXTBOOKS**

| | |
|---|---|
| 1 | Effective Technical Communication by M. Ashraf Rizvi (Author) 2nd Edition Paperback 2017 |
| 2 | Sylvan Barnet and Hugo Bedau, 'Critical Thinking Reading and Writing', Bedford/st. Martin's: Fifth Edition (June 28, 2004) |
| 3 | Meenakshi Upadhyay, Arun Sharma – Verbal Ability and Reading Comprehension. |
| 4 | Teaching Speaking: A Holistic Approach, Book by Anne Burns and Christine Chuen Meng Goh, Cambridge. |

**REFERENCES**

| | |
|---|---|
| 1 | Technical Communication: A Reader-Centered Approach" by Paul V. Anderson |
| 2 | "Technical Writing: Process and Product" by Sharon J. Gerson and Steven M. Gerson |
| 3 | "English for Engineers and Technologists: A Skill Approach" by Jeyanthi G. and Ramasamy P |
| 4 | "A Handbook for Technical Writers and Editors" by M. Ragunathan and M. Sundararajan |

| **COURSEOUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | To create clear and successful technical publications, use core technical communication concepts. | K2 |
| CO2 | Modify technical communication to the requirements and expectations of various audiences. | K2 |
| CO3 | Use proper language and genres to effectively communicate technical knowledge. | K2 |
| CO4 | Use technology technologies to improve the generation, management, and dissemination of technical material. | K2 |

| | | |
|---|---|---|
| CO5 | Navigate ethical quandaries and explore global views in technological communication methods. | K2 |

| COs/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | 1 | 2 | 1 | 1 | - | - | - | - | - | - | - | - |
| CO2 | 1 | 2 | 1 | 1 | 1 | 1 | - | - | - | - | - | - | - | - |
| CO3 | 1 | 1 | 2 | 2 | 1 | 2 | - | - | - | - | - | - | - | - |
| CO4 | 1 | 1 | 1 | 1 | 1 | 1 | - | - | - | - | - | - | - | - |
| CO5 | 2 | 1 | 1 | 1 | 1 | 1 | - | - | - | - | - | - | - | - |

JEPPIAAR INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

Self-Belief | Self Discipline | Self Respect

Kunnam, Sunguvarchatram, Sriperumbudur-631604

# DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

## AUTONOMOUS SYLLABUS R2024

## CHOICE BASED CREDIT SYSTEM

# SEM – II

| AMA103 - MATHEMATICS FOR ELECTRONICS ENGINEERS | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE& ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **2** | **BS** | **3** | **1** | **0** | **4** |
| Preamble | ➢ acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.<br>➢ familiarize with the notions of vector and scalar fields required in engineering problems<br>➢ acquaint with the concepts of vector calculus needed for problems in all engineering disciplines.<br>➢ To collect the matrix algebra techniques and the concepts of basis and dimension in vector spaces.<br>➢ To construct normalization of vectors and ortho-normal vectors. | | | | | | |
| **Unit 1** | **ORDINARY DIFFERENTIAL EQUATIONS** | | | | | | **9+3** |
| Higher order linear differential equations with constant coefficients - Method of variation of parameters - Cauchy's and Legendre's linear equations - Simultaneous first order linear equations with constant coefficients. | | | | | | | |
| **Unit 2** | **VECTOR FUNCTIONS** | | | | | | **9+3** |
| Vector and scalar point functions - Vector Differential Operator – gradient of a scalar point vector divergence and of a vector point function – directional derivative – conservative vector field - solenoidal and irrotational vector fields. | | | | | | | |
| **Unit 3** | **VECTOR CALCULUS** | | | | | | **9+3** |
| Gradient, divergence and curl - Directional derivative - Irrotational and solenoidal vector fields - Vector integration - Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) - Simple applications involving cubes and rectangular parallelopipeds. | | | | | | | |
| **Unit 4** | **LINEAR TRANSFORMATION** | | | | | | **9+3** |
| Vector spaces – Subspaces – Linear combinations and system of Linear equations – Linear independence and Linear dependence – Bases and Dimensions – Linear Transformation – Matrix representation of Linear Transformation - Null space, Range space and dimension theorem (without proof). | | | | | | | |
| **Unit 5** | **INNER PRODUCT SPACES** | | | | | | **9+3** |
| Inner product and norms - Gram Schmidt orthonormalization process - QR Factorization - Singular value decomposition. | | | | | | | |
| | | | | | | | **Total: 60** |
| **TEXTBOOKS** | | | | | | | |
| 1 | Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley India, 2011. | | | | | | |
| 2 | Grewal. B.S., Higher Engineering Mathematics, 42nd Edition, Khanna Publishers, Delhi, 2012. | | | | | | |
| 3 | Narayanan. S., Manickavachagam Pillay. T. K and Ramanaiah. G Advanced Mathematics for Engineering Students, Vol. II & III, S. Viswanathan Publishers Pvt. Ltd.1998. | | | | | | |
| **REFERENCES** | | | | | | | |
| 1 | Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill Education Private Ltd., 9th Edition, New Delhi 2010. | | | | | | |
| 2 | Veerarajan. T, Engineering Mathematics –II, Mc Graw Hill Education, 2018. | | | | | | |
| **WEB LINKS** | | | | | | | |

| | |
|---|---|
| 1. https://archive.nptel.ac.in/courses/111/105/111105122/<br>2. http://www.math.iitb.ac.in/~gopal/MA108/Slides_Laplace_Transforms_april_17_2019.pdf | |
| **COURSEOUTCOMES:**<br>**At the end of the course, learners will be able to** | **Bloom's Taxonomy Level** |
| CO1 Apply the methods as a potent tool in the solution of a variety of problems in the natural sciences and technology. | K3 |
| CO2 Apply vectors in higher dimensional space in experimental data. | K3 |
| CO3 Interpret the fundamentals of vector calculus and be fluent in the use of Stokes theorem and Gauss divergence theorem. | K4 |
| CO4 Apply the concepts of basis and dimension in vector spaces to the solution of related complex engineering problems. | K3 |
| CO5 Construct orthonormal basis by the concepts of normalization in inner products and to analyse complex engineering problems. | K4 |

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

| **APH101 - COMPUTATIONAL PHYSICS** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE& ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **2** | **BS** | **3** | **0** | **0** | **3** |
| Preamble | • To instill knowledge on physics of semiconductors, determination of charge carriers and device applications.<br>• The students will acquire knowledge on the concepts of Photonics.<br>• To provide the basic concepts of quantum mechanics and various formalism of quantum mechanics<br>• To acquire the knowledge of basic sciences required to understand the fundamentals of nanomaterials.<br>• To motivate the students towards the applications of quantum mechanics and quantum computing | | | | | | |
| **Unit 1** | **PHOTONICS AND SEMICONDUCTOR DEVICES** | | | | | | **9** |
| Intrinsic Semiconductor- Energy Band Diagram- -Direct and Indirect Band Gap Semi-Conductors – Diode Laser-Hall Effect and Devices- Logic Gates- AND, OR, NOT, NAND, E-OR, E-NOR Gates.<br><br>Introduction to theory of Laser-Characteristics-Spontaneous and Stimulated Emission- Einstein's Coefficients – Population Inversion- Applications of Photonics. | | | | | | | |
| **Unit 2** | **DIFFERENTIAL EQUATIONS IN** | | | | | | **9** |

| | | |
|---|---|---|
| | **COMPUTATIONAL PHYSICS** | |
| Solution of differential equations: Taylor series method, Euler method, Runge-Kutta method, predictor-corrector method. Eigen values and Eigen vectors of matrix: Determinant of a matrix, characteristic equation of a matrix, eigen values and eigen vectors of a matrix, power method. | | |
| **Unit 3** | **FUNDAMENTALS OF QUANTUM MECAHNICS** | **9** |
| Photons and light waves- Electrons and matter waves- The Schrodinger equation (Time dependent and time independent wave equation)- Physical significance of wave function- particle in an infinite potential well: 1D, 2D and 3D Boxes-Degeneracy and Non-Degeneracy. | | |
| **Unit 4** | **INTRODUCTION TO NANO MATERIAL** | **9** |
| Introduction to nanomaterial -Electron density in bulk material - Size dependence of Fermi energy - Quantum confinement - Quantum structures - Density of states in quantum well, quantum wire and quantum dot structure - Band gap of nanomaterial- Properties and Applications of nano materials- Tunneling: single electron phenomena and single electron transistor-Quantum dot laser. | | |
| **Unit 5** | **QUANTUM INFORMATION AND COMPUTING** | **9** |
| Quantum computing: Introduction - Postulates of quantum Mechanics- Differences between quantum and classical computation. Quantum system for information processing-quantum states-Classical bits-quantum bits or qubits - Density matrices- Entanglement-Quantum gates-C-NOT Gate-Bloch sphere. | | |
| | | **Total: 45** |

| **TEXTBOOKS** | |
|---|---|
| 1 | Hintendra K Malik, A K Singh, "Engineering Physics" Tata McGraw Hill Education Private Limited, New Delhi 2010. |
| 2 | Vanchna Singh, Sheetal Kumar, "Engineering Physics" Cengage Learning India Pvt. Ltd. Delhi 2010. |
| 3 | V Rajendran, "Engineering Physics" Tata McGraw Hill Education Private Limited, New Delhi 2011. |
| **REFERENCES** | |
| 1 | Dattu R Joshi, "Engineering Physics" Tata McGraw Hill Education Private Limited, New Delhi 2010. |
| 2 | A Marikani, "Engineering Physics" PHI Learning Private Limited New Delhi 2010. |
| 3 | Kenneth B. Howell, "Ordinary Differential Equations", CRC Press, 21 January 2023. |

| **COURSEOUTCOMES:** On completion of this course, the students will gain knowledge and will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | understand clearly of semiconductor physics and functioning of semiconductor devices. | K2 |
| CO2 | solve differential equations arising in computational physics | K2 |
| CO3 | understand the basic concepts and principles of quantum mechanics | K2 |
| CO4 | explain the effects of quantum confinement on the electronic structure and corresponding physical and chemical properties of materials. | K2 |
| CO5 | Apply the quantum mechanical principals and basic concept of quantum computing | K3 |

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | - |
| CO2 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | - |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | - |
| CO4 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | - |
| CO5 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | - |

| **AAI101 - INTRODUCTION TO DATA SCIENCE** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE& ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **2** | **ES** | **3** | **0** | **0** | **3** |
| Preamble | ➢ To understand the data science fundamentals and process.<br>➢ To learn to describe the data for the data science process.<br>➢ To learn to describe the relationship between data.<br>➢ To utilize the Python libraries for Data Wrangling.<br>➢ To present and interpret data using visualization libraries in Python | | | | | | |
| **Unit 1** | **INTRODUCTION** | | | | | | **9** |
| Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation - Exploratory Data analysis – build the model–presenting findings and building applications - Data Mining - Data Warehousing – Basic Statistical descriptions of Data | | | | | | | |
| **Unit 2** | **DESCRIBING DATA** | | | | | | **9** |
| Types of Data - Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores | | | | | | | |
| **Unit 3** | **DESCRIBING RELATIONSHIPS** | | | | | | **9** |
| Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula forcorrelation coefficient – Regression –regression line –least squares regression line – Standard error of estimate – interpretation of r2 –multiple regression equations –regression towards the mean | | | | | | | |
| **Unit 4** | **PYTHON LIBRARIES FOR DATA WRANGLING** | | | | | | **9** |
| Basics of Numpy arrays –aggregations –computations on arrays –comparisons, masks, Boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets –aggregation and grouping – pivot tables | | | | | | | |
| **Unit 5** | **DATA VISUALIZATION** | | | | | | **9** |
| Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn. | | | | | | | |
| | | | | | | | **Total: 45** |
| **TEXTBOOKS** | | | | | | | |
| 1 | David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016. (Unit I) | | | | | | |
| 2 | Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017.(Units II and III | | | | | | |
| 3 | Jake Vander Plas, “Python Data Science Handbook”, O’Reilly, 2016. (Units IV and V) | | | | | | |
| **REFERENCES** | | | | | | | |

| | |
|---|---|
| 1 | Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press,2014. |

| **COURSEOUTCOMES: At the end of the course, learners will be able to** | | **Bloom’s Taxonomy Level** |
|---|---|---|
| CO1 | Define the data science process | K1 |
| CO2 | Understand different types of data description for data science process | K2 |
| CO3 | Gain knowledge on relationships between data | K2 |
| CO4 | Use the Python Libraries for Data Wrangling | K3 |
| CO5 | Apply visualization Libraries in Python to interpret and explore data | K3 |

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO1 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 1 | 2 | 2 | - | - | - | - | 1 | 1 | 2 | 2 | 2 | 1 |
| CO2 | 2 | 3 | 2 | 3 | 2 | - | - | - | 2 | 2 | 3 | 2 | 3 | 2 | 1 |
| CO3 | 2 | 3 | 2 | 1 | 1 | - | - | - | 2 | 2 | 3 | 2 | 2 | 3 | 1 |
| CO4 | 2 | 3 | 2 | 2 | 3 | - | - | - | 2 | 2 | 3 | 2 | 2 | 3 | 1 |
| CO5 | 2 | 3 | 1 | 2 | 2 | - | - | - | - | - | - | 1 | 3 | 2 | 2 |

## AEC104 - ELECTRONIC CIRCUITS

| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| | | **2** | **PC** | **3** | **0** | **0** | **3** |

| | | |
|---|---|---|
| **Preamble** | ➢ To impart knowledge of electronic circuit principles and analytical viewpoints. | |
| **Unit – I** | **Transistor Biasing** | **9** |
| Need for biasing, operating point, load line analysis, BJT biasing-methods, basic stability, fixed bias, collector to base bias, self-bias, Bias Stabilization and stability factors, compensation, Thermal runaway, Thermal stability. | | |
| **Unit - II** | **Biasing of JFET** | **9** |
| JFET - DC Load Line and Bias Point - Various biasing methods of JFET - JFET Bias Circuit Design. | | |
| **Unit - III** | **Transistor Amplifiers** | **9** |
| Small signal Analysis of Common Emitter amplifiers – Small signal Analysis of JFET-Common source amplifier, Differential Amplifier, Cascade, Cascode amplifiers. | | |
| **Unit - IV** | **Frequency Analysis of transistor amplifiers** | **9** |
| Amplifier frequency response -Low frequency and Miller effect, High frequency analysis of CE amplifier, short circuit current gain, cut off frequency – fα and fβ unity gain and Determination of bandwidth of single stage amplifiers. | | |

| Unit - V | Feedback Amplifiers and Oscillators | 9 |
|---|---|---|
| Voltage / Current, Series, Shunt feedback Amplifiers – positive feedback–Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts, and Crystal oscillators. | | |
| | | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | S. Salivahanan, N. Suresh Kumar and A. Vallavaraj, Electronic Devices and Circuits, 2nd Edition, TMH, 2007. |
| 2. | Donald.A. Neamen, Electronic Circuit Analysis and Design –2nd Edition,Tata Mc Graw Hill, 2009. |

**REFERENCES:**

| | |
|---|---|
| 1. | David A., "Bell Electronic Devices and Circuits", Oxford Higher Education Press, 5th Edition, 2010 |
| 2. | D.Schilling and C.Belove, "Electronic Circuits", 3rd Edition, Mc Graw Hill, 1989. |
| 3. | Robert L. Boylestad and Louis Nasheresky, "Electronic Devices and Circuit Theory", 10th Edition, Pearson Education / PHI, 2008. |

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Design various biasing methods of BJT. | K3 |
| CO2 | Design various biasing methods of JFET. | K3 |
| CO3 | Derive the small signal parameters of amplifiers. | K3 |
| CO4 | Analyze frequency response of BJT and FET amplifiers | K4 |
| CO5 | Design feedback amplifiers and oscillators. | K3 |

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

## AEC105 - DIGITAL ELECTRONICS

| Programme & Branch | BE & ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | 2 | PC | 3 | 0 | 0 | 3 |

| | |
|---|---|
| Preamble | ➢ This subject explores the fundamental principles of digital logic and circuits, laying the groundwork for understanding modern computing systems.<br>➢ From Boolean algebra to sequential logic design, the course delves into the core concepts that underpin digital electronics.<br>➢ Through a combination of theory and practical experimentation, students learn to design and analyze digital circuits, preparing them for a variety of applications in fields such as computer engineering, electronics, telecommunications, and beyond. |

| | | |
|---|---|---|
| **Unit – I** | **BASIC CONCEPTS** | **9** |

Review of number systems-representation-conversions, Review of Boolean algebra- theorems, sum of product and product of sum simplification, canonical forms min term and max term, Simplification of Boolean expressions-Karnaugh map, completely and incompletely specified functions, Implementation of Boolean expressions using universal gates, Tabulation methods.

| | | |
|---|---|---|
| **Unit – II** | **COMBINATIONAL LOGIC CIRCUITS** | **9** |

Problem formulation and design of combinational circuits - Code-Converters, Half and Full Adders, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/Demux, Case study: Digital trans-receiver / 8 bit Arithmetic and logic unit, Parity Generator/Checker, Seven Segment display decoder

| | | |
|---|---|---|
| **Unit – III** | **SYNCHRONOUS SEQUENTIAL CIRCUITS** | **9** |

Latches, Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment, lock - out condition circuit implementation - Counters, Ripple Counters, Ring Counters, Shift registers, Universal Shift Register. Model Development: Designing of rolling display/real time clock

| | | |
|---|---|---|
| **Unit – IV** | **ASYNCHRONOUS SEQUENTIAL CIRCUITS** | **9** |

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Fundamental and Pulse mode sequential circuits, Design of Hazard free circuits.

| | | |
|---|---|---|
| **Unit – V** | **LOGIC FAMILIES AND PROGRAMMABLE LOGIC DEVICES** | **9** |

Logic families- Propagation Delay, Fan - In and Fan - Out - Noise Margin - RTL, TTL, ECL, CMOS - Comparison of Logic families - Implementation of combinational logic/sequential logic design using standard ICs, PROM, PLA and PAL, basic memory, static ROM, PROM, EPROM, EEPROM, EAPROM.

**Total:45**

**TEXTBOOK:**


1. M. Morris Mano and Michael D. Ciletti, ‘Digital Design’, Pearson, 5th Edition, 2013. (Unit - I - V)


**REFERENCES:**


1. Charles H. Roth, Jr, ‘Fundamentals of Logic Design’, Jaico Books, 4th Edition, 2002.
2. William I. Fletcher, "An Engineering Approach to Digital Design", Prentice- Hall of India, 1980.
3. Floyd T.L., "Digital Fundamentals", Charles E. Merril publishing company,1982.
4. John. F. Wakerly, "Digital Design Principles and Practices", Pearson Education, 4 th Edition,2007.

| COURSE OUTCOMES:<br>At the end of the course, learners will be able to | | Bloom's Taxonomy Level |
|---|---|---|
| CO1 | Use Boolean algebra and simplification procedures relevant to digital logic. | K2 |
| CO2 | Design various combinational digital circuits using logic gates. | K3 |
| CO3 | Analyze and design synchronous sequential circuits. | K4 |
| CO4 | Analyze and design asynchronous sequential circuits. | K4 |
| CO5 | Build logic gates and use programmable devices | K4 |

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

| AHS101 - **தமிழர்மரபு** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE& ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **2** | **HS** | **1** | **0** | **0** | **1** |
| Preamble | | | | | | | |
| **அலகு I** | **மொழிமற்றும்இலக்கியம்** | | | | | | **3** |
| இந்திய மொழிக் குடும்பங்கள்-திராவிட மொழிகள்-தமிழ் ஒரு செம்மொழி தமிழ் செவ்விலக்கியங்கள்-சங்க இலக்கியத்தின் சமயச்சார் பற்ற தன்மை சங்க இலக்கியத்தில்பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள்-தமிழ்க் காப்பியங்கள்,தமிழகத்தில் சமணபௌத்த சமயங்களின் தாக்கம்-பக்தி இலக்கியம்,ஆழ்வார்கள் மற்றும் நாயன்மார்கள்-சிற்றிலக்கியங்கள்-தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி தமிழ் இலக்கியவளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு. | | | | | | | |
| **அலகு II** | **மரபு –பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை சிற்பக்கலை** | | | | | | **3** |
| நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன்சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப்பொருட்கள், பொம்மைகள் – தேர்செய்யும்கலை – சுடுமண்சிற்பங்கள் – நாட்டுப்புறத்தெய்வங்கள் – குமரி முனையில் திருவள்ளுவர் சிலை – இசைக்கருவிகள் – மிருதங்கம் , பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூகபொருளாதார வாழ்வில் கோவில்களின் பங்கு. | | | | | | | |
| **அலகு III** | **நாட்டுப் புறக்கலைகள் மற்றும்** | | | | | | **3** |

| | | |
|---|---|---|
| | **வீரவிளையாட்டுகள்** | |
| தெருக்கூத்து,கரகாட்டம், வில்லுப்பாட்டு, கணியான்கூத்து, ஒயிலாட்டம், தோல்பாவைக்கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள் | | |
| **அலகு IV** | **தமிழர்களின் திணைக் கோட்பாடுகள்** | **3** |
| தமிழகத்தின் தாவரங்களும்,விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக்கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறைமுகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி. | | |
| **அலகு V** | **இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு** | **3** |
| இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின்பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சுவரலாறு. | | |
| | | **Total: 15** |
| **TEXTBOOKS** | | |
| 1 | **தமிழகவரலாறு – மக்களும்பண்பாடும் – கே.கே. பிள்ளை** (**வெளியீடு:தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்**). | |
| 2 | **கணினித்தமிழ் – முனைவர்இல. சுந்தரம்**. (**விகடன்பிரசுரம்**). | |
| 3 | Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print) | |
| **REFERENCES** | | |
| 1 | **கீழடி – வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம்** (**தொல்லியல்துறைவெளியீடு**) | |
| 2 | **பொருநை ஆற்றங்கரை நாகரிகம்**. (**தொல்லியல் துறை வெளியீடு**) | |
| 3 | Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (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.) | |

| **AHS101 -HERITAGE OF TAMILS** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE& MECH** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **2** | **HS** | **1** | **0** | **0** | **1** |
| Preamble | | | | | | | |
| **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, VilluPattu, KaniyanKoothu, Oyillattam, Leather puppetry, 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** |
| **TEXTBOOKS** | | |
| 1 | **தமிழகவரலாறு – மக்களும்பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு:தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).** | |
| 2 | **கணினித்தமிழ் – முனைவர்இல. சுந்தரம். (விகடன்பிரசுரம்).** | |
| 3 | Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print) | |
| **REFERENCES** | | |
| 1 | **கீழடி – வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல்துறைவெளியீடு)** | |
| 2 | **பொருநை ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)** | |
| 3 | Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (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.) | |

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

| AMC103 - INDIAN CONSTITUTION | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE& ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **2** | **MC** | **2** | **0** | **0** | **0** |
| Preamble | ➢ This Course intends to impart a comprehensive outlook about the nature of the Indian constitution; rights and duties of the citizens, Political Institutions of Central and State governments and its relationship with each other and the organization and functions of local government.<br>➢ A detailed analysis of the functions of the statutory bodies are incorporated in this course. | | | | | | |
| **Unit 1** | | | | | | | **9** |
| Constitutional Assembly – Philosophy – Preamble – Salient Features of Indian Constitution | | | | | | | |
| **Unit 2** | | | | | | | **9** |
| Fundamental Rights – Directive Principles of State Policy – Fundamental Duties. | | | | | | | |
| **Unit 3** | | | | | | | **9** |
| Union Executive – President: Election – Powers and Functions – Council of Ministers – Prime Minister: Position and Powers – Relationship between Prime Minister and President. State Executive – Governor: Powers and functions – Chief Minister: Position and Powers – Relationship between Chief Minister and Governor. | | | | | | | |
| **Unit 4** | | | | | | | **9** |
| Union Legislature: Structure, Powers and Functions – Speaker: Power and Functions – Procedures of Constitutional Amendment – State Legislature: Structure, Powers and Functions. | | | | | | | |
| **Unit 5** | | | | | | | **9** |
| Judiciary – Supreme Court: Powers and Functions – High Court: Powers and Functions – Judicial Review | | | | | | | |
| | | | | | | | **Total: 45** |
| **TEXTBOOKS** | | | | | | | |
| 1 | Siwach,J.R, Dynamics of Indian Government and Politics, New Delhi: Sterling, 1985. | | | | | | |
| 2 | Narang, A.S., Indian Government and Politics New Delhi: Gitanjali ,1995 | | | | | | |
| **REFERENCES** | | | | | | | |
| 1 | Thakur, R. The Government and Politics of India: London: Macmillan, 1995. | | | | | | |
| 2 | Gupta,D.C, Indian Government and Politic, New Delhi, 1996 | | | | | | |

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

| AEC303 - ELECTRONIC CIRCUITS LABORATORY | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **2** | **PC** | **0** | **0** | **2** | **1** |

| | |
|---|---|
| **Preamble** | To build a firm foundation on electronic circuits. |
| **List of Exercises / Experiments:** | |
| 1. | Characterization of CE and CS amplifiers. |
| 2. | Transfer characteristics of Differential Amplifiers. |
| 3. | Characterization of Cascode Amplifiers. |
| 4. | Characterization of Cascade Amplifiers. |
| 5. | Determination of bandwidth of single stage amplifiers. |
| 6. | Analysis of BJT with Fixed bias and Voltage divider bias using Spice. |
| 7. | Analysis of FET with fixed bias, self-bias and voltage divider bias using simulation software like Spice. |
| 8. | Analysis of Cascode and Cascade amplifiers using Spice. |
| | **Total: 30** |
| **REFERENCES/MANUAL/SOFTWARE:** | |
| 1. | Laboratory Manual |
| 2. | SPICE |

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Analyze the Characteristics of various transiter amplifiers | K4 |
| CO2 | Analyze performance parameters of differential amplifier | K4 |
| CO3 | Investigate the frequency response of single stage amplifiers | K4 |
| CO4 | Examine Various biasing methods using SPICE simulation | K4 |
| CO5 | Infer the frequency response of single and multistage amplifiers using SPICE simulation | K4 |

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

## AEC304 - DIGITAL ELECTRONICS LABORATORY

| **Programme & Branch** | **BE & ECE** | **Sem** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| | | **2** | **PC** | **0** | **0** | **2** | **1** |
| Preamble | To build a firm foundation on electronic circuits. | | | | | | |
| **List of Exercises / Experiments:** | | | | | | | |
| 1. | Verification of Boolean theorems using logic gates. | | | | | | |
| 2. | Design and implementation of combinational circuits using gates for arbitrary functions. | | | | | | |
| 3. | Implementation of 4-bit binary adder/subtractor circuits. | | | | | | |
| 4. | Implementation of code converters. | | | | | | |
| 5. | Implementation of BCD adder, encoder, and decoder circuits. | | | | | | |

| | |
|---|---|
| 6. | Design and implementation of Multiplexer and De-multiplexer using logic gates |
| 7. | Construction and verification of 4-bit ripple counter and Mod-10 / Mod-12 Ripple counters |
| 8. | Design and implementation of 3-bit synchronous up/down counter |
| 9. | Design and implementation of SISO, SIPO, PISO, PIPO Shift Registers. |
| 10. | Design and Implementation of a Universal Shift register. |
| | **Total: 30** |

**REFERENCES/MANUAL/SOFTWARE:**

| | |
|---|---|
| 1. | Laboratory Manual |

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Design various combinational digital circuits using logic gate | K4 |
| CO2 | Design distinct code converters. | K4 |
| CO3 | Design Coding and multiplexing circuits using logic gates | K4 |
| CO4 | Analyze the performance of different types of shift registers. | K4 |
| CO5 | Design different types of counters. | K4 |

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

## APH301 - COMPUTATIONAL PHYSICS LABORATORY

| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| | | **2** | **BS** | **0** | **0** | **4** | **2** |

**Preamble**

- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To make the student an active participant in each part of all exercises.

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects |
| 2. | Simple harmonic oscillations of cantilever |
| 3. | Non-uniform bending - Determination of Young's modulus |
| 4. | Uniform bending – Determination of Young's modulus |
| 5. | Laser- Determination of the wavelength of the laser using grating |
| 6. | Air wedge - Determination of thickness of a thin sheet/wire |
| 7 (a). | Optical fibre -Determination of Numerical Aperture and acceptance angle |
| 7(b). | Compact disc- Determination of width of the groove using laser |
| 8. | Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids |

| | | |
|---|---|---|
| | | **Total: 60** |
| **REFERENCES/MANUAL/SOFTWARE:** | | |
| 1. | Laboratory Manual | |
| **COURSE OUTCOMES:**<br>Upon completion of the course, the students should be able to | | **Bloom's Taxonomy Level** |
| CO1 | Understand the functioning of various physics laboratory equipment | K2 |
| CO2 | Use graphical models to analyze laboratory data | K4 |
| CO3 | Use mathematical models as a medium for quantitative reasoning and describing physical reality | K2 |
| CO4 | Access, process and analyze scientific information | K4 |
| CO5 | Solve problems individually and collaborative | K3 |

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

| AMC301 - YOGA AND HAPPY LIVING | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme& Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **2** | **MC** | **0** | **0** | **3** | **0** |
| | | | | | | | |
| Preamble | ➢ To gain a foundational understanding of the principles and philosophy underlying Asana (physical postures), Pranayama (breathing techniques), and Mudra (gestures).<br>➢ To practice breathing techniques (pranayama) that can be performed while seated, improving respiratory function and promoting relaxation.<br>➢ To develop the skills and confidence to sustain a personal Mudra Pranayama practice, fostering long-term physical, mental, and emotional health benefits.<br>➢ To Cultivate positive relationships and social connections.<br>➢ To Foster personal growth and self-awareness. | | | | | | |
| **Unit – I** | **Foundations of Yoga: Asana, Pranayama, and Mudra Practices** | | | | | | **6** |
| Introduction to Asana – Pranayama – Mudhra – Practices | | | | | | | |
| **Unit – II** | **Yoga on a Chair: Practicing Sugasana, Padhmasana, Vajrasana, and Dhrona Mudra** | | | | | | **6** |
| Sugasana – Padhmasana – Vajrasana – On chair with Dhrona mudhra - Practices | | | | | | | |
| **Unit – III** | **Essential Mudra Pranayama: Introduction to Types and Sectional Breathing** | | | | | | **6** |
| Mudhra Pranayama – Intro. – Types – Sectional Breathing - Practices | | | | | | | |
| **Unit – IV** | **Building Positive Relationships** | | | | | | **6** |
| The importance of social connections -Effective communication skills - Conflict resolution and empathy | | | | | | | |
| **Unit – V** | **Work-Life Balance** | | | | | | **6** |
| Time management and prioritization - Setting boundaries and saying no - Finding purpose and meaning in work. | | | | | | | |
| | | | | | | | **Total:30** |

**REFERENCES:**


| | |
|---|---|
| 1. | B.K.S. Iyengar, Light on Yoga", HarperCollins Publishers, Latest Edition. |
| 2. | "The Yoga Sutras of Patanjali" translated by Sri Swami Satchidananda, Integral Yoga Publications, Latest Edition. |
| 3. | Gretchen Rubin "The Happiness Project", HarperCollins Publishers, Latest Edition. |
| 4. | Tal Ben-Shahar, "Happier: Learn the Secrets to Daily Joy and Lasting Fulfillment", McGraw-Hill Education, Latest Edition. |


| **Course Outcomes** |
|---|
| Upon successful completion of the course, the student will be able to |

| | |
|---|---|
| CO1 | Gain knowledge of the basic postures (asanas) in yoga, including their physical and mental benefits. |
| CO2 | Learn the correct technique and benefits of Sukhasana (Easy Pose), a simple cross-legged sitting posture that promotes relaxation and meditation. |
| CO3 | Understand the basic principles of pranayama, including its importance in yoga and overall health. |
| CO4 | Understand the significance of building and maintaining strong social connections and how these connections contribute to overall well-being and success in personal and professional life. |
| CO5 | Improve their decision-making skills by learning how to evaluate tasks and commitments in relation to their goals and values. |

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | - | - | - | - | 1 | - | - | 1 | - | - | 1 | - | - |
| CO2 | - | - | - | - | - | 1 | - | - | 1 | - | - | 1 | - | - |
| CO3 | - | - | - | - | - | 1 | - | - | 1 | - | - | 1 | - | - |
| CO4 | - | - | - | - | - | 1 | - | - | 1 | - | - | 1 | - | - |
| CO5 | - | - | - | - | - | 1 | - | - | 1 | - | - | 1 | - | - |

JEPPIAAR INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

Self-Belief | Self Discipline | Self Respect

Kunnam, Sunguvarchatram, Sriperumbudur-631604

# DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

## AUTONOMOUS SYLLABUS R2024

## CHOICE BASED CREDIT SYSTEM

# SEM – III

| AMA104 - TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE& ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **3** | **BS** | **3** | **1** | **0** | **4** |
| Preamble | ➢ Understand the applications of Fourier series in engineering apart from its uses in solving boundary value problems.<br>➢ Understand the basic concepts of the Fourier transform techniques and its application in Engineering.<br>➢ Use the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems. | | | | | | |
| **Unit 1** | **PARTIAL DIFFERENTIAL EQUATIONS** | | | | | | **9+3** |
| Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation – Linear homogeneous partial differential equations of second and higher order with constant coefficients. | | | | | | | |
| **Unit 2** | **FOURIER SERIES** | | | | | | **9+3** |
| Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Parseval's identity – Harmonic analysis. | | | | | | | |
| **Unit 3** | **APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS** | | | | | | **9+3** |
| Classification of PDE – Method of separation of variables - Solutions of one-dimensional wave equation using Fourier series – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Cartesian coordinates only). | | | | | | | |
| **Unit 4** | **FOURIER TRANSFORMS** | | | | | | **9+3** |
| Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity | | | | | | | |
| **Unit 5** | **Z – TRANSFORMS** | | | | | | **9+3** |
| Z- transforms - Elementary properties – Convolution theorem - Inverse Z - transform using partial and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform. | | | | | | | |
| | | | | | | | **Total: 60** |
| **TEXTBOOKS** | | | | | | | |
| 1 | Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley India, 2011. | | | | | | |
| 2 | Grewal. B.S., Higher Engineering Mathematics, 42nd Edition, Khanna Publishers, Delhi, 2012. | | | | | | |
| 3 | Narayanan. S., ManickavachagamPillay. T. K and Ramanaiah. G Advanced Mathematics for Engineering Students, Vol. II & III, S. Viswanathan Publishers Pvt. Ltd.1998. | | | | | | |
| **REFERENCES** | | | | | | | |
| 1 | Veerarajan. T., Transforms and Partial Differential Equation, Tata McGraw Hill Publishing Company Limited, New Delhi, 2012. | | | | | | |

| | |
|---|---|
| 2 | Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill Education Private Ltd., 9th Edition, New Delhi 2010 |
| 3 | Michael Greenberg, Advanced Engineering Mathematics, 2nd Edition, Pearson Education, 2011 |

| **COURSEOUTCOMES: At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Acquire problem solving skills to handle first order and higher order Partial differential equations. | K3 |
| CO2 | Demonstrate Fourier series to study the behaviour of periodic functions and their applications in engineering problems such as system communications, digital signal processing and field theory. | K3 |
| CO3 | Develop skills in classification, formulation, solution, and interpretation of PDE models. | K3 |
| CO4 | Develop the skill of conversion between time domain to frequency domain using the concept of Fourier Transforms. | K3 |
| CO5 | Use the effective mathematical tools for the solutions of partial differential equations by using Z-transform techniques for discrete time systems. | K4 |

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

## AEC106 - SIGNALS AND SYSTEMS

| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| | | **3** | **PC** | **3** | **0** | **0** | **3** |

| | |
|---|---|
| Preamble | ➢ This course provides a foundation for understanding the various types of signals and systems.<br>➢ Processing signals is the process of digitizing real-world signals and then manipulating them mathematically in time or frequency domain.<br>➢ It helps in noise suppression in communication. |

| **Unit – I** | **CLASSIFICATION OF SIGNALS AND SYSTEMS** | **9** |
|---|---|---|

Basic Operation on the signals- Classification of Signals: Continuous Time and Discrete Time- Classification of systems: Continuous Time systems and Discrete Time Systems

| **Unit – II** | **CONTINUOUS TIME SIGNAL ANALYSIS** | **9** |
|---|---|---|

Fourier Series representation of Periodic Signals-Convergence issues-Properties-Continuous Time Fourier Transform-Properties

| Unit – III | CONTINUOUS TIME SYSTEM ANALYSIS | 9 |
|---|---|---|
| Continuous Time LTI systems -Laplace Transform-Region of Convergence-Properties- Analysis and characterization of LTI systems using the Laplace Transform | | |
| **Unit – IV** | **DISCRETE TIME SIGNAL ANALYSIS** | **9** |
| Sampling Theorem-Reconstruction of a signal from its samples-Aliasing- Fourier Series representation of Discrete Time Periodic Signals- Properties-Discrete Time Fourier Transform-Properties | | |
| **Unit – V** | **DISCRETE TIME SYSTEM ANALYSIS** | **9** |
| Discrete Time LTI systems- Z-Transform-Region of Convergence-Properties-Inverse Z Transform-Analysis and characterization of LTI systems using the Z Transform | | |
| | | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | Ramesh Babu.P, Anandanatarajan.R,"Signals and Systems "5th Revised Edition, Vijay Nicole Imprints, 2022 |
| 2. | Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson, 2007 |
| 3. | B. P. Lathi, "Principles of Linear Systems and Signals", Second Edition, Oxford, 2009 |

**REFERENCES:**

| | |
|---|---|
| 1. | Simon Haykin,"Signals and Systems",Secod Edition,John Wiley,1999 |
| 2. | R.E.Zeimer, W.H.Tranter and R.D.Fannin, "Signals & Systems - Continuous and Discrete", Pearson, 2007. |
| 3. | John Alan Stuller, —An Introduction to Signals and Systems, Thomson, 2007. |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Analyze the properties of signals & systems | K4 |
| CO2 | Apply Fourier Series and Fourier transform in Continuous time signal analysis | K3 |
| CO3 | Analyze continuous time LTI systems using Fourier and Laplace Transforms | K4 |
| CO4 | Apply Fourier Series and Fourier transform in Discrete time signal analysis | K3 |
| CO5 | Examine discrete time LTI systems using Z transform and DTFT | K4 |

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

## AEC107 - CONTROL SYSTEMS

| Programme & Branch | BE & ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **3** | **PC** | **3** | **0** | **0** | **3** |

| | |
|---|---|
| Preamble | ➢ In this course it aims to introduce to the students the principles and applications of control systems in everyday life.<br>➢ The basic concept of block diagram reduction, time domain analysis solutions to time invariant systems and deals with the different aspects of stability analysis of systems in time domain and frequency domain |

| | | |
|---|---|---|
| **Unit – I** | **Introduction** | **9** |

Concept of control system, Classification of control systems – Open loop and closed loop control systems, Differences, Examples of control systems- Effects of feedback, Feedback Characteristics. Transfer Function Representation: Block diagram algebra, Determining the Transfer function from Block Diagrams, Signal flow graphs (SFG) – Reduction using Mason's gain formula- Transfer function of SFG's.

| | | |
|---|---|---|
| **Unit – II** | **Time Response Analysis** | **9** |

Standard test signals, Time response of first order systems, Characteristic Equation of Feedback control systems, Transient response of second order systems – Time domain specifications, Steady state response, Steady state errors and error constants. PID controllers: Effects of proportional derivative, proportional integral systems on steady state error.

| | | |
|---|---|---|
| **Unit – III** | **Stability Analysis in S-Domain** | **9** |

The concept of stability – Routh-Hurwitz's stability criterion – qualitative stability and conditional stability – Limitations of Routh-Hurwitz's stability. Root Locus Technique: Concept of root locus – Construction of root locus.

| | | |
|---|---|---|
| **Unit – IV** | **Frequency Response Analysis** | **9** |

Introduction, Frequency domain specifications, Bode plot diagrams-Determination of Phase margin and Gain margin, Stability analysis from Bode plots, Polar plots.

| | | |
|---|---|---|
| **Unit – V** | **State Space Analysis of Continuous Systems** | **9** |

Concepts of state, state variables and state model, Derivation of state models from block diagrams, Diagonalization, Solving the time invariant state equations, State Transition Matrix and it's properties, Concepts of Controllability and observability.

**Total:45**

**TEXTBOOK:**

| | |
|---|---|
| 1. | R. Stefani, B. Shahrian, C. Savant & G. Hostetter, "Design of Feedback Control Systems", Oxford University Press, 2002. |
| 2. | K. Ogata, "Modern Control Engineering", Prentice Hall, 1997. |

**REFERENCES:**

| | |
|---|---|
| 1. | B. C. Kuo & F. Golnaraghi, "Automatic Control Systems", John Wiley, 2003. |
| 2. | M. Gopal, "Control Systems: Principles and Designs", 2nd Edition, McGraw Hill, 2002. |
| 3. | R. C. Dorf & R. H. Bishop, "Modern Control Systems", Prentice Hall, 2000 |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Analysis the modeling of linear-time-invariant systems using transfer function and state space forms. | K4 |
| CO2 | Analyze the system response and stability in both time, domain | K3 |

| | | |
|---|---|---|
| CO3 | Analyze the system response and stability in frequency domain. | K4 |
| CO4 | Apply and Design different types of compensators using in time-domain and frequency domain specifications. | K3 |
| CO5 | Analyze the system response and stability of systems represented in state space form | K4 |

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

## AEC108 - ELECTROMAGNETIC FIELDS

| Programme & Branch | BE & ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | 3 | PC | 3 | 0 | 0 | 3 |

| | |
|---|---|
| Preamble | ➢ This course provides a foundation for understanding the basics of Static Electric, Magnetic and Electromagnetic Fields.<br>➢ To study the Electric and Magnetic fields through Faraday's Law, Displacement Current and Maxwell's Equation.<br>➢ It helps to determine the Significance of Time Varying Fields and Propagation of EM Waves. |

| | | |
|---|---|---|
| **Unit – I** | **INTRODUCTION** | **9** |

Electromagnetic model - Units and constants - Review of vector algebra - Rectangular, cylindrical and spherical coordinate systems - Line, surface and volume integrals - Gradient of a scalar field - Divergence of a vector field - Divergence theorem - Curl of a vector field - Stoke's theorem - Null identities - Helmholtz's theorem

| | | |
|---|---|---|
| **Unit – II** | **ELECTROSTATICS** | **9** |

Electric field, 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 - Electrostatics boundary value problems - Capacitance, Parallel, cylindrical and spherical capacitors, Electrostatic energy - Poisson's and Laplace's equations

| | | |
|---|---|---|
| **Unit – III** | **MAGNETOSTATICS** | **9** |

Lorentz force equation - Ampere's law - Vector magnetic potential - Biot-Savart law and applications - Magnetic field intensity and idea of relative permeability - Calculation of magnetic field intensity for various current distributions Magnetic circuits - Behaviour of magnetic materials - Boundary conditions - Inductance and inductors - Magnetic energy - Magnetic forces and torques

| | | |
|---|---|---|
| **Unit – IV** | **TIME-VARYING FIELDS AND MAXWELL's EQUATIONS** | **9** |

Faraday's law - Displacement current and Maxwell-Ampere law - Maxwell's equations - Potential functions - Electromagnetic boundary conditions - Wave equations and solutions - Time-harmonic fields - Observing the Phenomenon of wave propagation with the aid of Maxwell's equations

| | | |
|---|---|---|
| **Unit – V** | **PLANE ELECTROMAGNETIC WAVES** | **9** |

Plane waves in lossless media - Plane waves in lossy media (low-loss dielectrics and good conductors), Group velocity - Electromagnetic power flow and Poynting vector - Normal incidence at a plane conducting boundary - Normal incidence at a plane dielectric boundary

**Total:45**

**TEXTBOOK:**

| | |
|---|---|
| 1. | K.A.Gangadhar and P.M.Ramanathan, Electromagnetic Field Theory (Including Antennas and Wave Propagation), Khanna Publishers, Standard Edition (1 January 1997) |
| 2. | D.K. Cheng, Field and wave electromagnetics, 2nd ed., Pearson (India), 2002 |
| 3. | M.N.O.Sadiku and S.V. Kulkarni, Principles of electromagnetics, 6th ed., Oxford(Asian Edition), 2015 |
| **REFERENCES:** | |
| 1. | Edward C. Jordan & Keith G. Balmain,Electromagnetic waves and Radiating Systems, Second Edition, Prentice-Hall Electrical Engineering Series, 2012. |
| 2. | W.H. Hayt and J.A. Buck, Engineering electromagnetics, 7th ed., McGraw-Hill (India), 2006 |
| 3. | B.M. Notaros, Electromagnetics, Pearson: New Jersey, 2011 |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Relate the fundamentals of vector, coordinate system to electromagnetic concepts | K3 |
| CO2 | Analyze the characteristics of Electrostatic field | K4 |
| CO3 | Interpret the concepts of Electric field in material space and solve the boundary conditions | K4 |
| CO4 | Explain the concepts and characteristics of Magneto Static field in material space and solve boundary conditions. | K4 |
| CO5 | Determine the significance of time varying fields | K4 |

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO 9 | PO10 | PO 11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | 1 | 1 | - | | | | | 1 | - | 2 | 1 | 2 |
| CO2 | 2 | 2 | 3 | 3 | 2 | | | | | 1 | 1 | 2 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 2 | 2 | | | | | 1 | 1 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 3 | 2 | 2 | | | | | 1 | 1 | 2 | 1 | 1 |
| CO5 | 2 | 2 | 2 | 2 | 2 | | | | | 2 | 2 | 1 | 2 | 2 |

| AEC109 - MICROPROCESSOR AND MICROCONTROLLER | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **3** | **PC** | **3** | **0** | **0** | **3** |
| | | | | | | | |
| Preamble | ➢ This course understands the architecture of Microprocessor and Microcontroller. It helps to interface microcontroller with supporting chips.<br>➢ It helps to o study the Architecture of RISC Processor.<br>➢ It helps to design a microcontroller-based system | | | | | | |
| **Unit – I** | **THE 8086 MICROPROCESSORS** | | | | | | **9** |
| Overview of Microprocessors, 8086 – Architecture, Signals, Addressing modes, Instruction set and assembler directives, Assembly language programming, Stacks, Procedures, Macros, Interrupts and interrupt service routines, System bus timing. | | | | | | | |
| **Unit – II** | **8051 MICROCONTROLLERS** | | | | | | **9** |
| Functional block diagram and pin diagram of 8051- Power supply, clock and reset circuit- Program Counter and ROM space in 8051-Program and Data Memory organization-addressing modes. Instruction Set: data transfer, arithmetic and logical, program branching instructions and Boolean variable manipulation. | | | | | | | |
| **Unit – III** | **ON-CHIP PERIPHERALS AND PROGRAMMING TECHNIQUES** | | | | | | **9** |
| Parallel Port Structure and bit-manipulation programming, timer/counter-Operating Modes-Programming 8051 Timers - Counter Programming-Serial Communication: Basics of Serial Communication-UART Operating Modes-RS232 Standards-8051 connection to RS232-Serial Port Programming. Interrupt: 8051 Interrupt- External and Internal Interrupts- Programming timer Interrupts, external hardware interrupts and serial communication interrupts -Interrupt Priority and Programming. Power Saving Modes. | | | | | | | |
| **Unit – IV** | **PERIPHERAL INTERFACING AND PROGRAMMING** | | | | | | **9** |
| Parallel communication interface, Serial communication interface, D/A and A/D Interface, Timer, Keyboard /display controller, Traffic Light control, and Stepper Motor Interfacing Techniques | | | | | | | |
| **Unit – V** | **RISC ARCHITECTURE** | | | | | | **9** |
| Overview of RISC processor, Hybrid architecture, Advantages of RISC, Features of RISC, Design issues of RISC Processor, Performance issues in pipelined system, Architecture of ARM7 and Sun Ultra SPARC. | | | | | | | |
| | | | | | | | **Total:45** |
| **TEXTBOOK:** | | | | | | | |
| 1. | Muhammad Ali Mazidi, J.G. Mazidi, R.D. McKinlay," The 8051 Microcontroller and Embedded Systems", Second Edition, Prentice Hall of India Pvt. Ltd., 2007 | | | | | | |
| 2. | A.K.Ray,K.M.Bhurchandi, "Advanced Microprocessors and Peripherals" 3rd edition, Tata McGrawHill, 2012 | | | | | | |
| **REFERENCES:** | | | | | | | |
| 1. | Krishna Kant, — "Microprocessors and Microcontrollers- Architecture, programming and system design 8085, 8086, 8051,8096", Prentice Hall of India, New Delhi, 2007. | | | | | | |
| 2. | Kenneth J Ayala, — "The 8051 Microcontroller – Architecture, Programming and Applications", Penram International Publications, Mumbai India, 1996 | | | | | | |

| | |
|---|---|
| 3. | Doughlas V.Hall,"Microprocessors and Interfacing, Programming and Hardware", TMH, 2012 |
| | |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Analyze the programs on 8086 microprocessors | K3 |
| CO2 | Interpret 8051 Microcontrollers architecture and its functionalities. | K2 |
| CO3 | Design microcontroller-based systems for real time applications | K3 |
| CO4 | Interface the peripherals and I/O devices using 8051 microcontrollers. | K3 |
| CO5 | Analyze the architecture of RISC processors. | K3 |

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

| **AEC110 - ANALOG AND DIGITAL COMMUNICATION** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **3** | **PC** | **3** | **0** | **0** | **3** |
| **Preamble** | ➢ To endow the fundamentals and analytical perspectives of communication systems. | | | | | | |
| **Unit - I** | **Amplitude Modulation** | | | | | | **9** |
| Introduction: Modulation and its need– Linear modulation schemes: DSBSC, SSBSC and VSB-power spectrum –Frequency translation – Frequency division multiplexing – Super heterodyne receivers – Noise in AM receivers: coherent detection, envelope detection. | | | | | | | |
| **Unit - II** | **Angle Modulation** | | | | | | **9** |
| Frequency modulation, Narrowband FM, Wideband FM – Generation of FM: indirect method – FM demodulation: frequency discriminator – Non-linear effects in FM systems – Noise in FM receivers – capture effect – pre-emphasis and de-emphasis in FM | | | | | | | |
| **Unit - III** | **Pulse Modulation and Baseband Pulse Transmission** | | | | | | **9** |
| Sampling process – PAM – Quantization process –PCM – TDM – Delta modulation, Line coding: unipolar NRZ, Polar NRZ, Unipolar RZ, Manchester – Matched Filter as optimum receiver – Inter symbol Interference – Eye patterns – Nyquist Criterion for distortion less baseband binary transmission – Pulse shaping with raised cosine filter – Duobinary signaling – Adaptive equalization: LMS algorithm | | | | | | | |
| **Unit - IV** | **Passband Digital Transmission and Spread Spectrum Communication** | | | | | | **9** |
| Introduction – Coherent Phase shift keying: BPSK, QPSK, OQPSK, π/4 shifted QPSK – QAM- BER analysis of BPSK and QPSK-concepts of MSK-Spread Spectrum: PN sequence and its properties- Direct Sequence Spread Spectrum- Frequency Hopping Spread Spectrum | | | | | | | |
| **Unit - V** | **Information Theory and Coding** | | | | | | **9** |

| |
|---|
| Entropy and its properties – Source coding theorem: Huffman coding, LZ coding – Discrete Memory less Channel –mutual information and its properties – Channel coding theorem – information capacity theorem; Hamming codes –Convolutional codes – Trellis diagram– Viterbi algorithm – Trellis coded modulation :8 ary PSK |
| **Total:45** |

| **TEXTBOOK:** | |
|---|---|
| 1. | Simon Haykin, Michael Moher, "Introduction to Analog and Digital Communications", 2nd Edition, John Wiley &Sons, New Delhi, 2012. |
| **REFERENCES:** | |
| 1. | B.P.Lathi,"Modern Analog and Digital Communication Systems", 3 rd Edition, Oxford University Press,2007. |
| 2. | Gautam Sahe, Taub & Schilling, "Principles of Communication Systems", 4th Edition, McGraw-Hill, New Delhi,2007. |
| 2. | Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2009. |

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Infer the effect of noise in AM receivers | K3 |
| CO2 | Interpret the effect of noise in FM receivers | K3 |
| CO3 | Identify inter-symbol interference | K3 |
| CO4 | Apply the scheme of passband digital transmission | K3 |
| CO5 | Inspect the characteristics of discrete memory less channel forlossless, error free communication | K4 |

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

| **AMC104 - ENVIRONMENTAL ENGINEERING AND SUSTAINABILITY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Programme & Branch** | **BE& ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **3** | **MC** | **2** | **0** | **0** | **0** |
| Preamble | ➢ To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.<br>➢ To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.<br>➢ To facilitate the understanding of global and Indian scenario of renewable and non renewable resources, causes of their degradation and measures to preserve them.<br>➢ To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of | | | | | | |

| | | |
|---|---|---|
| | sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.<br>➢ To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization. | |
| **Unit 1** | **ENVIRONMENT AND BIODIVERSITY** | **6** |
| Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ. | | |
| **Unit 2** | **ENVIRONMENTAL POLLUTION** | **6** |
| Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts. | | |
| **Unit 3** | **RENEWABLE SOURCES OF ENERGY** | **6** |
| Energy management and conservation, New Energy Sources: Need of new sources. Different types of new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy. | | |
| **Unit 4** | **SUSTAINABILITY AND MANAGEMENT** | **6** |
| Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study. | | |
| **Unit 5** | **SUSTAINABILITY PRACTICES** | **6** |
| Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles - carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio economic and technological change. | | |
| | | **Total: 30** |

**TEXTBOOKS**


| | |
|---|---|
| 1 | Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018. |
| 2 | Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016. |
| 3 | Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004. |
| 4 | Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall. |
| 5 | Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning. |

| | |
|---|---|
| 6 | Environment Impact Assessment Guidelines, Notification of Government of India, 2006. |
| 7 | Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998. |
| **REFERENCES** | |
| 1 | R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 . Edition 2010. |
| 2 | Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001. |
| 3 | Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007. |
| 4 | Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015. |
| 5 | Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013. |

| **COURSEOUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation. | K2 |
| CO2 | To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society. | K2 |
| CO3 | To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations. | K2 |
| CO4 | To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development. | K2 |
| CO5 | To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization. | K2 |

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

| **AHS302 - SOFT SKILLS I (COMPREHENSIVE SOFT SKILLS DEVELOPMENT)** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme &** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Branch** | | **3** | **HS** | **0** | **0** | **2** | **0** |
| Preamble | | | | | | | |

| | | |
|---|---|---|
| **Unit 1** | **Foundations of Communication Skills** | 8 |

- Introduction to Communication Skills
- Understanding the Communicative Environment
- Active Listening Skills
- Effective Speaking Techniques
- Initiating and Sustaining Conversations

| | | |
|---|---|---|
| **Unit 2** | **Advanced Communication Techniques** | 8 |

- Presentation Skills – Structuring Content
- Using Multimedia in Presentations
- Understanding Communication Styles
- Group Communication and Dynamics

| | | |
|---|---|---|
| **Unit 3** | **Critical Thinking and Communication** | 8 |

- Introduction to Critical Thinking
- Analyzing Arguments and Information
- Constructing Clear and Persuasive Arguments
- Problem-Solving and Decision-Making
- Interactive Exercises and Case Studies

| | | |
|---|---|---|
| **Unit 4** | **Emotional Intelligence in Communication** | 8 |

- Introduction to Emotional Intelligence (EI).
- Self-Awareness and Self-Regulation Empathy and Social Skills
- Managing Stress and Emotions in Communication.
- Practical Exercises in EI

| | | |
|---|---|---|
| **Unit 5** | **Integrating Soft Skills for Effective Communication** | 8 |

- Motivation and Persuasion Techniques
- Negotiation Skills
- Leadership Communication
- Applying Soft Skills in the Workplace
- Final Project and Presentations

**Total:40**

**REFERENCES:**


| | |
|---|---|
| 1. | Business Communication: Making Connections in a Digital World by Raymond V. Lesikar, Marie E. Flatley, Kathryn Rentz. |
| 2. | Everyone Communicates, Few Connect: What the Most Effective People Do Differently by John C. Maxwell. |
| 3. | Emotional Intelligence: Why It Can Matter More Than IQ by Daniel Goleman |
| 4. | Leaders Eat Last: Why Some Teams Pull Together and Others Don't by Simon Sinek |


| **AEC305 - MICROPROCESSOR AND MICROCONTROLLER LABORATORY** |
|---|
| |

| Programme & Branch | BE & ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | 3 | PC | 0 | 0 | 2 | 1 |
| **Preamble** | To Introduce ALP concepts, features, and Coding methods | | | | | | |
| **List of Exercises / Experiments:** | | | | | | | |
| | **8086 Programs using kits and MASM** | | | | | | |
| 1. | Basic arithmetic and Logical operations | | | | | | |
| 2. | Move a data block without overlap | | | | | | |
| 3. | Code conversion, decimal arithmetic, and Matrix operations. | | | | | | |
| 4. | Floating point operations, string manipulations, sorting and searching | | | | | | |
| 5. | Password checking, Print RAM size and system date | | | | | | |
| 6. | Counters and Time Delay | | | | | | |
| | **Peripherals and Interfacing Experiments** | | | | | | |
| 7. | Traffic light controller | | | | | | |
| 8. | Stepper motor control | | | | | | |
| 9. | Keyboard and Display | | | | | | |
| 10. | A/D and D/A interface and Waveform Generation | | | | | | |
| 11. | Serial interface and Parallel interface | | | | | | |
| | **8051 Experiments using kits and MASM** | | | | | | |
| 12. | Basic arithmetic and Logical operations | | | | | | |
| 13. | Square and Cube program, Find 2's complement of a number | | | | | | |
| 14. | Unpacked BCD to ASCII | | | | | | |
| | **Total: 30** | | | | | | |
| **REFERENCES/MANUAL/SOFTWARE:** | | | | | | | |
| 1. | Laboratory Manual | | | | | | |
| 2. | MASM | | | | | | |

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Write ALP Programs for fixed and Floating Point and Arithmetic | K2 |
| CO2 | Interface different I/Os with processor | K3 |
| CO3 | Generate waveforms using Microprocessors | K3 |
| CO4 | Implement the basic programs in 8051 microcontrollers | K3 |
| CO5 | Write ALP Programs in 8051 using MASM | K2 |

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

| AEC306 - ANALOG AND DIGITAL COMMUNICATION LABORATORY | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE & ECE** | **Sem** | **Category** | **L** | **T** | **P** | **C** |
| | | **3** | **PC** | **0** | **0** | **2** | **1** |
| **Preamble** | To build a firm foundation on analog and digital communication systems. | | | | | | |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Verification of analog pulse modulation using discrete components |
| 2. | Verification of Pulse code modulation and demodulation |
| 3. | Verification of Delta Modulation and demodulation |
| 4. | Verification of PAM, PPM & PWM Modulation and demodulation |
| 5. | Verification of Time division multiplexing and demultiplexing |
| 6. | Simulation of line coding schemes |
| 7. | Simulation of AM & FM Modulation and Demodulation |
| 8. | Simulation of Analog signal sampling and reconstruction |
| 9. | Simulation of ASK, PSK, FSK |
| 10. | Simulation of DPSK, QPSK, QAM generation and detection schemes |
| 11. | Generation of Huffman coding and decoding |
| 12. | Simulation of Linear Block Codes and cyclic error control coding schemes |
| | **Total:30** |

**REFERENCES/MANUAL/SOFTWARE:**

| | |
|---|---|
| 1. | Laboratory Manual |
| 2. | MATLAB |

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Examine the analog modulation and analog to digital pulse conversion | K4 |
| CO2 | Analyze passband digital modulation | K4 |
| CO3 | Implementation of Shift keying using MATLAB | K4 |
| CO4 | Infer the performance of source coding | K3 |
| CO5 | Infer the performance of channel coding | K3 |

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

JEPPIAAR INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

Self-Belief | Self Discipline | Self Respect

Kunnam, Sunguvarchatram, Sriperumbudur-631604

# DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

## AUTONOMOUS SYLLABUS R2024

## CHOICE BASED CREDIT SYSTEM

# SEM – IV

| AEC111 - EMBEDDED SYSTEMS AND IOT DESIGN | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **4** | **PC** | **3** | **0** | **0** | **3** |
| | | | | | | | |
| Preamble | ➢ This course helps to understand the architecture and features of 8051.<br>➢ It helps to study the design process of an embedded system.<br>➢ It helps to understand the real – time processing in an embedded system. It helps to learn the architecture and design flow of IoT.<br>➢ To build an IoT based system. | | | | | | |
| **Unit – I** | **8051 MICROCONTROLLERS** | | | | | | **9** |
| Microcontrollers for an Embedded System – 8051 – Architecture – Addressing Modes – Instruction Set – program and Data Memory – Stacks – Interrupts – Timers/Counters – Serial Ports – Programming | | | | | | | |
| **Unit – II** | **EMBEDDED SYSTEMS** | | | | | | **9** |
| Embedded System Design Process – Model Train Controller – ARM Processor – Instruction Set Preliminaries – CPU – Programming Input and Output – Supervisor Mode – Exceptions and Trap – Models for programs – Assembly, Linking and Loading – Compilation Techniques – Program Level Performance Analysis. | | | | | | | |
| **Unit – III** | **PROCESSES AND OPERATING SYSTEMS** | | | | | | **9** |
| Structure of a real – time system – Task Assignment and Scheduling – Multiple Tasks and Multiple Processes – Multirate Systems – Preemptive real – time Operating systems – Priority based scheduling – Interprocess Communication Mechanisms – Distributed Embedded Systems – MPSoCs and Shared Memory Multiprocessors – Design Example – Audio Player, Engine Control Unit and Video Accelerator. | | | | | | | |
| **Unit – IV** | **IOT ARCHITECTURE AND PROTOCOLS** | | | | | | **9** |
| Internet – of – Things – Physical Design, Logical Design – IoT Enabling Technologies – Domain Specific IoTs – IoT and M2M – IoT System Management with NETCONF – YANG – IoT Platform Design – Methodology – IoT Reference Model – Domain Model – Communication Model – IoT Reference Architecture – IoT Protocols - MQTT, XMPP, Modbus, CANBUS and BACNet | | | | | | | |
| **Unit – V** | **IOT SYSTEM DESIGN** | | | | | | **9** |
| Basic building blocks of an IoT device – Raspberry Pi – Board – Linux on Raspberry Pi – Interfaces – Programming with Python – Case Studies: Home Automation, Smart Cities, Environment and Agriculture. | | | | | | | |
| | | | | | | | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | Mohammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D.McKinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C, Second Edition, Pearson Education, 2008.(Unit –I) |
| 2. | Marilyn Wolf, Computers as Components – Principles of Embedded Computing System Design, Third Edition, Morgan Kaufmann, 2012. (Unit – II, III) |
| 3. | Arshdeep Bahga, Vijay Madisetti, Internet – of- Things – A Hands-on Approach, Universities Press, 2015. (Unit – IV, V) |

**REFERENCES:**

| | |
|---|---|
| 1. | Mayur Ramgir, Internet – of – Things, Architecture, Implementation and Security, First Edition, Pearson Education, 2020. |
| 2. | Lyla B.Das, Embedded Systems: An Integrated Approach, Pearson Education 2013. |
| 3. | Jane.W.S .Liu, Real – Time Systems, Pearson Education, 2003. |

| | |
|---|---|
| | |

| COURSE OUTCOMES:<br>At the end of the course, learners will be able to | | Bloom's Taxonomy Level |
|---|---|---|
| CO1 | Explain the architecture and features of 8051. | K3 |
| CO2 | Develop a model of an embedded system | K2 |
| CO3 | List the concepts of real time operating systems | K3 |
| CO4 | Learn the architecture and protocols of IoT. | K3 |
| CO5 | Design an IoT based system for any application | K3 |

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

| AEC112 - DIGITAL SIGNAL PROCESSING | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **4** | **PC** | **3** | **0** | **0** | **3** |
| Preamble | ➢ This course will introduce the learners to various filter design and constructing various digital signal processors.<br>➢ This can be helpful to acquire knowledge on various applications of DSP processor. | | | | | | |
| **Unit – I** | **DISCRETE FOURIER TRANSFORM** | | | | | | **9** |
| Sampling Theorem, concept of frequency in discrete-time signals, summary of analysis & synthesis equations for FT & DTFT, frequency domain sampling, Discrete Fourier transform (DFT) - deriving DFT from DTFT, properties of DFT - periodicity, symmetry, circular convolution. Linear filtering using DFT. Filtering long data sequences - overlap save and overlap add method. 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 FFT. | | | | | | | |
| **Unit – II** | **INFINITE IMPULSE RESPONSE FILTERS** | | | | | | **9** |
| Characteristics of practical frequency selective filters. characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency 81 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** |
| Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - 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 - ADC - 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 - scaling to prevent overflow. | | |
| **Unit – V** | **INTRODUCTION TO DIGITAL SIGNAL PROCESSORS** | **9** |
| Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor – Adaptive Filters: Introduction, Applications of adaptive filtering to equalization-DSP Architecture Fixed and Floating-point architecture principles | | |
| | | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | John G. Proakis and Dimitris G.Manolakis, Digital Signal Processing – Principles, Algorithms and Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007. |
| 2. | A. V. Oppenheim, R.W. Schafer and J.R. Buck, ―Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004. |

**REFERENCES:**

| | |
|---|---|
| 1. | Emmanuel C. Ifeachor& Barrie. W. Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, 2002. |
| 2. | Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata Mc Graw Hill, 2007. |
| 3. | Andreas Antoniou, "Digital Signal Processing", Tata Mc Graw Hill, 2006. |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Apply DFT for the analysis of digital signals & systems | K3 |
| CO2 | Design IIR filters | K4 |
| CO3 | Design FIR filters | K4 |
| CO4 | Characterize the effects of finite precision representation on digital filters | K4 |
| CO5 | Apply adaptive filters appropriately in communication systems and DSP Processors | K3 |

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

## AEC113 - TRANSMISSION LINES AND RF SYSTEMS

| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| | | **4** | **PC** | **3** | **0** | **0** | **3** |

| | |
|---|---|
| Preamble | This course aims to provide students with the technological skills needed in understanding the behaviour of two wire line, planar transmission lines and the design of RF circuits. |

| Unit – I | TRANSMISSION LINE THEORY | 9 |
|---|---|---|
| Types, General theory of Transmission lines - the transmission line - general solution - terminated lossless two-wire line – characteristic impedance, propagation constant, input impedance. The infinite line -Wavelength, velocity of propagation - Waveform distortion - the distortion less line. | | |
| **Unit – II** | **HIGH FREQUENCY TRANSMISSION LINES** | **9** |
| 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 dissipation less line - Reflection losses. | | |
| **Unit – III** | **IMPEDANCE MATCHING IN HIGH FREQUENCY LINE** | **9** |
| Impedance matching: Quarter wave transformer, One Eighth wave line, Half wave line- Impedance matching by stubs- Single stub matching - Smith chart – Application of Smith chart, Single stub matching using Smith chart. | | |
| **Unit – IV** | **WAVEGUIDES** | **9** |
| Waves between parallel planes of perfect conductors- Transverse Electric waves and Transverse Magnetic waves, Characteristics of TE, TM and TEM waves, TM and TE waves in rectangular waveguides. | | |
| **Unit – V** | **ACTIVE RF DEVICES** | **9** |
| Active RF components: Bipolar junction transistors, RF field effect transistors, High electron mobility transistors, RF Amplifiers: power relation, stability considerations, gain considerations and noise figure. | | |
| | | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | David M. Pozar," Microwave Engineering," John Wiley & Sons, Fourth Edition, 2015. |
| 2. | G. S. N. Raju, Electromagnetic Field Theory and Transmission Lines, Pearson education 2009. |
| 3. | John D Ryder, "Networks lines and fields", Prentice Hall of India, New Delhi,2005. |
| 4. | Annapurna Das, Sisir K. Das, "Microwave Engineering", McGraw Hill Education (India) private limited, Third edition, 2000. |

**REFERENCES:**

| | |
|---|---|
| 1. | Mathew M. Radmanesh, "Radio Frequency & Microwave Electronics", Pearson Education Asia, Second Edition, 2002 |
| 2. | D. K. Misra, "Radio Frequency and Microwave Communication Circuits"- Analysis and Design, John Wiley & Sons, 2004. |
| 3. | Richard Chi-Hsi Li - , "RF Circuit Design" – A John Wiley & Sons, Inc, Publications |
| 4. | W.Alan Davis, Krishna Agarwal, "Radio Frequency Circuit Design", John willy & Sons,2001 |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Explain the characteristics of transmission lines and its losses. | K2 |
| CO2 | Calculate the standing wave ratio and input impedance in high-frequency transmission lines. | K3 |
| CO3 | Analyze impedance matching by stubs using Smith Charts. | K2 |
| CO4 | Comprehend the characteristics of TE and TM waves. | K3 |
| CO5 | Illustrate various RF active devices. | K3 |

| CO/PO | PO | PO2 | PO | PO4 | PO5 | PO6 | PO7 | PO8 | PO | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 3 | | | | | | 9 | | | | | |
| CO1 | 3 | 3 | 3 | 3 | 2 | 1 | | | | 1 | | 1 | 2 | 1 |
| CO2 | 3 | 2 | 2 | 3 | 2 | 1 | | | | 1 | | 1 | 2 | 1 |
| CO3 | 3 | 3 | 3 | 2 | 1 | 2 | | | | 1 | | 1 | 2 | 1 |
| CO4 | 3 | 3 | 2 | 3 | 2 | 1 | | | | 1 | | 1 | 2 | 1 |
| CO5 | 3 | 2 | 3 | 2 | 2 | 1 | | | | 1 | | 1 | 2 | 1 |

## AEC114 - LINEAR INTEGRATED CIRCUITS

| Programme & Branch | BE & ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | 4 | PC | 3 | 0 | 0 | 3 |

| | |
|---|---|
| Preamble | This course aims to provide students with the technological skills needed to understand the behavior of two-wire lines, planar transmission lines, and the design of RF circuits |

| **Unit – I** | **BASICS OF OPERATIONAL AMPLIFIERS** | **9** |
|---|---|---|

Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages - and internal circuit diagrams of IC 741, Current mirror and current sources, DC and AC performance characteristics, slew rate.

| **Unit – II** | **APPLICATIONS OF OPERATIONAL AMPLIFIERS** | **9** |
|---|---|---|

Sign Changer, Scale Changer, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Comparators, clipper and clamper.

| **Unit – III** | **ANALOG MULTIPLIER AND PLL** | **9** |
|---|---|---|

Analog multiplier ICs and their applications, - Gilbert Multiplier cell – Variable transconductance technique, Operation of the basic PLL, Voltage controlled oscillator, Monolithic PLL IC 565, Application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing.

| **Unit – IV** | **ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS** | **9** |
|---|---|---|

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, A/D Converters – specifications - Flash type – Successive Approximation type - Dual Slope type

| **Unit – V** | **WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS** | **9** |
|---|---|---|

Sine-wave generators, Triangular wave generator, Saw-tooth wave generator, Timer IC 555, IC Voltage regulators - IC 723 general purpose regulator - Audio Power amplifier, Video Amplifier, Isolation Amplifier.

**Total:45**

**TEXTBOOK:**


1. D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2018, Fifth Edition. (Unit I – V)
2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4th Edition, Tata Mc Graw-Hill, 2016 (Unit I – V)


**REFERENCES:**


1. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2015
2. Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2001
3. S.Salivahanan & V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH,2nd Edition, 4th Reprint, 2016.

| COURSE OUTCOMES:<br>At the end of the course, learners will be able to | | Bloom's Taxonomy Level |
|---|---|---|
| CO1 | Design linear and nonlinear applications of OP – AMPS | K3 |
| CO2 | Design applications using analog multiplier and PLL | K3 |
| CO3 | Design ADC and DAC using OP- Amp | K3 |
| CO4 | Generate waveforms using OP – AMP Circuits | K2 |
| CO5 | Analyze special function ICs | K4 |

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

**AHS303 - SOFT SKILLS II (SKILL ENHANCEMENT COURSE (SEC))**

| Programme & Branch | BE & ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | 4 | HS | 0 | 0 | 2 | 0 |

| | |
|---|---|
| Preamble | ➢ To acquaint the students with some very relevant and necessary soft skills and also to help them to develop their personality as well as to be self-motivated.<br>➢ The different units are designed in such a manner so as to give the students inputs on personality development, social skills, etiquette, communication skills, attitude, appearing and grooming. |

| Unit 1 | Foundations of Personal Development | 8 |
|---|---|---|

Attitude and Motivation-Significance –Positive and Negative Attitude Attitude-Advantages and Disadvantages of Attitude- Relationship between Attitude and Motivation- Concept, Significance and Importance of Self Motivation- De-motivation-Factors Affecting Motivation in Learning-Self and Identity-Distinction between Self- Respect and Ego-Transforming Ego to Self-Respect-Indian Perspective in Personality Development.

| Unit 2 | Personality Development | 8 |
|---|---|---|

Concept of Personality and Personality Development Definition-Determinants of Personality Development- Deterrents to Personality Development-Types of Personality-Introvert, Extrovert, and Ambivert- Dimensions of Personality-Physical, Intellectual, Emotional, Moral, Social, and Spiritual-Perception- Concept and Definition- Perceptual Process-Self.

| Unit 3 | Moral of Esteem and Leadership | 8 |
|---|---|---|

Esteem-Maslow and Eric Erikson's Idea of Self-Esteem- Mind Mapping, Competency Mapping, and

| | | |
|---|---|---|
| 360Degree Assessment-Cultivating Assertiveness-Leadership: Concept, Dimensions, and Types of Leadership. | | |
| **Unit 4** | **Etiquette and Grooming** | 8 |
| Etiquette-Importance in Personal and Professional Life- Principles and their Significance-Culture and Gender Sensitivity in Communication-Conversation Skills and Small Talk-Email and Telephone Etiquette-Online Etiquette: Managing Digital Presence and Reputation- Dress Code and Professional Appearance. | | |
| **Unit 5** | **Experiential Paradigm in Practice** | 8 |
| Self Awareness Definition and Development- SWOT Analysis-Interpersonal and Communication Skills-Self-Management Skills Definition and Examples-Goal Setting-Definition, Process and Examples-Positive Emotions and Well-being Resilience, Optimism, Compassion, Forgiveness, Gratitude. | | |
| | | **Total:40** |

**REFERENCES:**


| | |
|---|---|
| 1. | Atherton, J.B. (2002) Learning and teaching: Teaching from experience, Columbus. Ohio: Merrill. Carr, A. (2011). Positive Psychology: The Science of happiness and human strength. Routledge. |
| 2. | Cornelissen, R. M. M., Misra, G., & Varma, S., (2011). Foundation of Indian Psychology: Concepts and Theories. (Vol. 1), New Delhi: Pearson. |
| 3. | Covey, S. R. (2013). The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change. Simon & Schuster. |
| 4. | Exeter, D. J. (2001). Learning in the outdoors. London: Outward Bound. |
| 5. | Salmon, D & Maslow, J., (2007). Yoga Psychology and the Transformation of Consciousness: Seeing through the eyes of infinity. St. Paul, MN., USA: Paragon House. |
| 6. | Vohra, S. S. & Kailash. S. (2010). Experiential learning (section III) in Psychology of Turbulent Relationships. New Delhi: Icon Publishers. |
| 7. | Wentz, Frederick H. (2012). Soft Skills Training: A Workbook to Develop Skills for Employment. Create Space Independent Publishing Platform. |


| **COURSE OUTCOMES:** Upon completion of the course, the students should be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO | Appreciate the significance of soft skills and personality augmentation with reference to their personal as well as their professional lives. This course module will enhance the employability quotient of the students as well. In a nutshell, the module is on the lines of the 'finishing schools'. | K2 |

| **AEC307 - EMBEDDED SYSTEMS AND IOT DESIGN LABORATORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **4** | **PC** | **0** | **0** | **2** | **1** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

| | |
|---|---|
| **Preamble** | To learn the working of ARM processor and concepts of 8051 |
| **List of Exercises / Experiments:**<br>**Experiments using 8051** | |
| 1. | Programming Arithmetic and Logical Operations in 8051. |
| 2. | Generation of Square waveform using 8051 |
| 3. | Programming using on – Chip ports in 8051. |
| 4. | Programming using Serial Ports in 8051 |
| 5. | Design of a Digital Clock using Timers/Counters in 8051 |
| **Experiments using ARM** | |
| 6. | Interfacing ADC and DAC |
| 7. | Blinking of LEDs and LCD |
| 8. | Interfacing keyboard and Stepper Motor |
| | **Mini projects for IoT** |
| 9. | Garbage Segregator and Bin Level Indicator |
| 10. | Colour based Product Sorting |
| 11. | Image Processing based Fire Detection |
| 12. | Vehicle Number Plate Detection |
| 13. | Smart Lock System |
| | **Total: 30** |
| **REFERENCES/MANUAL/SOFTWARE:** | |
| 1. | Laboratory Manual |
| 2. | Keil µ vision-ARM Processor |

| **COURSE OUTCOMES:**<br>At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Explain the architecture and features of 8051. | K2 |
| CO2 | Implement the ALP Programs using 8051 | K3 |
| CO3 | Interface peripherals like memory, ADC, DAC, interrupt, keyboard, display, motor and sensor with ARM system | K3 |
| CO4 | Learn the architecture and protocols of IoT | K3 |
| CO5 | Formulate a mini project using IoT | K3 |

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

| **AEC308 - DIGITAL SIGNAL PROCESSING LABORATORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme &** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |

| Branch | | 4 | PC | 0 | 0 | 2 | 1 |
|---|---|---|---|---|---|---|---|
| Preamble | ➢ This course will introduce the learners to various filter design and constructing various digital signal processors.<br>➢ This can be helpful to acquire knowledge on various applications of DSP processor. | | | | | | |

**PRACTICAL EXERCISES:**

**MATLAB / EQUIVALENT SOFTWARE PACKAGE/ DSP PROCESSOR BASED IMPLEMENTATION**

1. Generation of elementary Discrete-Time sequences
2. Linear and Circular convolutions
3. Auto correlation and Cross Correlation
4. Frequency Analysis using DFT
5. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation
6. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations
7. Study of architecture of Digital Signal Processor
8. Perform MAC operation using various addressing modes
9. Generation of various signals and random noise
10. Design and demonstration of FIR Filter for Low pass, High pass, Band pass and Band stop filtering
11. Design and demonstration of Butter worth and Chebyshev IIR Filters for Low pass, High pass, Band pass and Band stop filtering
12. Implement an Up-sampling and Down-sampling operation in DSP Processor

**TOTAL:30**

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Carryout basic signal processing operations | K2 |
| CO2 | Demonstrate their abilities towards MATLAB based implementation of various DSP systems | K4 |
| CO3 | Analyze the architecture of a DSP Processor | K4 |
| CO4 | Design and Implement the FIR and IIR Filters in DSP Processor for performing filtering operation over real-time signals | K3 |
| CO5 | Design a DSP system for various applications of DSP | K3 |

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

| **AEC309 - LINEAR INTEGRATED CIRCUITS LABORATORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **4** | **PC** | **0** | **0** | **4** | **2** |
| **Preamble** | | | | | | | |

| | |
|---|---|
| | ➢ To gain hands on experience in designing electronic circuits. |
| **List of Exercises / Experiments:** | |
| 1. | Series and Shunt feedback amplifiers |
| 2. | RC Phase shift oscillator |
| 3. | Hartley Oscillator |
| 4. | Integrator and Differentiator circuits using Op-Amp |
| 5. | Clippers and Clampers |
| 6. | Active low-pass & High pass |
| 7. | Instrumentation Amplifier |
| **Experiments using Spice** | |
| 8. | Tuned Collector Oscillator |
| 9. | Wein Bridge Oscillator |
| 10. | Bistable Multivibrator |
| | **Total: 60** |

**REFERENCES/MANUAL/SOFTWARE:**

| | |
|---|---|
| 1. | Laboratory Manual |
| 2. | SPICE |

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Analyze various types of feedback amplifiers | K4 |
| CO2 | Design oscillators, wave-shaping circuits and Filters | K4 |
| CO3 | Design and simulate oscillators, tuned amplifiers, and multivibrators, using SPICE Tool. | K4 |
| CO4 | Design amplifiers, and oscillators, using operational amplifiers. | K4 |
| CO5 | Design filters using op-amp and experiment on frequency response | K4 |

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

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# DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

## AUTONOMOUS SYLLABUS R2024

## CHOICE BASED CREDIT SYSTEM

# SEM – V

| AEC115 - VLSI DESIGN | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **5** | **PC** | **3** | **0** | **0** | **3** |
| | | | | | | | |
| Preamble | ➢ This course aims at understanding the basic concepts of Digital CMOS VLSI Circuit by studying Logic design, Physical structure and fabrication of semiconductor devices<br>➢ How they are combined to build systems for efficient data processing and also it aims at ASIC Physical design flow, including logic synthesis, floor-planning, Placement and Routing.<br>➢ Students Work from design entry using Verilog code to GDSII file generation of an ASIC. | | | | | | |
| **Unit – I** | **MOS TRANSISTOR PRINCIPLES** | | | | | | **9** |
| MOS logic families (NMOS and CMOS) - Ideal and Non Ideal IV Characteristics - CMOS devices. MOS(FET) Transistor Characteristic under Static and Dynamic Conditions - Technology Scaling - power consumption | | | | | | | |
| **Unit – II** | **COMBINATIONAL LOGIC CIRCUITS** | | | | | | **9** |
| Propagation Delays - stick diagram - Layout diagrams - Examples of combinational logic design - Elmore's constant - Static Logic Gates - Dynamic Logic Gates - Pass Transistor Logic - Power Dissipation - Low Power Design principles | | | | | | | |
| **Unit – III** | **SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES** | | | | | | **9** |
| Static Latches and Registers - Dynamic Latches and Registers – Pipelines – Non bistable Sequential Circuits. Timing classification of Digital Systems - Synchronous Design - Self-Timed Circuit Design | | | | | | | |
| **Unit – IV** | **INTERCONNECT, MEMORY ARCHITECTURE AND ARITHMETIC CIRCUITS** | | | | | | **9** |
| Interconnect Parameters – Capacitance, Resistance, and Inductance - Electrical Wire Models - Sequential digital circuits: adders, multipliers, comparators, shift registers. Logic Implementation using Programmable Devices (ROM, PLA, FPGA) - Memory Architecture and Building Blocks - Memory Core and Memory Peripherals Circuitry | | | | | | | |
| **Unit – V** | **ASIC DESIGN AND TESTING** | | | | | | **9** |
| Introduction to wafer to chip fabrication process flow - Microchip design process & issues in test and verification of complex chips - embedded cores and SOCs - Fault models - Test coding. ASIC Design Flow - Introduction to ASICs - Introduction to test benches - Writing test benches in Verilog HDL - Automatic test pattern generation - Design for testability - Scan design: Test interface and boundary scan | | | | | | | |
| | | | | | | | **Total:45** |
| **TEXTBOOK:** | | | | | | | |
| 1. | Jan D Rabaey, Anantha Chandrakasan, "Digital Integrated Circuits: A Design Perspective", PHI, 2016.(Units II, III and IV) | | | | | | |
| 2. | Neil H E Weste, Kamran Eshranghian, "Principles of CMOS VLSI Design: A System Perspective," Addison Wesley, 2009.( Units - I, IV). | | | | | | |
| 3. | Michael J Smith ," Application Specific Integrated Circuits, Addison Wesley, (Unit - V) | | | | | | |
| 4. | Samir Palnitkar," Verilog HDL:A guide to Digital Design and Synthesis", Second Edition, Pearson Education,2003.(Unit - V) | | | | | | |
| 5. | Parag K.Lala," Digital Circuit Testing and Testability", Academic Press, 1997, (Unit - V) | | | | | | |
| **REFERENCES:** | | | | | | | |

| | |
|---|---|
| 1. | D.A. Hodges and H.G. Jackson, Analysis and Design of Digital Integrated Circuits, International Student Edition, McGraw Hill 1983 |
| 2. | P. Rashinkar, Paterson and L. Singh, "System-on-a-Chip Verification-Methodology and Techniques", Kluwer Academic Publishers,2001 |
| 3. | SamihaMourad and YervantZorian, “Principles of Testing Electronic Systems”, Wiley 2000 |
| 4. | M. Bushnell and V. D. Agarwal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers,2000 |


| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom’s Taxonomy Level** |
|---|---|---|
| CO1 | Knowledge of MOS technology in depth | K2 |
| CO2 | Understand Combinational Logic Circuits and Design Principles | K2 |
| CO3 | Understand Sequential Logic Circuits and Clocking Strategies | K2 |
| CO4 | Understand Memory architecture and building blocks | K2 |
| CO5 | Understand the ASIC Design Process and Testing | K2 |

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

## AEC116 - ANTENNAS AND WAVE PROPAGATION

| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| | | **5** | **PC** | **3** | **0** | **0** | **3** |

| | | |
|---|---|---|
| Preamble | ➢ The objective of this course is to provide an in-depth understanding of modern antenna concepts, and practical antenna design for various applications. | |
| **Unit - I** | **Fundamental Concepts of Antenna** | **9** |
| Antenna in real world applications-Cellular, Satellite, and RADAR. Radiation mechanism, Antenna parameters-Radiated power, radiation pattern, Beamwidth, Power intensity, Directivity, Gain, Effective aperture, Impedance bandwidth, VSWR polarization- Field regions. Friss transmission equation. | | |
| **Unit - II** | **Radiation from Wires, Loops and aperture** | **9** |
| Infinitesimal dipole-small dipole, finite length dipole, Half wavelength dipole, Wire antennas: Folded dipole, loop antenna, Aperture antennas, Huygens principle. | | |
| **Unit - III** | **Antenna Arrays** | **9** |
| Isotropic Broadside and End fire array, Pattern multiplication, N element array, Phased array, Cellular applications, Yagi-Uda, Log periodic array, FSS, IRS. | | |
| **Unit - IV** | **Horn, Reflector and Circularly polarized Antennas** | **9** |

Radiation from Horn, Reflector antennas, Principle of circular polarization, Helical, Spiral antennas.
**Planar Antennas:** Microstrip patch- Basic characteristics, design, feeding methods, MPA tuning for bandwidth and polarization, Planar Inverted F antenna -Principle, design, Multiband antennas for typical wireless applications.

| **Unit - V** | **Antenna Measurements and Wave propagation** | **9** |
|---|---|---|

Radiation pattern and Gain measurements, Radomes, Anechoic chamber, Mode of propagation in different environment (Ground wave, sky wave and tropospheric wave propagation, Characteristics and Parameters, Cellular link calculations.

**Total:45**

**TEXTBOOK:**

| | |
|---|---|
| 1. | C. A. Balanis, "Antenna Theory and Design", 4th Ed., John Wiley &Sons., 2016. |
| 2. | John D.Kraus," Antennas for all Applications", Tata McGraw Hill ,2002 |

**REFERENCES:**

| | |
|---|---|
| 1. | W. L. Stutzman, and G. A. Thiele, "Antenna Theory and Design", 2nd Ed., John Wiley &Sons., 1998 |
| 2. | F.E.Terman, "Electronic and Radio Engineering", Mc Graw Hill, 1985 |
| 3. | NPTEL Course Antenna and wave propagation: https://nptel.ac.in/courses/ 108101092/ |

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Understand the role of antenna in real world applications and study the antenna parameters | K2 |
| CO2 | Understand the concepts of wire, loop, aperture antennas. | K2 |
| CO3 | Understand array concept and design antenna arrays for wireless applications | K2 |
| CO4 | Understand the radiation mechanism and design Horn, reflector, Helical antennas | K2 |
| CO5 | Measure the antenna parameters and explain the process of radio wave propagation in the atmosphere | K1 |

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

## AEC310 - VLSI DESIGN LABORATORY

| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| | | **5** | **PC** | **0** | **0** | **4** | **2** |
| **Preamble** | To build a firm foundation on Digital System Design | | | | | | |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Design of basic combinational and sequential (Flip-flops) circuits using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA |
| 2. | Design an Adder; Multiplier (Min 8 Bit) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA |
| 3. | Design and implement Universal Shift Register using HDL. Simulate it using Xilinx/Altera Software |
| 4. | Design Memories using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA |
| 5. | Design Finite State Machine (Moore/Mealy) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA |
| 6. | Design 3-bit synchronous up/down counter using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA |
| 7. | Design 4-bit Asynchronous up/down counter using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA |
| 8. | Design and simulate a CMOS Basic Gates & Flip-Flops. Generate Manual/Automatic Layout |
| 9. | Design and simulate a 4-bit synchronous counter using a Flip-Flops. Generate Manual/Automatic Layout |
| 10. | Design and simulate a CMOS Inverting Amplifier |
| 11. | Design and Simulate basic Common Source, Common Gate and Common Drain Amplifiers |
| 12. | Design and simulate simple 5 transistor differential amplifier |
| | **Total: 60** |

**REFERENCES/MANUAL/SOFTWARE:**

| | |
|---|---|
| 1. | Laboratory Manual |
| 2. | CADENCE Software & Xilinx Software |

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Write HDL code for basic as well as advanced digital integrated circuit | K4 |
| CO2 | Import the logic modules into FPGA Boards | K4 |
| CO3 | Synthesize Place and Route the digital Ips | K4 |
| CO4 | Design, Simulate and Extract the layouts of Digital & Analog IC Blocks using EDA tools | K4 |
| CO5 | Test and Verification of IC design | K4 |

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

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# DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

## AUTONOMOUS SYLLABUS R2024

## CHOICE BASED CREDIT SYSTEM

# SEM – VI

| AEC117 - WIRELESS COMMUNICATION | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **6** | **PC** | **3** | **0** | **0** | **3** |
| **Preamble** | To impart knowledge of wireless communication technologies. | | | | | | |
| **Unit – I** | **The Cellular Concept-System Design Fundamentals** | | | | | | **9** |
| Introduction-Frequency Reuse-Channel Assignment Strategies-Handoff Strategies, Interference and System Capacity: Co-Channel Interference and System Capacity, Adjacent Channel Interference, Improving Coverage and Capacity in Cellular Systems: Cell Splitting, Sectoring. | | | | | | | |
| **Unit - II** | **Mobile Radio Propagation** | | | | | | **9** |
| Large Scale Path Loss: Introduction to Radio Wave Propagation - Free Space Propagation Model –Small Scale Fading and Multipath: Small Scale Multipath Propagation, Factors Influencing Small-Scale Fading, Doppler Shift, Coherence Bandwidth, Doppler Spread and Coherence Time. Types of Small- Scale Fading: Fading Effects Due to Multipath Time Delay Spread, Fading Effects Due to Doppler Spread. | | | | | | | |
| **Unit - III** | **Modulation Techniques** | | | | | | **9** |
| Digital Modulation – An Overview: Factors That Influence The Choice Of Digital Modulation, Linear Modulation Techniques: Minimum Shift Keying (MSK), Gaussian Minimum Shift Keying(GMSK), Spread Spectrum Modulation Techniques: Pseudo- Noise (PN) Sequences, Direct Sequence Spread Spectrum (DS-SS) | | | | | | | |
| **Unit - IV** | **Equalization and Diversity** | | | | | | **9** |
| Equalization, Diversity and Channel Coding: Introduction-Fundamentals of Equalization- Diversity Techniques: Practical Space Diversity Considerations, Polarization Diversity, Frequency Diversity, Time Diversity. | | | | | | | |
| **Unit - V** | **Multiple Access Techniques** | | | | | | **9** |
| Introduction: Introduction To Multiple Access- Frequency Division Multiple Access (FDMA)- Time Division Multiple Access (TDMA)- Spread Spectrum Multiple Access-Code Division Multiple Access (CDMA)- Space Division Multiple Access (SDMA)- OFDM. | | | | | | | |
| | | | | | | **Total:45** | |

**TEXTBOOK:**

| | |
|---|---|
| 1. | Rappaport,T.S.-"Wireless communications", Pearson Education, Second Edition, 2010. |

**REFERENCES:**

| | |
|---|---|
| 1. | Wireless Communication –Andrea Goldsmith, Cambridge University Press, 2011 |
| 2. | Van Nee, R. and Ramji Prasad, ―OFDM for wireless multimedia communications, Artech House, 2000 |
| 3. | David Tse and Pramod Viswanath, ―Fundamentals of Wireless Communication, Cambridge University Press, 2005. |
| 4. | Upena Dalal, ―Wireless Communication", Oxford University Press, 2009. |
| 5. | Andreas.F. Molisch, ―Wireless Communications", John Wiley – India, 2006. |
| 6. | Wireless Communication and Networks –William Stallings, Pearson Education, Second Edition<br>2002. |

| **COURSE OUTCOMES:**<br>At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Understand The Concept and Design of a Cellular System. | K2 |
| CO2 | Understand Mobile Radio Propagation and Various Digital Modulation Techniques. | K2 |

| | | |
|---|---|---|
| CO3 | Understand Various Digital Modulation Techniques. | K2 |
| CO4 | Illustrate various Equalization & Diversity techniques | K3 |
| CO5 | Understand The Concepts of Multiple Access Techniques and Wireless Networks. | K2 |

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

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# DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

## AUTONOMOUS SYLLABUS R2024

## CHOICE BASED CREDIT SYSTEM

# SEM – VII

## AEC118 - COMPUTER VISION

| Programme & Branch | BE & ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | 7 | PC | 3 | 0 | 0 | 3 |

**Preamble**

- To understand the fundamental concepts related to Image formation and processing.
- To learn feature detection, matching and detection. To understand image-based rendering and recognition

| | | |
|---|---|---|
| **Unit – I** | **INTRODUCTION TO IMAGE FORMATION AND PROCESSING** | **9** |

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

| | | |
|---|---|---|
| **Unit - II** | **FEATURE DETECTION, MATCHING AND SEGMENTATION** | **9** |

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.

| | | |
|---|---|---|
| **Unit - III** | **FEATURE-BASED ALIGNMENT & MOTION ESTIMATION** | **9** |

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.

| | | |
|---|---|---|
| **Unit - IV** | **3D RECONSTRUCTION** | **9** |

Shape from X - Active range finding - Surface representations - Point-based representations- Volumetric representations - Model-based reconstruction - Recovering texture maps and albedos.

| | | |
|---|---|---|
| **Unit - V** | **IMAGE-BASED RENDERING AND RECOGNITION** | **9** |

View interpolation Layered depth images - Light fields and Lumi graphs - Environment mattes - Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets.

**Total:45**

**TEXTBOOK:**

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

**REFERENCES:**

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | To understand basic knowledge, theories and methods in image processing and computer vision. | K2 |
| CO2 | To implement basic and some advanced image processing techniques in OpenCV. | K3 |
| CO3 | To apply 2D a feature-based based image alignment, segmentation and motion estimations. | K3 |

| | | |
|---|---|---|
| CO4 | To apply 3D image reconstruction techniques | K3 |
| CO5 | To design and develop innovative image processing and computer vision applications. | K3 |

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

| **AEC311 - COMPUTER VISION LABORATORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **7** | **PC** | **0** | **0** | **4** | **2** |
| Preamble | ➢ To understand and implement image processing techniques using open source software builds a firm foundation on electronic circuits. | | | | | | |
| **List of Exercises / Experiments:** | | | | | | | |
| 1. | To acquire an image, store in different formats and display the properties of the images | | | | | | |
| 2. | To write a Program to change the Brightness of Image | | | | | | |
| 3. | To write a program to Flip the image around the vertical and horizontal line | | | | | | |
| 4. | To write a program to Display the color components of the image Red Green Blue Components of Image | | | | | | |
| 5. | To write a program to find the negative of an image | | | | | | |
| 6. | To write a program to Calculate the Histogram of a given image | | | | | | |
| 7. | To write a program for Histogram Equalization of an image | | | | | | |
| 8. | To write a program for Image Filtering (low pass filter) 1) Average filter 2) Weighted Average filter 3) Median filter High pass filters using 1) Sobel operator 2) Laplacian operator | | | | | | |
| 9. | To write a program for Edge detection with gradient and convolution of an Image | | | | | | |
| 10. | To write a program for Program to find threshold of grayscale image | | | | | | |
| | **Total: 60** | | | | | | |
| **REFERENCES/MANUAL/SOFTWARE:** | | | | | | | |
| 1. | Laboratory Manual | | | | | | |
| 2. | MATLAB | | | | | | |
| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | | | | | | **Bloom's Taxonomy Level** |
| CO1 | Understand the acquisition and storage of different types of images | | | | | | K2 |

| | | |
|---|---|---|
| CO2 | Analyze different image transforms and their properties | K4 |
| CO3 | Apply different Image Smoothening & Sharpening algorithms in time and frequency domain | K3 |
| CO4 | Apply different algorithms for image restoration | K3 |
| CO5 | Apply different techniques for image segmentation | K3 |

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

## AEC312 - PROJECT - I

| Programme & Branch | BE & ECE | Sem. | Category | T | P | C |
|---|---|---|---|---|---|---|
| | | 7 | EEC | 0 | 10 | 5 |

| | |
|---|---|
| Preamble | To train the students in<br>➢ Identifying problems and developing the structured methodology to solve the identified problem in the industry or research problem at research Institution or college.<br>➢ Conducting experiments, analyze and discuss the test results, and make conclusions.<br>➢ Preparing project reports and presentation |

- The students shall individually / or as group work on a specific topic approved by the Department.
- The student can select any topic which is relevant to his/her specialization of the program me.
- The student should continue the work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work, results and discussion, conclusion and references should be prepared as per the format prescribed by the University and submitted to the Head of the department.
- The students will be evaluated based on the report and viva-voce examination by a panel of examiners as per the Regulations.

**Total:150**

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Formulate and analyze problem / create a new product/ process. | K2 |
| CO2 | Design and conduct experiments to find solution | K4 |
| CO3 | Analyze the results and provide solution for the identified problem, prepare project report and make presentation. | K3 |

JEPPIAAR INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

Self-Belief | Self Discipline | Self Respect

Kunnam, Sunguvarchatram, Sriperumbudur-631604

# DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

## AUTONOMOUS SYLLABUS R2024

## CHOICE BASED CREDIT SYSTEM

# SEM – VIII

## AEC313 - PROJECT - II

| Programme & Branch | BE & ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | 8 | EEC | 0 | 0 | 10 | 5 |

| | |
|---|---|
| Preamble | To train the students in<br>➢ Identifying problems and developing the structured methodology to solve the identified problem in the industry or research problem at research Institution or college.<br>➢ Conducting experiments, analyze and discuss the test results, and make conclusions.<br>➢ Preparing project reports and presentation |

- The students shall individually / or as group work on a specific topic approved by the Department.
- The student can select any topic which is relevant to his/her specialization of the program me.
- The student should continue the work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work, results and discussion, conclusion and references should be prepared as per the format prescribed by the University and submitted to the Head of the department.
- The students will be evaluated based on the report and viva-voce examination by a panel of examiners as per the Regulations.

**Total:150**

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Formulate and analyze problem / create a new product/ process. | K2 |
| CO2 | Design and conduct experiments to find solution | K4 |
| CO3 | Analyze the results and provide solution for the identified problem, prepare project report and make presentation. | K3 |

JEPPIAAR INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

Self-Belief | Self Discipline | Self Respect

Kunnam, Sunguvarchatram, Sriperumbudur-631604

**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**AUTONOMOUS SYLLABUS R2024 (CBCS)**

# PROFESSIONAL ELECTIVES

# DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

## AUTONOMOUS SYLLABUS R2024 (CBCS)

**VERTICAL - I - SEMICONDUCTOR CHIP DESIGN AND TESTING**

| S.No | Course Code | Course Title | Periods | | | Total Contact Periods | Credits |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | | |
| 1 | AEC501 | Low Power VLSI Design | 3 | 0 | 0 | 3 | 3 |
| 2 | AEC502 | FPGA Based System Design | 3 | 0 | 0 | 3 | 3 |
| 3 | AEC503 | Advanced Digital System Design | 3 | 0 | 0 | 3 | 3 |
| 4 | AEC504 | Validation and Testing Technology | 3 | 0 | 0 | 3 | 3 |
| 5 | AEC505 | Mixed Signal IC Design Testing | 3 | 0 | 0 | 3 | 3 |

**VERTICAL – II - SIGNAL PROCESSING**

| S.No | Course Code | Course Title | Periods | | | Total Contact Periods | Credits |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | | |
| 1 | AEC506 | Advanced Digital Signal Processing | 3 | 0 | 0 | 3 | 3 |
| 2 | AEC507 | Multimedia Compression Techniques | 3 | 0 | 0 | 3 | 3 |
| 3 | AEC508 | Speech Processing | 3 | 0 | 0 | 3 | 3 |
| 4 | AEC509 | DSP Architecture and Programming | 3 | 0 | 0 | 3 | 3 |
| 5 | AEC510 | Software Defined Radio | 3 | 0 | 0 | 3 | 3 |

**VERTICAL - III- RF TECHNOLOGIES**

| S.No | Course Code | Course Title | Periods | | | Total Contact Periods | Credits |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | | |
| 1 | AEC511 | EMI/EMC Pre Compliance Testing | 3 | 0 | 0 | 3 | 3 |
| 2 | AEC512 | RFID System Design and Testing | 3 | 0 | 0 | 3 | 3 |
| 3 | AEC513 | RF Transceivers | 3 | 0 | 0 | 3 | 3 |
| 4 | AEC514 | Signal Integrity | 3 | 0 | 0 | 3 | 3 |
| 5 | AEC515 | MICs and RF System Design | 3 | 0 | 0 | 3 | 3 |

**VERTICAL - IV- BIO MEDICAL TECHNOLOGIES**

| S.No | Course Code | Course Title | Periods | | | Total Contact Periods | Credits |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | | |
| 1 | AEC516 | Biomedical Signal Processing | 3 | 0 | 0 | 3 | 3 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2 | AEC517 | Wearable Devices | 3 | 0 | 0 | 3 | 3 |
| 3 | AEC518 | Medical Imaging Systems | 3 | 0 | 0 | 3 | 3 |
| 4 | AEC519 | Brain Computer Interface and Applications | 3 | 0 | 0 | 3 | 3 |
| 5 | AEC520 | Body Area Networks | 3 | 0 | 0 | 3 | 3 |

**VERTICAL - V -HIGH SPEED COMMUNICATIONS**

| S.No | Course Code | Course Title | Periods | | | Total Contact Periods | Credits |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | | |
| 1 | AEC521 | Communication Networks | 3 | 0 | 0 | 3 | 3 |
| 2 | AEC522 | Optical Communication & Networks | 3 | 0 | 0 | 3 | 3 |
| 3 | AEC523 | 4G/5G Communication Networks | 3 | 0 | 0 | 3 | 3 |
| 4 | AEC524 | Wireless Broad Band Networks | 3 | 0 | 0 | 3 | 3 |
| 5 | AEC525 | Massive MIMO Networks | 3 | 0 | 0 | 3 | 3 |
| 6 | AEC526 | Advanced Wireless Communication Techniques | 3 | 0 | 0 | 3 | 3 |

**VERTICAL - VI- EMERGING TECHNOLOGIES AND IOT**

| S.No | Course Code | Course Title | Periods | | | Total Contact Periods | Credits |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | | |
| 1 | AEC527 | Artificial Intelligence and its Applications | 3 | 0 | 0 | 3 | 3 |
| 2 | AEC528 | Wireless Sensor Network Design | 3 | 0 | 0 | 3 | 3 |
| 3 | AEC529 | IoT Based Systems Design | 3 | 0 | 0 | 3 | 3 |
| 4 | AEC530 | MEMS | 3 | 0 | 0 | 3 | 3 |
| 5 | AEC531 | Advanced Machine Learning | 3 | 0 | 0 | 3 | 3 |

**VERTICAL - VII- SPACE TECHNOLOGIES**

| S.No | Course Code | Course Title | Periods | | | Total Contact Periods | Credits |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | | |
| 1 | AEC532 | Satellite Communication | 3 | 0 | 0 | 3 | 3 |
| 2 | AEC533 | Radar Engineering | 3 | 0 | 0 | 3 | 3 |
| 3 | AEC534 | Remote Sensing | 3 | 0 | 0 | 3 | 3 |
| 4 | AEC535 | Positioning and Navigation Systems | 3 | 0 | 0 | 3 | 3 |
| 5 | AEC536 | Rocketry Space Mechanics | 3 | 0 | 0 | 3 | 3 |

# VERTICAL - I - SEMICONDUCTOR CHIP DESIGN AND TESTING

| AEC501 - LOW POWER VLSI DESIGN | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **-** | **PE** | **3** | **0** | **0** | **3** |
| **Preamble** | ➢ This course provides a foundation for understanding the Concept of Wide Band Gap Devices, Advantages, Disadvantages and its Application in Real World.<br>➢ It also helps to Learn Basic Operation and Design Principles of Modern Power Devices and ability to deal high frequency Design Complexity. | | | | | | |
| **Unit – I** | **FUNDAMENTALS** | | | | | | **9** |
| Need for Low Power Circuit Design, Sources of Power Dissipation- Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects -Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect. | | | | | | | |
| **Unit – II** | **DESIGN APPROACHES** | | | | | | **9** |
| **Low-Power Design Approaches:** Low-Power Design through Voltage Scaling VTCMOS circuits, MTCMOS circuits, Architectural Level Approach -Pipelining and Parallel Processing Approaches. **Switched Capacitance Minimization Approaches:** System Level Measures, Circuit Level Measures, and Mask level Measures. | | | | | | | |
| **Unit – III** | **LOW – VOLTAGE LOW - POWER ADDERS** | | | | | | **9** |
| Low-Voltage Low-Power Adders: Introduction, Standard Adder Cells, CMOS Adder's Architectures Ripple Carry Adders, Carry Look Ahead Adders, Carry Select Adders, Carry Save Adders, Low Voltage Low-Power Design Techniques- Trends of Technology and Power Supply Voltage, Low Voltage Low-Power Logic Styles | | | | | | | |
| **Unit – IV** | **LOW - VOLTAGE LOW - POWER MULTIPLIERS** | | | | | | **9** |
| Low-Voltage Low-Power Multipliers: Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh- Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier. | | | | | | | |
| **Unit – V** | **LOW - VOLTAGE LOW - POWER MEMORIES** | | | | | | **9** |
| Low-Voltage Low-Power Memories: Basics of ROM, Low-Power ROM Technology. Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self- Refresh Circuit, Future Trend and Development of DRAM. | | | | | | | |
| | | | | | | | **Total:45** |
| **TEXTBOOK:** | | | | | | | |
| 1. | CMOS Digital Integrated Circuits - Analysis and Design-Sung-Mo Kang. Yusuf Leblebici, TMH, 2011. | | | | | | |
| 2. | Low-Voltage, Low-Power VLSI Subsystems-Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering. | | | | | | |
| **REFERENCES:** | | | | | | | |

| | |
|---|---|
| 1. | Introduction to VLSI Systems: A Logic, Circuit and System Perspective- Ming-BO Lin, CRC Press, 2011 |
| 2. | Low Power CMOS VLSI Circuit Design-Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000. |
| 3. | Practical Low Power Digital VLSI Design-Gary K. Yeap, Kluwer Academic Press, 2002. |
| 4. | Leakage in Nanometer CMOS Technologies- Siva G. Narendran, Anatha Chandrakasan, Springer, 2005. |


| **COURSE OUTCOMES: Upon successful completion of the course the student will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Able to carry out research and Development in the area of Low Power VLSI Circuits. | K4 |
| CO2 | Apply techniques to improve power consumption of VLSI Circuits | K4 |
| CO3 | Utilize logic simulation methods to design Low Power VLSI Circuits | K4 |
| CO4 | Apply Logic-level, Architecture-level and System-level techniques in various designs to optimize power consumption of the VLSI Circuits | K4 |
| CO5 | Kown the design Low-Voltage Low-Power Memories and Suitable for real life and Industry applications. | K4 |

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

## AEC502 - FPGA BASED SYSTEM DESIGN

| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| | | **-** | **PE** | **3** | **0** | **0** | **3** |

| | | |
|---|---|---|
| **Preamble** | This course provides foundation for understanding the Concept of FPGA Architecture and technologies, Modeling of complex digital sub-systems, Implementation of complex FPGA applications in real world scenario | |
| **Unit – I** | **PROGRAMMABLE LOGIC DEVICES** | **9** |
| Types of Programmable Logic Devices: PLA, PAL, CPLD - FPGA Architecture – Programming Technologies-Chip I/O- Programmable Logic Blocks- Fabric and Architecture of FPGA | | |
| **Unit – II** | **HDL FUNDAMENTALS** | **9** |
| Verilog Behavioral, Data Flow and Structural Modeling, Useful Modeling Techniques Arithmetic Circuits: High Speed Adders, Carry look-ahead adder, Carry save adders, Conditional Sum adders, Sequential and Parallel Multipliers | | |
| **Unit – III** | **FSM AND MEMORY MODELLING** | **9** |

| | | |
|---|---|---|
| Synchronous and Asynchronous FIFO – Single port and Dual port ROM and RAM - FSM Verilog modeling of Sequence detector - Serial adder - Vending machine. | | |
| **Unit – IV** | **SOC DESIGN** | **9** |
| Introduction to hardware – software codesign, Introduction to Qsys and Intel Quartus prime tool, Nios II Software Build Tools for Eclipse, Incorporate custom peripherals & instructions into an embedded system | | |
| **Unit – V** | **FPGA APPLICATIONS** | **9** |
| Embedded system design using FPGAs, DSP using FPGAs, Dynamic architecture using FPGAs, reconfigurable systems, application case studies. Simulation / implementation exercises of combinational, sequential and DSP kernels on Xilinx / Altera boards | | |
| | | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | Michael D Ciletti, Advanced Digital Design with the Verilog HDL, Prentice Hall, Second Edition, 2017 |

**REFERENCES:**

| | |
|---|---|
| 1. | Charles H Roth Jr, Lizy Kurian John and ByeongKil Lee Digital Systems Design using Verilog, Cengage Learning, First Edition, 2016. |
| 2. | Wayne Wolf, FPGA Based System Design, Prentices Hall Modern Semiconductor Design Series, 2011 |
| 3. | Ming-Bo Lin, Digital Systems Design and Practice: Using Verilog HDL and FPGAs, Create Space Independent Publishing Platform, Second Edition, 2015. |

| **COURSE OUTCOMES: Upon successful completion of the course the student will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Understand architectures of programmable logic devices | K4 |
| CO2 | Understand various abstraction level in Verilog HDL high speed arithmetic and memory circuits | K4 |
| CO3 | Analyze the synthesis and timing constraints/reports | K4 |
| CO4 | Design the system using soft core processors | K4 |
| CO5 | Develop the FPGA based system for various applications in signal processing | K4 |

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

| **AEC503-ADVANCED DIGITAL SYSTEM DESIGN** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |

| & Branch | | - | PE | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|---|---|

| | |
|---|---|
| Preamble | This course gives the knowledge of the hardware description languages, design methodology and implementation of advanced digital systems. |

| | | |
|---|---|---|
| **Unit – I** | **INTRODUCTION** | **9** |

Digital System Design Process, EDA tools and design viewpoints, Behavioural, dataflow, and gate level descriptions.

| | | |
|---|---|---|
| **Unit – II** | **HARDWARE DESCRIPTION LANGUAGES** | **9** |

VHDL and Verilog modeling concepts, Behavioral and Structural architecture descriptions: Concurrent and Sequential statements, Event driven Simulation.

| | | |
|---|---|---|
| **Unit – III** | **BUILDING BLOCKS FOR DIGITAL SYSTEMS** | **9** |

Tristate buffers, multiplexers, latches, flip-flops, registers, counters, arithmetic and logic circuits (ALU Design), Finite State Machines.

| | | |
|---|---|---|
| **Unit – IV** | **DESIGN METHODOLOGY** | **9** |

Synchronous Systems, Top-Down Design, Register Transfer Level Design, Algorithmic State Machines, and Synthesis from VHDL.

| | | |
|---|---|---|
| **Unit – V** | **IMPLEMENTATION ISSUES** | **9** |

Design Case Studies, Hardware Testing & Design for testability, test vectors, fault analysis for combinational and sequential circuits. Timing and signal conventions, synchronization, Signaling Circuits: Terminations, Transmitter and receiver circuits. Microprogramming, Micro-programme sequencer 2910. Introduction to Programmable Logic Devices (FPGAs, CPLDs).

**Total:45**

**TEXTBOOK:**


1. William I Fletcher: An Engineering approach to Digital Design, Eastern Economy Edition, PHI Limited, 2000
2. Digital System Engineering: William J Dally and John W Poulton Published by Cambridge University Press
3. A VHDL Primer: Jayaram Bhasker Published by Prentice-Hall India
4. Digital Design and Verilog fundamentals: Joseph Cavanaugh Published by CRC Press.
5. The Art of Digital Design: An Introduction to Top down design: Franklin P Processer and David E Winkel Published by Prentice-Hall.
6. Digital Systems Design: Charles H. Roth,Jr., LIzy Kurian John.


| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Analyze the digital circuits for different applications | K4 |
| CO2 | Develop Specifications for digital systems | K3 |
| CO3 | Design and develop the digital circuits using VHDL and Verilog | K3 |
| CO4 | Develop test strategies for digital systems | K3 |
| CO5 | Design robust digital systems | K3 |

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

**AEC504-VALIDATION AND TESTING TECHNOLOGY**

| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| | | **-** | **PE** | **3** | **0** | **0** | **3** |

| | |
|---|---|
| Preamble | ➢ This course aims to provide about Getting familiar with various IC technology, Learn MOS theory and testing, getting expertise on CMOS characterization.<br>➢ Explore circuit and device level testing methods |

| **Unit – I** | **TECHNOLOGY INTRODUCTION** | **9** |
|---|---|---|

Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS Technologies. VLSI Fabrication, Oxidation, Lithography, Diffusion, Ion Implantation, Metallization, Integrated Resistors and Capacitors.

| **Unit – II** | **MOS THEORY ANALYSIS-I** | **9** |
|---|---|---|

Basic Electrical Properties of MOS Circuits: Ids-Vds Relationships, MOS Transistor Threshold Voltage Vth, gm, gds, Figure of Merit ωo, Short Channel and Narrow Channel Width Effects.

| **Unit – III** | **MOS THEORY ANALYSIS- II** | **9** |
|---|---|---|

Pass Transistor, Transmission Gate, NMOS Inverter, Various Pull-ups, CMOS Inverter Analysis and Design, Bi-CMOS Inverters, Latch up in CMOS Circuits.

| **Unit – IV** | **CMOS CIRCUIT CHARACTERISATION AND PERFORMANCE ESTIMATION** | **9** |
|---|---|---|

Sheet Resistance RS, conductivity and its Concept to MOS, Area Capacitance Units, Calculations - Delays, Driving Large Capacitive Loads, Delay Estimation, Logical Effort and Transistor Sizing, Power Dissipation, Reliability

| **Unit – V** | **BASIC OF SILICON VALIDATION** | **9** |
|---|---|---|

Need for Testing, Testing at Various Levels, Objectives of Testing - VLSI Test process and Test Equipment - Types of Testing: Functionality Tests, Silicon Debug, Manufacturing Tests, Defect during manufacturing - Fault Modelling, Observability and Controllability, Fault Coverage, Fault Sampling - ATE, Test economics.

**Total:45**

**TEXTBOOK:**

| | |
|---|---|
| 1. | Kamran Ehraghian, Dauglas A. Pucknell and Sholeh Eshraghiam, “Essentials of VLSI Circuits and Systems” – PHI, EEE, 2005 Edition |
| 2. | Neil H. E. Weste and David. Harris Ayan Banerjee, “CMOS VLSI Design” - Pearson Education, 1999 |

**REFERENCES**

| | |
|---|---|
| 1 | M.L. Bushnell and V.D. Agrawal, “Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits”, Kluwer Academic Publishers, 2004 |
| 2 | N.K. Jha and S.G. Gupta, “Testing of Digital Systems”, Cambridge University Press, 2003 |

| | |
|---|---|
| 3 | Etienne Sicard, Sonia Delmas Bendhia, "Basics of CMOS Cell Design", TMH, EEE, 2005 |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Complete overview to CMOS fabrication process | K2 |
| CO2 | Understand the fundamental concept of MOS FET and testing | K2 |
| CO3 | Explain the concept of MOS theory and analysis | K2 |
| CO4 | To give the student an understanding of CMOS performance testing and estimation | K3 |
| CO5 | Explain the basics of Testing and Fault Modeling | K3 |

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

## AEC505-MIXED SIGNAL IC DESIGN TESTING

| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| | | **-** | **PE** | **3** | **0** | **0** | **3** |

| | |
|---|---|
| Preamble | This course aims to provide about mixed-signal devices and the need for testing these devices, various techniques for testing, ADC and DAC based testing, understand the Clock and Serial Data Communications Channels, the general-purpose measuring devices. |

**Unit – I** **MIXED – SIGNAL TESTING** **9**

Common Types of Analog and Mixed- Signal Circuits – Applications of Mixed-Signal Circuits – Post Silicon Production Flow - Test and Packing – Characterization versus Production Testing – Test and Diagnostic Equipment - Automated Test Equipments – Wafer Probers – Handlers – E-Beam Probers – Focused Ion Beam Equipments – Forced –Temperature

**Unit – II** **YIELD, MEASUREMENT ACCURACY, AND TEST TIME** **9**

Yield - Measurement Terminology - Repeatability, Bias, and Accuracy - Calibrations and checkers - Tester Specifications - Reducing Measurement Error with Greater Measurement Time – Guardbands - Effects of Measurement Variability on Test Yield - Effects of Reproducibilty and Process Variation on Yield - Statistical Process Control

**Unit – III** **DAC TESTING** **9**

Basics of Data Converters -Principles of DAC and ADC Conversion, Data Formats, Comparison of DACs and ADCs, DAC Failure Mechanisms - Basic DC Tests - Transfer Curve Tests - Dynamic DAC Tests - Tests for Common DAC Applications

**Unit – IV** **ADC TESTING** **9**

ADC Testing Versus DAC Testing - ADC Code Edge Measurements - Edge Code Testing Versus Center Code Testing, Step Search and Binary Search Methods, Servo Method, Linear Ramp 106 Histogram Method, Histograms to Code Edge Transfer Curves, Rising Ramps Versus Falling Ramps, Sinusoidal Histogram Method - DC Tests and Transfer Curve Tests - Dynamic ADC Tests - Tests for Common ADC

| | | |
|---|---|---|
| Applications | | |
| **Unit – V** | **CLOCK AND SERIAL DATA COMMUNICATIONS CHANNEL MEASUREME** | **9** |
| Synchronous and Asynchronous Communications - Time-Domain Attributes of a Clock Signal - Frequency-Domain Attributes of a Clock Signal - Communicating Serially Over a Channel - Bit Error Rate Measurement - Methods to Speed Up BER Tests in Production - Deterministic Jitter Decomposition - Jitter Transmission Tests. | | |
| | | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | Gordon W.Roberts, Friedrich Taenzler, Mark Burns, "An Introduction to Mixed-signal IC Test and Measurement" Oxford University Press, Inc.2012 (Unit I - V) |
| 2. | M.L.Bushnell and V.D.Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2002. (Unit - III) |
| 3 | BapirajuVinnakota, "Analog and mixed-signal test", Prentice Hall, 1998.(Unit - II) |
| 4 | Digital and Analogue Instrumentation: Testing and Measurement by NihalKularatna |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Learn the fundamentals of mixed signal circuits | K2 |
| CO2 | Define the various measurement terminologies | K2 |
| CO3 | Acquire knowledge of Analog to Digital Converters | K2 |
| CO4 | Learn testing of Analog to Digital Converters | K3 |
| CO5 | Comprehend the attributes of a clock signal | K3 |

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

# VERTICAL - II - SIGNAL PROCESSING

## AEC506 - ADVANCED DIGITAL SIGNAL PROCESSING

| Programme & Branch | BE & ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | - | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Preamble** | To impart knowledge about multirate signal processing and its applications. | |
| **Unit – I** | **MULTIRATE SIGNAL PROCESSING** | **9** |
| Review of Convolution, DFT and ZT, Multirate Signal Processing - Decimation, Interpolation, Sampling Rate Conversion by a rational factor – digital filter banks, sub band coding, Quadrature Mirror Filter. | | |
| **Unit – II** | **DISCRETE TIME RANDOM PROCESSES** | **9** |
| Stationary random processes, Autocorrelation, Rational Power Spectra, Filters for generating random Processes from white noise and inverse filter – AR, MA and ARMA processes – relationship between autocorrelation and the filter parameters. | | |
| **Unit – III** | **LINEAR PREDICTION AND FILTERING** | **9** |
| Linear Prediction – Forward and Backward - Wiener filters for filtering and prediction – FIR Wiener Filter – IIR Wiener Filter – Kalman Filter. | | |
| **Unit – IV** | **ADAPTIVE FILTERING** | **9** |
| FIR adaptive filters – adaptive filters based on steepest descent method – LMS algorithm – Variants of LMS algorithm – adaptive echo cancellation – adaptive channel equalization – RLS Algorithm. | | |
| **Unit – V** | **SPECTRUM ESTIMATION** | **9** |
| Estimation of power spectra from finite duration observations of signals – Non parametric methods of spectrum estimation – the Bartlett and the Welch method – Parametric spectrum estimation – AR, MA and ARMA. | | |
| | | **Total:45** |

**TEXTBOOK:**


1. John G. Proakis & Dimitris G.Manolakis, ―Digital Signal Processing – Principles, Algorithms & Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993.


**REFERENCES:**


1. Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2008.
2. Haykin, Adaptive Filter Theory, 4th Edition, Pearson Education, New Delhi, 2006.
3. Sophoncles J. Orfanidis, “Optimum Signal Processing “, McGraw Hill, 2000.


| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom’s Taxonomy Level** |
|---|---|---|
| CO1 | Comprehend multirate signal processing and demonstrate its applications | K2 |
| CO2 | Demonstrate an understanding of the power spectral density and apply to discrete random signals and systems. | K2 |
| CO3 | Apply linear prediction and filtering techniques to discrete random signals for signal detection and estimation. | K3 |
| CO4 | Analyze adaptive filtering problems and demonstrate its application. | K3 |
| CO5 | Apply power spectrum estimation techniques to random signals. | K3 |

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO 6 | PO 7 | PO8 | PO9 | PO10 | PO11 | PO1 2 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 2 | 2 | | | | | | 1 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 | | | | | | 2 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 2 | | | | | | 2 | 2 | 2 |
| CO4 | 3 | 3 | 2 | 2 | 2 | 2 | | | | | | 2 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 2 | 1 | 1 | | | | | | 1 | 2 | 2 |

| **AEC507-MULTIMEDIA COMPRESSION TECHNIQUES** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE& ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **-** | **PE** | **3** | **0** | **0** | **3** |
| Preamble | ➢ This course enables the learner to study the various representations of multimedia such as text, audio, image and video.<br>➢ It deals with necessity and fundamentals of compression techniques, various compression mechanisms and standards | | | | | | |
| **Unit – I** | **FUNDAMENTALS OF COMPRESSION** | | | | | | **9** |
| Special features of multimedia-Graphics, Image and Video representations – Fundamental concepts of video, digital audio – Storage requirements of multimedia applications – Need for compression – Taxonomy of compression Algorithms– Error Free Compression – Lossy Compression. | | | | | | | |
| **Unit – II** | **TEXT COMPRESSION** | | | | | | **9** |
| Compression principles-source encoders and destination encoders- entropy encoding –source encoding- text compression –static Huffman coding dynamic Huffman coding –arithmetic coding – Lempel Ziv-Welsh Compression- Shannon Fano coding | | | | | | | |
| **Unit – III** | **AUDIO COMPRESSION** | | | | | | **9** |
| Audio compression–DPCM-Adaptive PCM –adaptive predictive coding-linear Predictive coding. Code excited LPC-perpetual coding. Audio compression Techniques – μ Law and A Law companding - Speech compression - Frequency domain and filtering – Basic subband coding – Application to speech coding – G.722 –Application to audio coding – MPEG audio. | | | | | | | |
| **Unit – IV** | **IMAGE COMPRESSION** | | | | | | **9** |
| Image Compression: Fundamentals — Compression Standards – JPEG Standard –Sub-band coding – Wavelet Based compression – Implementation using Filters – EZW, SPIHT coders – JPEG 2000 standards – JBIG and JBIG2 standards. Discrete cosine Transform. Sequential and Progressive DCT based encoding algorithms, lossless coding, hierarchical coding. | | | | | | | |
| **Unit – V** | **VIDEO COMPRESSION** | | | | | | **9** |
| Video compression techniques and Standards–MPEG video coding: MPEG-1 and MPEG-2 video coding: MPEG-3 and MPEG-4–Motion estimation and compensation techniques–H.261 Standard – - DVI technology – DVI real time compression – Current Trends in compression standards. | | | | | | | |
| | | | | | | | **Total:45** |
| **TEXTBOOK:** | | | | | | | |
| 1. | Fred Halshall “Multimedia Communication - Applications, Networks, Protocols and Standards”, Pearson Education, 2007. | | | | | | |
| 2. | Tay Vaughan, “Multimedia: Making it Work”, 7 th Edition, TMH 2008 98. | | | | | | |
| 3. | Kurose and W.Ross” Computer Networking “A Top down Approach, Pearson Education 2005. | | | | | | |
| **REFERENCES:** | | | | | | | |

| | |
|---|---|
| 1. | Marcus Goncalves “Voice over IP Networks”, Mc Graw Hill 1999. |
| 2. | KR. Rao,Z S Bojkovic, D A Milovanovic, “Multimedia Communication Systems: Techniques, Standards, and Networks”, Pearson Education 2007. |
| 3. | R. Steimnetz, K. Nahrstedt, “Multimedia Computing, Communications and Applications”, Pearson Education Ranjan Parekh, “Principles of Multimedia”, TMH 2007. |
| 4. | Yun Q.Shi, Huifang Sun, “Image and Video Compression for Multimedia Engineering - Fundamentals, Al-gorithms & Standards”, CRC press, 2003. |


| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom’s Taxonomy Level** |
|---|---|---|
| CO1 | Understand the basic ideas of compression algorithms related to multimedia components. | K2 |
| CO2 | Understand the principles and standards of Text and Audio Compression Techniques. | K2 |
| CO3 | Understand the principles and standards of Image and Video Compression Techniques | K2 |
| CO4 | Make use of the techniques in real-time applications. | K3 |
| CO5 | Implement various applications using compression algorithms. | K3 |

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

## AEC508 - SPEECH PROCESSING

| **Programme & Branch** | **BE& ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| | | **-** | **PE** | **3** | **0** | **0** | **3** |

**Preamble**

- This course enables the learner to study the fundamentals of speech signal and extracts various speech features.
- To understand different speech coding techniques for speech compression applications.

| **Unit – I** | **FUNDAMENTALS OF SPEECH** | **9** |
|---|---|---|

The Human speech production mechanism, Discrete-Time model of speech production, Speech perception - human auditory system, Phonetics - articulatory phonetics, acoustic phonetics, and auditory phonetics, Categorization of speech sounds, Spectrographic analysis of speech sounds, Pitch frequency, Pitch period

| **Unit – II** | **SPEECH FEATURES AND DISTORTION MEASURES** | **9** |
|---|---|---|

Significance of speech features in speech-based applications, Speech Features – Cepstral Coefficients, Mel Frequency Cepstral Coefficients (MFCCs), Perceptual Linear Prediction (PLP), Log Frequency Power Coefficients (LFPCs), Speech distortion measures.

| **Unit - III** | **SPEECH CODING** | **9** |
|---|---|---|

| | | |
|---|---|---|
| Need for speech coding, Waveform coding of speech – PCM, Adaptive PCM, DPCM, ADPCM, Delta Modulation, Adaptive Delta Modulation, G.726 Standard for ADPCM, Parametric Speech Coding – Channel Vocoders, Linear Prediction Based Vocoders, Code Excited Linear Prediction (CELP) based Vocoders. | | |
| **Unit – IV** | **SPEECH ENHANCEMENT** | **9** |
| Classes of Speech Enhancement Algorithms, Spectral-Subtractive Algorithms - Multiband Spectral Subtraction, MMSE Spectral Subtraction Algorithm, Spectral Subtraction Based on Perceptual Properties, Wiener Filtering - Wiener Filters in the Time Domain, Wiener Filters in the Frequency Domain, Wiener Filters for Noise Reduction, Maximum-Likelihood Estimators, Bayesian Estimators. | | |
| **Unit – V** | **SPEECH SYNTHESIS AND APPLICATION** | **9** |
| A Text-to-Speech systems (TTS), Synthesizers technologies – Concatenative synthesis, Use of Formants for concatenative synthesis, Use of LPC for concatenative synthesis, HMM-based synthesis, Sinewave synthesis, Speech transformations. | | |
| | | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | Shaila D. Apte, Speech and Audio Processing, Wiley India (P) Ltd, New Delhi, 2012. |
| 2. | Philipos C. Loizou, Speech Enhancement Theory and Practice, Second Edition, CRC Press, Inc., United States, 2013 |

**REFERENCES:**

| | |
|---|---|
| 1. | Rabiner L. R. and Juang B. H, Fundamentals of speech recognition, Pearson Education, 2003 |
| 2. | Thomas F. Quatieri, Discrete-time speech signal processing - Principles and practice, Pearson, 2012. |

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Understand the fundamentals of speech. | K2 |
| CO2 | Extract various speech features for speech related applications | K2 |
| CO3 | Choose an appropriate speech coder for a given application. | K2 |
| CO4 | Build a speech enhancement system. | K2 |
| CO5 | Build a text-to-speech synthesis system for various applications | K2 |

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

## AEC509 - DSP ARCHITECTURE AND PROGRAMMING

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Programme & Branch** | **BE& ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **-** | **PE** | **3** | **0** | **0** | **3** |
| **Preamble** | ➢ To impart knowledge about the architecture of programmable DSP processors. | | | | | | |

| | | |
|---|---|---|
| | ➢ Learn to implement various standard DSP algorithms in DSP Processors | |
| **Unit – I** | **ARCHITECTURES FOR PROGRAMMABLE DSP PROCESSORS** | **9** |
| Basic Architectural features, DSP Computational building blocks, Bus architecture and memory, Data addressing capabilities, Address generation Unit, Programmability and program execution, Speed issues, Features for external interfacing. | | |
| **Unit - II** | **TMS320C5X PROGRAMMABLE DSP PROCESSOR** | **9** |
| Architecture of TMS320C54xx DSP processors, Addressing modes – Assembly language Instructions - Memory space, interrupts, and pipeline operation of TMS320C54xx DSP Processor, On-Chip peripherals, Block Diagram of TMS320C54xx DSP starter kit. | | |
| **Unit - III** | **TMS320C6X PROGRAMMABLE DSP PROCESSOR** | **9** |
| Commercial TI DSP processors, Architecture of TMS320C6x DSP Processor, Linear and Circular addressing modes, TMS320C6x Instruction Set, Assembler directives, Linear Assembly, Interrupts, Multichannel buffered serial ports, Block diagram of TMS320C67xx DSP Starter Kit and Support Tools | | |
| **Unit - IV** | **IMPLEMENTATION OF DSP ALGORITHMS** | **9** |
| DSP Development system, On-chip, and On-board peripherals of C54xx and C67xx DSP development boards, Code Composer Studio (CCS) and support files, Implementation of Conventional FIR, IIR, and Adaptive filters in TMS320C54xx/TMS320C67xx DSP processors for real-time DSP applications, Implementation of FFT algorithm for frequency analysis in real-time. | | |
| **Unit - V** | **APPLICATIONS OF DSP PROCESSORS** | **9** |
| Voice scrambling using filtering and modulation, Voice detection and reverse playback, Audio effects, Graphic Equalizer, Adaptive noise cancellation, DTMF signal detection, Speech thesis using LPC, Automatic speaker recognition. | | |
| | | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, Cengage Learning India Private Limited, Delhi 2012 |
| 2. | RulphChassaing and Donald Reay, Digital Signal Processing and Applications with the TMS320C6713 and TMS320C6416 DSK, Second Edition, Wiley India (P) Ltd, New Delhi, 2008 |

**REFERENCES:**

| | |
|---|---|
| 1. | B.Venkataramani and M.Bhaskar, "Digital Signal Processors – Architecture, Programming and Applications", Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003. |
| 2. | TMS320C5416/6713 DSK user manual at https://www.ti.com |

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Understand the architectural features of DSP Processors. | K2 |
| CO2 | Comprehend the organization of TMS320C54xx DSP processors. | K2 |
| CO3 | Build solutions using TMS320C6x DSP Processor. | K2 |
| CO4 | Implement DSP Algorithms. | K2 |
| CO5 | Study the applications of DSP Processors. | K2 |

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 2 | 2 | | | | 1 | | 1 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 2 | 2 | 2 | | | | 1 | | 2 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 2 | | | | 1 | | 2 | 2 | 2 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO4 | 3 | 3 | 2 | 3 | 2 | 2 | | | | 1 | | 2 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 2 | 2 | 2 | | | | 1 | | 1 | 2 | 2 |

**AEC510- SOFTWARE DEFINED RADIO**

| **Programme & Branch** | **BE& ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| | | **-** | **PE** | **3** | **0** | **0** | **3** |

**Preamble**

- To impart knowledge about know about RF implementation challenges for software defined radios.
- To understand the digital generation of signals.
- To learn the software and hardware requirements for software defined radios.

| **Unit – I** | **INTRODUCTION TO SOFTWARE RADIO** | **9** |
|---|---|---|

The Need for Software Radios. Characteristics and Benefits of a Software Radio. Design Principles of a Software Radio.

| **Unit - II** | **RF IMPLEMENTATION** | **9** |
|---|---|---|

Purpose of RF front – end, Dynamic range, RF receiver front – end topologies, Enhanced flexibility of the RF chain with software radios, Importance of the components to overall performance, Transmitter architectures and their issues, Noise and distortion in the RF chain, Hybrid DDS – PLL systems, Applications of Direct Digital Synthesis.

| **Unit - III** | **DIGITAL GENERATION OF SIGNALS** | **9** |
|---|---|---|

Comparison of direct digital synthesis with analog signal synthesis, Approaches to direct digital synthesis, Analysis of spurious signals, Performance of direct digital synthesis systems, Applications of direct digital synthesis.

| **Unit - IV** | **SMART ANTENNAS** | **9** |
|---|---|---|

Benefits of smart antennas, Structures for beamforming systems, Smart antenna algorithms, Hardware implementation of smart antennas, Digital Hardware Choices-Key hardware elements

| **Unit - V** | **HARDWARE AND SOFTWARE FOR SDR & CASE STUDIES** | **9** |
|---|---|---|

DSP Processors, FPGA, ASICs. Trade-offs, Object oriented programming, Object Brokers, GNU Radio-USRP. Case Studies: SPEAK easy, JRTS, SDR-3000.

**Total:45**

**TEXTBOOK:**


1. Jeffrey Hugh Reed, "Software Radio: A Modern Approach to Radio Engineering," Prentice Hall Professional, 2002.
2. Tony J Rouphael, "RF and DSP for SDR," Elsevier Newnes Press, 2008.


**REFERENCES:**


1. P. Kenington, "RF and Baseband Techniques for Software Defined Radio," Artech House, 2005.
2. Paul Burns, "Software Defined Radio for 3G," Artech House, 2002.
3. Behrouz. F. Bourjney"Signal Processing for Software defined Radios", Lulu 2008.

| **COURSE OUTCOMES:**<br>At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Demonstrate an understanding in the evolving paradigm of Software defined radio and technologies for its implementation. | K2 |
| CO2 | Analyse Radio frequency implementation issues | K2 |
| CO3 | Implement Smart antenna techniques for software defined radio. | K2 |
| CO4 | Compare various digital synthesis procedures. | K2 |
| CO5 | Comprehend various hardware and software requirements for software defined radios. | K2 |

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

# VERTICAL – III- RF TECHNOLOGIES

| AEC511-EMI / EMC PRE COMPLIANCE TESTING | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE& ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **-** | **PE** | **3** | **0** | **0** | **3** |
| **Preamble** | To introduce the basic concepts of Electromagnetic Interference & design issues | | | | | | |
| **Unit – I** | **NATURE AND ORIGINS OF ELECTROMAGNETIC COMPATIBILITY:** | | | | | | **9** |
| Introduction-Visualisiong the EMI problem-Source of EMI, EMI coupling to victim equipment, Intersystem and Intrasystem EMI, EMC standards and specifications | | | | | | | |
| **Unit – II** | **TYPES of EMI COUPLING:** | | | | | | **9** |
| Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode and ground loop coupling; Differential mode coupling, Near field cable to cable coupling; Field to cable coupling, Power mains and Power supply coupling; Transient EMI | | | | | | | |
| **Unit - III** | **MEASUREMENT DEVICES FOR EMI:** | | | | | | **9** |
| Introduction – Measurement by direct connection, Inductively coupled devices, EMC antennas – Basic antenna parameters, Antennas for radiated emission testing, Wideband antennas - Magnetic field antennas, Type of antennas used in susceptibility testing | | | | | | | |
| **Unit - IV** | **RECEIVERS, ANALYSERS AND MEASUREMENT EQUIPMENT:** | | | | | | **9** |
| EMI receiver, Spectrum Analyzers, RF power meter Frequency meters. Standards requiring immunity tests, Automatic EMC tests, Electromagnetic transient testing, Transient types, Continuous and transient signal, ESD-electrostatic discharge | | | | | | | |
| **Unit - V** | **PRE-COMPLIANCE TESTING TO AVOID EMC PROBLEMS:** | | | | | | **9** |
| Need for Pre-Compliance Testing; Intersystem and Intrasystem EMC - Developing an approach to EMC design - Process flow chart, - EMC strategy – Self certification; Solutions to avoid EMC: ESD Shielding, EMI Filters; Grounding; Bonding, Isolation transformer, Transient suppressors; EMI Suppression Cables.. | | | | | | | |
| | | | | | | | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | David Morgan, "A Handbook for EMC Testing and Measurement", IET Electrical Measurement, 2012 |
| 2. | Tim Williams, "EMC for Product Designers", 5th Edition, Newnes Elsevier, 2017 |

**REFERENCES:**

| | |
|---|---|
| 1. | V.P. Kodali, “Engineering EMC Principles, Measurements and Technologies”, IEEE Press, Newyork, 1996 |
| 2. | Paul, C.R., “Introduction to Electromagnetic Compatibility”, 2nd ed., Wiley (2010) |
| 3. | David K. Cheng, “Field and Wave Electromagnetics”, 2nd ed. Pearson Education, 2009 |

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom’s Taxonomy Level** |
|---|---|---|
| CO1 | Perceive the various types and mechanisms of Electromagnetic Interference | K3 |
| CO2 | Propose a suitable EMI mitigation technique. | K3 |
| CO3 | Evaluate EMI coupling & control principles | K4 |
| CO4 | Explain the importance receivers & Analyzer functionalities | K3 |
| CO5 | Inspect the design issues in EMI/EMC | K4 |

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

## AEC512 - RFID SYSTEM DESIGN AND TESTING

| Programme & Branch | BE& ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | - | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Preamble** | To articulate the standards and protocols used in RFID systems. | |
| **Unit – I** | **INTRODUCTION** | **9** |
| RFID Principles: Near-field based RFID – Properties of Magnetic field – Far-field based RFID – Properties of Backscatter RF Systems – Modulation techniques – Frequency based property comparison of RFID Systems. | | |
| **Unit - II** | **RFID STANDARDS AND PROTOCOLS** | **9** |
| RFID Industry standards: EPC global – ISO15693 Vicinity cards and RFID – ISO14443 Proximity cards and RFID – The NFC forum – Reading collocated RFID tags: Query Tree protocol – Query Slot protocol | | |
| **Unit - III** | **OPERATING PRINCIPLES** | **9** |
| RFID Tag components: RFID tag types – the 1-Bit Transponder and Chipless Tags – RFID readers and middleware component – Communication fundamentals: Coupling, Data encoding, multi-path effect – Tag, Reader and sensor communication. | | |
| **Unit - IV** | **DATA INTEGRITY AND SECURITY** | **9** |
| The checksum procedure – Multiaccess procedures – Attacks on RFID Systems – Protection by Cryptographic measures | | |
| **Unit - V** | **RFID ENABLED SENSORS AND APPLICATIONS** | **9** |
| RFID enabled Sensors: Antenna design challenges – IC design – Integration of sensors and RFID – Power consumption and Link budget.<br>Applications: Contactless smart cards – Access control – Electronic passport – Industrial Automation – Medical applications – Challenges and opportunities. | | |
| | | **Total:45** |

**TEXTBOOK:**

1. Roy Want, RFID Explained, Springer 2022.
2. Amin Rida, Li Yang, Manos M. Tentzeris, RFID Enabled Sensor Design and Applications, Artech House, 2010

**REFERENCES:**

1. Klaus Finkenzeller, RFID Handbook, 3rd Edition, Wiley, 2010
2. Syed Ahson, Mohammad Ilyas, RFID Handbook, CRC Press, 2008
3. Paris Kitsos, Security in RFID and Sensor Networks, CRC Press, 2016.

| **COURSE OUTCOMES:**<br>At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Classify RFID systems based on frequency, architecture and performance | K3 |
| CO2 | Define standards for RFID technology | K3 |

| | | |
|---|---|---|
| CO3 | Illustrate the operation of various components of RFID systems | K3 |
| CO4 | Describe the privacy and security issues in RFID Systems | K3 |
| CO5 | Discuss the construction and applications of RFID enabled sensor | K3 |

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

## AEC513 - RF TRANSCEIVERS

| Programme & Branch | BE& ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | - | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | To acquaint with the various components of RF system for wireless communications | |
| **Unit – I** | **CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES** | **9** |
| CMOS: Introduction to MOSFET Physics - Noise: Thermal, shot, flicker, popcorn noise - Transceiver Specifications: Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR - Phase noise - Transceiver Architectures: Receiver: Homodyne, Heterodyne, Image reject, Low-IF Architectures - Transmitter: Direct-up conversion, Two-step up conversion schemes. | | |
| **Unit – II** | **IMPEDANCE MATCHING NETWORKS AND AMPLIFIERS** | **9** |
| Review of S-parameters and Smith chart - Passive IC components - Impedance matching networks - Amplifiers: Common Gate, Common Source Amplifiers - OC Time constants in bandwidth estimation and enhancement - High frequency amplifier design - Low Noise Amplifiers: Power match and Noise match, single-ended and differential LNAs | | |
| **Unit - III** | **FEEDBACK SYSTEMS AND POWER AMPLIFIERS** | **9** |
| Feedback Systems: Stability of feedback systems, Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations, Compensation - Power Amplifiers: General model - Class A, AB, B, C, D, E and F amplifiers - Linearization Techniques - Efficiency boosting techniques - ACPR metric | | |
| **Unit - IV** | **FILTERS, OSCILLATORS AND MIXERS** | **9** |
| Overview - basic resonator and filter configuration, special filter realizations, filter implementation - Basic oscillator model, high-frequency oscillator configuration, Colpitt's oscillator - basic characteristics of mixers, single and double-balanced mixers. | | |
| **Unit - V** | **PLL AND FREQUENCY SYNTHESIZERS** | **9** |
| PLL: Linearized Model, Noise properties, Phase detectors, Loop filters and Charge pumps- Frequency Synthesizers: Integer-N frequency synthesizers - Direct Digital Frequency Synthesizers. | | |
| | | **Total:45** |

**TEXTBOOK:**


1. Lee T, Design of CMOS RF Integrated Circuits, Cambridge, Second Edition, 2004
2. Razavi B, RF Microelectronics, Pearson Education, Second Edition, 2012


**REFERENCES:**


1. Razavi B, Design of Analog CMOS Integrated Circuits, McGraw Hill, Second Edition, 2017

| | |
|---|---|
| 2. | Robert A.Monzingo, Randy L. Haupt and Thomas W.Miller, Introduction to Adaptive arrays, 2nd Edition, IET, 2011. |
| 3. | Kyung-WhanYeom, Microwave Circuit Design - A Practical Approach using ADS, Pearson Education, 2015 |

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Interpret the nonlinear effects in RF circuits | K4 |
| CO2 | Design RF circuits | K4 |
| CO3 | Analyze the performance of RF circuits | K4 |
| CO4 | Apply knowledge to identify a suitable architecture and systematically design an RF System | K4 |
| CO5 | Comprehensively record and report the measured data, and would be capable analyzing, interpreting the experimentally measured data and produce the conclusions | K4 |

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

| **AEC514 - SIGNAL INTEGRITY** | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| **Programme & Branch** | **BE& ECE** | **Sem.** | **Category** | **L** | **T** | **C** |
| | | **-** | **PE** | **3** | **0** | **3** |
| **Preamble** | Understand characteristic impedance of transmission line and impedance matching technique | | | | | |
| **Unit – I** | **SIGNAL REFLECTION AND IMPEDANCE MATCHING TECHNIQUE:** | | | | | **9** |
| Phenomenon of signal reflection. Signal reflection at transmitting end. Signal reflection at branch point. Multiple reflection in transmission line. Prevention of signal reflection by using impedance matching technique. | | | | | | |
| **Unit – II** | **CROSSTALK NOISE:** | | | | | **9** |
| Crosstalk definition and classification. Crosstalk mechanism. Analysis of crosstalk noise in transmission line. Main factor of causing crosstalk noise. | | | | | | |
| **Unit - III** | **DIFFERENTIAL SIGNAL TRANSMISSION CIRCUIT:** | | | | | **9** |
| Pros and cons of using differential signaling compared with that of single-ended signaling. High-speed differential interfaces. Theory of differential signaling. Differential signal termination techniques. | | | | | | |
| **Unit – IV** | **FREQUENCY RESPONSE OF A CIRCUIT:** | | | | | **9** |
| Frequency response of transmission line and circuit. Inter-symbol interference (ISI) and eye-pattern. Deterioration of a signal waveform due to ISI. Circuit techniques to prevent the deterioration. Linear time-invariant systems. Frequency response of pulse. | | | | | | |
| **Unit – V** | **EYE DIAGRAM AND JITTER:** | | | | | **9** |

| | |
|---|---|
| Jitter Definition and Types of Jitter; Jitter decomposition; Eye diagram analysis and related measurement. | |
| | **Total:45** |
| **TEXT BOOK:** | |
| 1. | Signal and Power integrity Simplified -Eric Bogatin, Pearson, 3rd Edition |
| 2. | High Speed Digital Design by Howard Johnson and Martin Graham, Prentice Hall,1st Edition |
| **REFERENCES:** | |
| 1. | High Speed Signal Propagation and Howard Johnson,Prentice Hall,1st Edition |

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Familiarity with High-speed design and related issues | K3 |
| CO2 | Understanding on critical design aspect | K3 |
| CO3 | Know about Jitter and related measurements which is critical for design | K3 |
| CO4 | Explain Practical application of high-speed differential signals | K3 |
| CO5 | Illustrate Measurement expertise up to industry expectations | K4 |

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

## AEC515 - MICs AND RF SYSTEM DESIGN

| **Programme & Branch** | **BE& ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| | | **-** | **PE** | **3** | **0** | **0** | **3** |

| | | |
|---|---|---|
| **Preamble** | To study the characteristics of Active RF & MIC components and applications | |
| **Unit – I** | **ACTIVE RF COMPONENTS AND APPLICATIONS** | **9** |
| RF diodes, BJT, RF FET'S, High electron mobility transistors, matching and biasing networks-impedance matching using discrete components, microstripline matching networks, amplifier classes of operation and biasing networks. | | |
| **Unit – II** | **RF FILTER DESIGN** | **9** |
| Overview, Basic resonator and filter configuration, special filter realizations, smith chart based filter design, coupled filter. | | |
| **Unit - III** | **INTRODUCTION TO MICROWAVE INTEGRATED CIRCUITS:** | **9** |
| Overview of ABCD and S parameters - Overview of Planar transmission lines (Stripline, Microstripline, Slotline, CPW, Finline)-Design Parameters for Strip Line and Micro strip line-Active Device Technologies- Design Approaches Multichip Module Technology- Substrates | | |
| **Unit – IV** | **NON-RECIPROCAL COMPONENTS FOR MICs** | **9** |
| Microstrip on Ferrimagnetic substrates, Microstrip circulators. Isolators and phase shifters, Design of microstrip circuits – high power and low power circuits. | | |
| **Unit - V** | **INTEGRATED ANTENNA DESIGN AND MEASUREMENTS** | **9** |

| | |
|---|---|
| Integrated Antenna Design- Photonic Band Gap Antennas - Micro Machined Antenna - Micro Electro Mechanical System Antennas - Test Fixture Measurements - Probe Station Measurements Thermal and Cryogenic Measurements- Experimental Field Probing Techniques. | |
| | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory and Applications, Pearson Education Asia, First Edition, 2001.(Unit – I, II) |
| 2. | Bharathi Bhat, Shiban K. Koul, "Stripline-like Transmission Lines for Microwave Integrated Circuits", New Age International Pvt Ltd Publishers, 2007.(Unit –III ,V) |
| 3. | Gupta KC and Amarjit Singh, "Microwave Integrated circuits", Wiley Eastern, 1974. (Unit IV) |

**REFERENCES:**

| | |
|---|---|
| 1. | MathewM. Radmanesh, Radio Frequency & Microwave Electronics, Pearson Education Asia, Second Edition, 2002. |
| 2. | Ulrich L. Rohde and David P. NewKirk, RF / Microwave Circuit Design, John Wiley & Sons USA 2000. |
| 3. | Roland E. Best, Phase Locked Loops: Design, simulation and applications, McGraw Hill Publishers 5TH edition 2003 |
| 4. | David Pozar, Microwave Engineering, Addison Wesley 3rd Edition |
| 5. | Ravender Goyal, "Monolithic MIC; Technology & Design", Artech House, First Edition 1989. |

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Apply knowledge of S parameter theory to any RF active component design circuit for obtaining performance measure. | K4 |
| CO2 | Analyze microwave circuits for filters design. | K4 |
| CO3 | Evaluate the performance of any practical Microwave integrated circuits | K4 |
| CO4 | Create communication circuits and subsystems with practical design parameters for non- reciprocal components in MICs. | K4 |
| CO5 | Design microwave integrated antenna design circuit for the required Performance using professional software tools. | K4 |

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

# VERTICAL – IV- BIO MEDICAL TECHNOLOGIES

| AEC516 - BIOMEDICAL SIGNAL PROCESSING | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **-** | **PE** | **3** | **0** | **0** | **3** |

| | |
|---|---|
| Preamble | ➢ This course aids the learners in providing information from the basics of various biomedical signals till their analysis and diagnosis.<br>➢ The course is structured as follows. Introduction to various bio signals and filtering of these signals are covered initially. It then steps forward by providing various applications in cardiovascular and neurological domains that includes the processes of filtering, detection and analysis.<br>➢ Finally wave shape analysis, signal classification based on statistical domain and neural network domains are explored. |

| **Unit – I** | **INTRODUCTION TO BIOMEDICAL SIGNALS** | **9** |
|---|---|---|

Bio signal Characteristics of Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Electrogastrogram (EGG), Electroneurogram (ENG), Event related potentials (ERPs), Phonocardiogram (PCG), Speech signal, Objectives of Biomedical signal analysis, Difficulties in Biomedical signal analysis, Computer-aided diagnosis.

| **Unit – II** | **FILTERING FOR REMOVAL OF ARTIFACTS** | **9** |
|---|---|---|

Time-domain Filters - synchronized averaging, Moving Average Filters, Derivative-based operators to remove low-frequency artifacts. Frequency-domain filters - Removal of High Frequency noise, Removal of low frequency noise, Removal of periodic artifacts, optimal filter- Wiener filter, Adaptive filters for removal of interference.

| **Unit – III** | **CARDIOVASCULAR APPLICATIONS** | **9** |
|---|---|---|

Noise & Artifacts, ECG Signal Processing: Baseline Wandering, Power line interference, Muscle noise filtering – QRS detection, Adaptive noise canceling in ECG, improved adaptive filtering in FECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets. Computation of diagnostic signal parameters of ECG like Heart rate and QRS detection using Multivariate analysis (PCA and ICA). Segmentation of PCG, intensity patterns, Spectral modeling and analysis of PCG signals.

| **Unit – IV** | **NEUROLOGICAL APPLICATIONS** | **9** |
|---|---|---|

EEG rhythms & waveforms, EEG applications- Epilepsy, sleep disorders, brain computer interface. Modeling EEG- linear, stochastic models - Nonlinear modeling of EEG - artifacts in EEG & their characteristics and processing – Nonparametric spectral analysis, Model based spectral analysis - EEG segmentation - Joint Time-Frequency analysis - correlation analysis of EEG channels -coherence analysis of EEG channels. Evoked potentials- noise characteristics, Noise reduction by linear filtering.

| **Unit – V** | **ANALYSIS ON WAVESHAPE, SIGNAL CLASSIFICATION AND RECOGNITION** | **9** |
|---|---|---|

Modeling intramuscular EMG-Intramuscular signal decomposition-Fractal analysis of EMG signals. Statistical analysis of VAG signals. Analysis on amplitude and latency of MEG signals. Analysis of ERP

| |
|---|
| effect. Signal classification and recognition – Statistical signal classification, linear discriminant function, direct feature selection and ordering, Back propagation neural network-based classification. Analysis of EEG using Empirical mode decomposition (EMD). |
| **Total:45** |

| **TEXTBOOK:** | |
|---|---|
| 1. | Rangayyan, "Biomedical Signal Analysis", Wiley 2002. |
| 2. | Semmlow, "Biosignal and Biomedical Image Processing", Marcel Dekker, 2004. |

| **REFERENCES:** | |
|---|---|
| 1. | Arnon Cohen, "Bio-Medical Signal Processing" Vol I and Vol II, CRC Press Inc., Boca Rato, Florida 1999. |
| 2. | D.C.Reddy, "Biomedical Signal Processing: Principles and techniques", Tata McGraw Hill, New Delhi, 2005 |
| 3. | Willis J Tompkins, "Biomedical Digital Signal Processing", Prentice Hall, 1993. |
| 4. | Bruce, "Biomedical Signal Processing & Signal Modeling", Wiley, 2001. |
| 5. | Sörnmo, "Bioelectrical Signal Processing in Cardiac & Neurological Applications", Elsevier 2005. |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Sketch different types of biomedical signals and identify their spectral components | K4 |
| CO2 | Apply different filters on biomedical signals and judge filter performance | K3 |
| CO3 | Identify physiological interferences and artefacts affecting ECG signal | K3 |
| CO5 | Apply an algorithm to classify biomedical signals | K3 |

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

## AEC517 - WEARABLE DEVICES

| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| | | **-** | **PE** | **3** | **0** | **0** | **3** |

| | |
|---|---|
| Preamble | This course gives the knowledge of the hardware requirement of wearable systems, communication and security aspects in the wearable devices and the applications of |

| | | |
|---|---|---|
| | wearable devices in the field of medicine. | |
| **Unit – I** | **INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS** | **9** |
| Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor. | | |
| **Unit – II** | **SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES** | **9** |
| Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles. | | |
| **Unit – III** | **WIRELESS HEALTH SYSTEMS** | **9** |
| Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques. | | |
| **Unit – IV** | **SMART TEXTILE** | **9** |
| Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques- Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks.Case study- smart fabric for monitoring biological parameters - ECG, respiration. | | |
| **Unit – V** | **APPLICATIONS OF WEARABLE SYSTEMS** | **9** |
| Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine. | | |
| | | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011 |
| 2. | Zhang and Yuan-Ting, Wearable Medical Sensors and Systems,Springer, 2013 |
| 3. | Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014 |
| 4. | Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012 |

**REFERENCES:**

| | |
|---|---|
| 1. | Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013. |
| 2. | Guang-Zhong Yang, Body Sensor Networks, Springer, 2006. |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | **Bloom's Taxonomy Level** |
|---|---|

| | | |
|---|---|---|
| CO1 | Describe the concepts of wearable system. | K2 |
| CO2 | Explain the energy harvestings in wearable device. | K2 |
| CO3 | Use the concepts of BAN in health care. | K1 |
| CO4 | Illustrate the concept of smart textile. | K2 |
| CO5 | Compare the various wearable devices in healthcare system. | K2 |

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

## AEC518 - MEDICAL IMAGING SYSTEMS

| Programme & Branch | BE & ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | - | PE | 3 | 0 | 0 | 3 |

| | |
|---|---|
| Preamble | ➢ This course helps the students to understand the generation of X-ray and its uses in medical imaging, the principle of Computed Tomography, the techniques used for visualizing various sections of the body.<br>➢ This also helps to learn the principles of different radio diagnostic equipment in Imaging. |

| | | |
|---|---|---|
| **Unit – I** | **X RAYS** | **9** |

Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Digital Radiography - discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography, cine Angiography. Digital subtraction Angiography. Mammography.

| | | |
|---|---|---|
| **Unit – II** | **COMPUTED TOMOGRAPHY** | **9** |

Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors – Viewing systems – spiral CT scanning – Ultra fast CT scanners. Image reconstruction techniques – back projection and iterative method.

| | | |
|---|---|---|
| **Unit – III** | **MAGNETIC RESONANCE IMAGING** | **9** |

Fundamentals of magnetic resonance- properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system – system magnet (Permanent, Electromagnet and Superconductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components, fMRI.

| | | |
|---|---|---|
| **Unit – IV** | **NUCLEAR IMAGING** | **9** |

| | | |
|---|---|---|
| Radioisotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera – Principle of operation, collimator, photomultiplier tube, X-Y positioning circuit, pulse height analyzer. Principles of SPECT and PET | | |
| **Unit – V** | **RADIATION THERAPY AND RADIATION SAFETY** | **9** |
| Radiation therapy – linear accelerator, Telegamma Machine. SRS – SRT – Recent Techniques in radiation therapy – 3D CRT – IMRT – IGRT and Cyber knife – radiation measuring instruments Dosimeter, film badges, Thermo Luminescent dosimeters – electronic dosimeter – Radiation protection in medicine – radiation protection principles | | |
| | | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | Isaac Bankman, I. N. Bankman, Handbook Of Medical Imaging: Processing and Analysis (Biomedical Engineering), Academic Press,2000 138 139 |
| 2. | Jacob Beutel (Editor), M. Sonka (Editor), Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis, SPIE Press 2000 |
| 3. | Khin Wee Lai, Dyah Ekashanti Octorina Dewi "Medical Imaging Technology", Springer Singapore, 2015 |

**REFERENCES:**

| | |
|---|---|
| 1. | Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw – Hill, New Delhi, 2003. |
| 2. | Dougherty, Geoff (Ed.), "Medical Image Processing - Techniques and Applications ", Springer-Verlag New York, 2011 |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Describe the working principle of the X-ray machine and its application. | K2 |
| CO2 | Illustrate the principle computed tomography | K2 |
| CO3 | Interpret the technique used for visualizing various sections of the body using Magnetic Resonance Imaging. | K3 |
| CO4 | Demonstrate the applications of radionuclide imaging. | K4 |
| CO5 | Analyze different imaging techniques and choose appropriate imaging equipment for better diagnosis and outline the methods of radiation safety | K4 |

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

| **AEC519 - BRAIN COMPUTER INTERFACE AND APPLICATIONS** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |

| & Branch | | - | PE | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|---|---|

| | |
|---|---|
| Preamble | This course helps the students to understand the basic concepts of brain computer interface, various signal acquisition methods and signal processing methods used in BCI. |

| Unit – I | INTRODUCTION TO BCI | 9 |
|---|---|---|

Fundamentals of BCI – Structure of BCI system – Classification of BCI – Invasive, Non-invasive and Partially invasive BCI – EEG signal acquisition - Signal Preprocessing – Artifacts removal.

| Unit – II | ELECTROPHYSIOLOGICAL SOURCES | 9 |
|---|---|---|

Sensorimotor activity – Mu rhythm, Movement Related Potentials – Slow Cortical Potentials-P300 - Visual Evoked Potential - Activity of Neural Cells - Multiple Neuro mechanisms.

| Unit – III | FEATURE EXTRACTION METHODS | 9 |
|---|---|---|

Time/Space Methods – Fourier Transform, PSD – Wavelets – Parametric Methods – AR, MA,ARMA models – PCA – Linear and Non-Linear Features.

| Unit – IV | FEATURE TRANSLATION METHODS | 9 |
|---|---|---|

Linear Discriminant Analysis – Support Vector Machines - Regression – Vector Quantization Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.

| Unit – V | APPLICATIONS OF BCI | 9 |
|---|---|---|

Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External device control, Case study: Brain actuated control of mobile Robot.

**Total:45**

**TEXTBOOK:**

| | |
|---|---|
| 1. | Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010. |

**REFERENCES:**

| | |
|---|---|
| 1. | R. Spehlmann, "EEG Primer", Elsevier Biomedical Press, 1981. |
| 2. | Arnon Kohen, "Biomedical Signal Processing", Vol I and II, CRC Press Inc, Boca Rato, Florida, 1986. |
| 3. | Bishop C.M., "Neural Networks for Pattern Recognition", Oxford, Clarendon Press, 1995. |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Describe BCI system and its potential applications. | K2 |
| CO2 | Analyze event related potentials and sensory motor rhythms. | K4 |
| CO3 | Compute the features suitable for BCI. | K3 |
| CO4 | Design classifier for a BCI system. | K2 |
| CO5 | Implement BCI for various applications. | K4 |

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

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | | | | | | 2 | 2 | 1 |

| AEC520 - BODY AREA NETWORKS | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **-** | **PE** | **3** | **0** | **0** | **3** |
| Preamble | This course gives the knowledge of the hardware requirement of BAN, communication and security aspects in the BAN and the applications of BAN in the field of medicine. | | | | | | |
| **Unit – I** | **INTRODUCTION** | | | | | | **9** |
| Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BAN Architecture – Introduction. | | | | | | | |
| **Unit – II** | **HARDWARE FOR BAN** | | | | | | **9** |
| Processor-Low Power MCUs, Mobile Computing MCUs, Integrated processor with radio transceiver, Memory, Antenna-PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources- Batteries and fuel cells for sensor nodes. | | | | | | | |
| **Unit – III** | **WIRELESS COMMUNICATION AND NETWORK** | | | | | | **9** |
| RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-Stand –Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1, IEEE P802.15.13, IEEE 802.15.14, Zigbee. | | | | | | | |
| **Unit – IV** | **COEXISTENCE ISSUES WITH BAN** | | | | | | **9** |
| Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues-Medical Device regulation in USA and Asia, Security and Self-protection-Bacterial attacks, Virus infection, Secured protocols, Self-protection. | | | | | | | |
| **Unit – V** | **APPLICATIONS OF BAN** | | | | | | **9** |
| Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill. | | | | | | | |
| | | | | | | | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, “Body Area Networks Safety, Security, and Sustainability’’, Cambridge University Press, 2013 |
| 2. | Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing Pte. Ltd., Singapore, 2012 |

**REFERENCES:**

| | |
|---|---|
| 1. | Zhang, Yuan-Ting, “Wearable Medical Sensors and Systems’’, Springer, 2013. |
| 2. | Guang-Zhong Yang (Ed.), “Body Sensor Networks’’, Springer, 2006. |
| 3. | Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011. |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | **Bloom’s Taxonomy Level** |
|---|---|

| | | |
|---|---|---|
| CO1 | Comprehend and appreciate the significance and role of this course in the present contemporary world. | K3 |
| CO2 | Design a BAN for appropriate application in medicine. | K3 |
| CO3 | Assess the efficiency of communication and the security parameters. | K3 |
| CO4 | Understand the need for medical device regulation and regulations followed in various regions. | K2 |
| CO5 | Extend the concepts of BAN for medical applications. | K2 |

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

# VERTICAL – V- HIGH SPEED COMMUNICATIONS

| AEC521 - COMMUNICATION NETWORKS | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **-** | **PE** | **3** | **0** | **0** | **3** |

| | |
|---|---|
| Preamble | To understand the division of network functionalities into layers, be familiar with the different types of networks. Determine the function of each layer of the network and describe the operation of the flow control and congestion control algorithms |

| | | |
|---|---|---|
| **Unit – I** | **Fundamentals & Link Layer** | **9** |

Network Topology- Network types –Layering and protocols – Layers in TCP/IP protocol suite – OSI Model- Switching Techniques. Connecting devices- Hubs, Switches, Routers-Data Link Layer Services.

| | | |
|---|---|---|
| **Unit – II** | **Media Access & Internetworking** | **9** |

Ethernet and multiple access networks 802.3 -Wireless: WiFi, Bluetooth, Cellphone technologies – Basic internetworking-IP, ARP, DHCP, ICMP- IPV4

| | | |
|---|---|---|
| **Unit – III** | **Routing** | **9** |

Unicast Routing (RIP, OSPF)– Multicast addresses – Multicast Routing (DVMRP, PIM) — Global Internet Areas, BGP- Overview of IPV6 Addressing – Transition from IPV4 to IPV6

| | | |
|---|---|---|
| **Unit – IV** | **Transport Layer** | **9** |

Transport Layer services – Simple, Stop-and-wait, Go-Back-N, Selective Repeat, Piggy backing. Transport Layer Protocols - User Datagram Protocols (UDP) and Transmission Control Protocols (TCP) – Services – Features – TCP Connection – State Transition Diagram – Flow, Error and Congestion Control - Congestion
avoidance (DECbit, RED) – QoS

| | | |
|---|---|---|
| **Unit – V** | **Application Layer** | **9** |

Traditional applications -Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – DNS – Introduction to Peer to Peer Networks – Client Server programming, Cryptography basics: Public and Private key, Firewalls.

**Total:45**

**TEXTBOOK:**


| | |
|---|---|
| 1. | Behrouz A. Forouzan, ―Data communication and Networking, Fifth Edition, Tata McGraw – Hill, 2013 |
| 2. | Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan |


**REFERENCES:**


| | |
|---|---|
| 1. | James F. Kurose, Keith W. Ross, Computer Networking - A Top-Down Approach Featuring the Internet, Seventh Edition, Pearson Education, 2016. |
| 2. | Nader. F. Mir, Computer and Communication Networks, Pearson Prentice Hall Publishers, 2nd Edition, 2014 |
| 3. | Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, Computer Networks: An Open Source Approach‖, McGraw Hill Publisher, 2011. |


| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Identify the required functionality at each layer for a given application and the importance of physical connectivity, networking models, and devices. | K2 |

| | | |
|---|---|---|
| CO2 | Analyze the functions of the data link layer. | K3 |
| CO3 | Construct solutions for the various routing algorithms in packet-switched networking. | K2 |
| CO4 | Examine the performance of transport layer protocols and the beneficial effects of adopting suitable congestion control schemes. | K3 |
| CO5 | Determine the features and protocols of the application layer | K4 |

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

## AEC522 - OPTICAL COMMUNICATION & NETWORKS

| Programme & Branch | BE & ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | - | PE | 3 | 0 | 0 | 3 |

| | |
|---|---|
| Preamble | This course aims to provide students with the Optical Fiber Modes, Configuration of Optical Fibers, Transmission Characteristics of Optical Fibers and Optical Sources, Detectors and Transmission Techniques. |

| Unit – I | INTRODUCTION TO OPTICAL FIBER COMMUNICATION | 9 |
|---|---|---|

Introduction - The General Systems - Advantages of Optical Fiber Communication- Ray Theory Transmission: Total Internal Reflection, Acceptance Angle, Numerical Aperture, Skew Rays - Electromagnetic Mode Cylindrical Fiber: Step index fibers, Graded index fibers - Single mode fibers.

| Unit – II | TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS | 9 |
|---|---|---|

Attenuation - Material absorption losses in silica glass fibers: Intrinsic absorption, Extrinsic absorption - Linear scattering losses: Rayleigh Scattering, Nonlinear scattering losses: Stimulated Brillouin Scattering, Stimulated Raman Scattering Dispersion- Chromatic dispersion: Material dispersion, Waveguide dispersion- Intermodal dispersion: Multimode step index fiber, Multimode graded index fiber.

| Unit – III | OPTICAL SOURCES AND OPTICAL DETECTORS | 9 |
|---|---|---|

The laser : Introduction - Basic concepts: Absorption and emission of radiation, Population inversion , LED: Introduction- Power and Efficiency – LED structures: Planar LED, Surface emitter LED, Edge emitter LED- Optical Detectors: Introduction, Optical Detection Principles, Quantum Efficiency, Responsivity, P-N Photodiode, P-I-N Photo Diode and Avalanche Photodiode.

| Unit – IV | OPTICAL FIBER MEASUREMENTS | 9 |
|---|---|---|

Introduction- Total Fiber Attenuation Measurement, Fiber Dispersion Measurements in Time Domain and Frequency Domain, Fiber Cut off Wavelength Measurements, Numerical Aperture Measurements. Fiber Diameter Measurements, Reflectance And Optical Return Loss, Field Measurements

| Unit – V | OPTICAL NETWORKS | 9 |
|---|---|---|

Introduction- Optical Network Concepts: Optical Networking Terminology, Optical Network Node an Switching Elements, Wavelength Division Multiplexed Networks, Public Telecommunications Networ Overview- Optical Network Transmission Modes, Layers and Protocols: Synchronous Network Asynchronous Transfer Mode, Open System Interconnection Reference Model, Optical Transport Network.

**Total:45**

| TEXTBOOK: | |
|---|---|
| 1. | John M.Senior, “Optical Fiber Communication”, Pearson Education, Fouth Edition.2010. |
| **REFERENCES:** | |
| 1. | Gred Keiser,"Optical Fiber Communication”, McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2013. |
| 2. | Govind P. Agrawal, “Fiber-Optic Communication Systems”, Third Edition, John Wiley & Sons, |
| 3. | J.Gower, “Optical Communication System”, Prentice Hall Of India, 2001 |
| 4. | Rajiv Ramaswami, “Optical Networks “ , Second Edition, Elsevier , 2004. |
| 5. | 5. P Chakrabarti, "Optical Fiber Communication”, McGraw Hill Education (India)Private Limited, |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom’s Taxonomy Level** |
|---|---|---|
| CO1 | Realize Basic Elements in Optical Fibers, Different Modes and Configurations. | K3 |
| CO2 | Analyze the Transmission Characteristics Associated with Dispersion and Polarization Techniques. | K3 |
| CO3 | Design Optical Sources and Detectors with their use in Optical Communication System. | K2 |
| CO4 | Construct Fiber Optic Receiver Systems, Measurements and Techniques. | K2 |
| CO5 | Design Optical Communication Systems and its Networks. | K4 |

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

| **AEC523 - 4G / 5G COMMUNICATION NETWORKS** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **-** | **PE** | **3** | **0** | **0** | **3** |
| Preamble | This course aims to provide students with fundamentals of 5G networks, 5G architecture, spectrum sharing and spectrum trading, security features in 5G networks. | | | | | | |
| **Unit – I** | **EVOLUTION OF WIRELESS NETWORKS** | | | | | | **9** |
| Networks evolution: 2G,3G,4G, evolution of radio access networks, need for 5G. 4G versus 5G, Next Generation core(NG-core), visualized Evolved Packet core(vEPC). | | | | | | | |
| **Unit – II** | **5G CONCEPTS AND CHALLENGES** | | | | | | **9** |
| Fundamentals of 5G technologies, overview of 5G core network architecture,5G new radio and cloud technologies, Radio Access Technologies (RATs), EPC for 5G. | | | | | | | |
| **Unit – III** | **NETWORK ARCHITECTURE AND THE PROCESSES** | | | | | | **9** |

| | | |
|---|---|---|
| 5G architecture and core, network slicing, multi access edge computing (MEC)visualization of 5G components, end-to-end system architecture, service continuity, relation to EPC, and edge computing. 5G protocols: 5G NAS, NGAP, GTP-U, IPSec and GRE. | | |
| **Unit – IV** | **DYNAMIC SPECTRUM MANAGEMENT AND MM-WAVES** | **9** |
| Mobility management, Command and control, spectrum sharing and spectrum trading, cognitive radio based on 5G, millimeter waves. | | |
| **Unit – V** | **SECURITY IN 5G NETWORKS** | **9** |
| Security features in 5G networks, network domain security, user domain security, flow based QoS framework, mitigating the threats in 5G. | | |
| | | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | 5G Core networks: Powering Digitalization , Stephen Rommer, Academic Press,2019 |
| 2. | An Introduction to 5G Wireless Networks : Technology, Concepts and Use cases, Saro |

**REFERENCES:**

| | |
|---|---|
| 1. | 5G Simplified: ABCs of Advanced Mobile Communications Jyrki. T.J.Penttinen,Copyrighted Material. |
| 2. | 5G system Design: An end to end Perspective , Wan Lee Anthony, Springer Publications,2019. |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Understand the evolution of wireless networks. | K3 |
| CO2 | Learn the concepts of 5G networks. | K4 |
| CO3 | Comprehend the 5G architecture and protocols. | K4 |
| CO4 | Understand the dynamic spectrum management. | K3 |
| CO5 | Learn the security aspects in 5G networks. | K2 |

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

## AEC524 - WIRELESS BROAD BAND NETWORKS

| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| | | **-** | **PE** | **3** | **0** | **0** | **3** |

| | | |
|---|---|---|
| Preamble | This course aims to provide students with the 3G, 4G technologies and LTE-A in mobile cellular network, emerging techniques in 5G network. | |
| **Unit – I** | **WIRELESS PROTOCOLS** | **9** |

| | | |
|---|---|---|
| Mobile network layer- Fundamentals of Mobile IP, data forwarding procedures in mobile IP, IPv4, IPv6, IP mobility management, IP addressing - DHCP, Mobile transport layer-Traditional TCP, congestion control, slow start, fast recovery/fast retransmission, classical TCP improvements- Indirect TCP, snooping TCP, Mobile TCP. | | |
| **Unit – II** | **3G EVOLUTION** | **9** |
| IMT-2000 - W-CDMA, CDMA 2000 - radio & network components, network structure, packet-data transport process flow, Channel Allocation, core network, interference-mitigation techniques, UMTS-services, air interface, network architecture of 3GPP, UTRAN – architecture, High Speed Packet Data-HSDPA,HSUPA. | | |
| **Unit – III** | **4G EVOLUTION** | **9** |
| Introduction to LTE-A – Requirements and Challenges, network architectures – EPC, E- UTRAN architecture - mobility management, resource management, services, channel -logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure. | | |
| **Unit – IV** | **LAYER-LEVEL FUNCTIONS** | **9** |
| Characteristics of wireless channels - downlink physical layer, uplink physical layer, MAC scheme - frame structure, resource structure, mapping, synchronization, reference signals and channel estimation, SC-FDMA, interference cancellation – CoMP, Carrier aggregation, Services - multimedia broadcast/multicast, location-based services. | | |
| **Unit – V** | **5G EVOLUTION** | **9** |
| 5G Roadmap - Pillars of 5G - 5G Architecture, The 5G internet - IoT and context awareness - Networking reconfiguration and virtualization support - Mobility QoS control - emerging approach for resource over provisioning, Small cells for 5G mobile networks- capacity limits and achievable gains with densification - Mobile data demand, Demand Vs Capacity, Small cell challenges, conclusion and future directions. | | |
| | | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | Kaveh Pahlavan, “Principles of wireless networks”, Prentice-Hall of India, 2008 |

**REFERENCES:**

| | |
|---|---|
| 1. | Vijay K.Garg, “Wireless Network Evolution - 2G & 3G”. Prentice Hall, 2008. |
| 2. | Clint Smith,P.E, Dannel Collins, “3G Wireless Networks” Tata McGraw- Hill, 2nd Edition, 2011. |
| 3. | Sassan Ahmadi, “LTE-Advanced – A practical systems approach to understanding the 3GPP LTE Releases 10 and 11 radio access technologies”, Elsevier, 2014. |
| 4. | Jonathan Rodriguez, "Fundamentals of 5G Mobile networks", John Wiley, 2015. |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom’s Taxonomy Level** |
|---|---|---|
| CO1 | Design and implement the various protocols in wireless networks. | K4 |
| CO2 | Analyze the architecture of 3G network standards. | K2 |
| CO3 | Analyze the difference of LTE-A network design from 4G standard. | K2 |

| | | |
|---|---|---|
| CO4 | Design the interconnecting network functionalities by layer level functions. | K3 |
| CO5 | Explore the current generation (5G) network architecture. | K4 |

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

## AEC525 - MASSIVE MIMO NETWORKS

| Programme & Branch | BE & ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | - | PE | 3 | 0 | 0 | 3 |

| | |
|---|---|
| Preamble | This course aims to provide students with the MIMO propagation channels and to learn about channel estimation in single cell and multicell massive MIMO systems and massive MIMO deployment. |

**Unit – I** **MASSIVE MIMO NETWORKS** **9**

Definition of Massive MIMO, Correlated Rayleigh Fading, System Model for Uplink and Downlink, Basic Impact of Spatial Channel Correlation, Channel Hardening and Favourable Propagation, Local Scattering Spatial Correlation Model

**Unit – II** **THE MASSIVE MIMO PROPAGATION CHANNEL** **9**

Favorable Propagation and Deterministic Channels-Capacity Upper Bound-Distance from Favorable Propagation-Favorable Propagation and Linear Processing-Singular Values and Favorable Propagation, Favorable Propagation and Random Channels-Independent Rayleigh Fading-Uniformly Random Line-of-Sight (UR-LoS)-Independent Rayleigh Fading versus UR-LoS - Finite-Dimensional Channels.

**Unit – III** **SINGLE-CELL SYSTEMS** **9**

Uplink Pilots and Channel Estimation - Orthogonal Pilots- De-Spreading of the Received Pilot Signal-MMSE Channel Estimation, Uplink Data Transmission - Zero-Forcing -Maximum-Ratio, Downlink Data Transmission-Linear Precoding-Zero-Forcing-Maximum-Ratio, Discussion- Interpretation of the Effective SINR Expressions-Implications for Power Control-Scaling Laws and Upper Bounds on the SINR - Near-Optimality of Linear Processing when M >> K - Net Spectral
Efficiency - Limiting Factors: Number of Antennas and Mobility

**Unit – IV** **MULTI-CELL SYSTEMS** **9**

Uplink Pilots and Channel Estimation, Uplink Data Transmission - Zero-Forcing -Maximum-Ratio, Downlink Data Transmission -Zero-Forcing - Maximum-Ratio, Discussion -Asymptotic Limits with Infinite Numbers of Base Station Antennas - The Effects of Pilot Contamination - Non-Synchronous Pilot Interference.

**Unit – V** **CASE STUDIES** **9**

Single-Cell Deployment Example: Fixed Broadband Access in Rural Area, Multi-Cell Deployment: Preliminaries and Algorithms, Multi-Cell Deployment Examples: Mobile Access - Dense Urban Scenario - Suburban Scenario - Minimum Per-Terminal Throughput Performance –Additional Observations -

| | |
|---|---|
| Comparison of Power Control Policies | |
| | **Total:45** |

| **TEXTBOOK:** | |
|---|---|
| 1. | Thomas L. Marzetta, Erik G. Larsson, Hong Yang, Hien Quoc Ngo, "Fundamentals of Massive MIMO", Cambridge University Press 2016. (UNITS II-V) |
| 2. | Spectral, Energy, and Hardware Efficiency", Foundations and Trends, Now, 2017. (UNIT I) |

| **REFERENCES:** | |
|---|---|
| 1. | Long Zhao, Hui Zhao, Kan Zheng, "Wei Xiang Massive MIMO in 5G Networks: Selected Applications", Springer 2018. |
| 2. | Leibo Liu, Guiqiang Peng, Shaojun Wei, "Massive MIMO Detection Algorithm and VLSI Architecture", Springer 2019. |
| 3. | Shahid Mumtaz, Jonathan Rodriguez, Linglong Dai, "mmWave Massive MIMO A Paradigm for 5G", Elsevier, 2017. |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Understand and explain massive MIMO networks. | K3 |
| CO2 | Analyze massive MIMO propagation channels and their capacity bounds | K2 |
| CO3 | Examine channel estimation techniques for single cell system. | K2 |
| CO4 | Analyze channel estimation techniques for multi cell system. | K3 |
| CO5 | Explain the concepts underlining the deployment of single and multicell massive | K2 |

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

## AEC526 - ADVANCED WIRELESS COMMUNICATION TECHNIQUES

| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| | | **-** | **PE** | **3** | **0** | **0** | **3** |

| | | |
|---|---|---|
| Preamble | This course aims to provide students understand the cooperative communication, green wireless communication, power saving strategies and energy efficient signal, system and network design based on wireless communication. | |
| **Unit – I** | **COOPERATIVE COMMUNICATIONS AND GREEN CONCEPTS** | **9** |

| | | |
|---|---|---|
| Network architectures and research issues in cooperative cellular wireless networks; Cooperative communications in OFDM and MIMO cellular relay networks: issues and approaches; Fundamental trade-offs on the design of green radio networks, Green modulation and coding schemes. | | |
| **Unit – II** | **COOPERATIVE TECHNIQUES** | **9** |
| Cooperative techniques for energy efficiency, Cooperative base station techniques for cellular wireless networks; Turbo base stations; Antenna architectures for cooperation; Cooperative communications in 3GPP LTE-Advanced, Partial information relaying and coordinated multi-point transmission in LTE-Advanced. | | |
| **Unit – III** | **RELAY-BASED COOPERATIVE CELLULAR NETWORKS** | **9** |
| Distributed space-time block codes; Collaborative relaying in downlink cellular systems; Radio resource optimization; Adaptive resource allocation ; Cross-layer scheduling design for cooperative wireless two-way relay networks ; Network coding in relay-based networks. | | |
| **Unit – IV** | **GREEN RADIO NETWORKS** | **9** |
| Base Station Power-Management Techniques- Opportunistic spectrum and load management, Energy-saving techniques in cellular wireless base stations, Power-management for base stations in smart grid environment, Cooperative multi cell processing techniques for energy-efficient cellular wireless communications. | | |
| **Unit – V** | **ACCESS TECHNIQUES FOR GREEN RADIO NETWORKS** | **9** |
| Cross-layer design of adaptive packet scheduling for green radio networks; Energy-efficient relaying for cooperative cellular wireless networks; Energy performance in TDD-CDMA multihop cellular networks; Resource allocation for green communication in relay-based cellular networks ; Green Radio Test-Beds and Standardization Activities. | | |
| | | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | Ekram Hossain, Dong In Kim, Vijay K. Bhargava, "Cooperative Cellular Wireless Networks", Cambridge University Press, 2011 |
| 2. | Ekram Hossain, Vijay K. Bhargava (Editor), Gerhard P. Fettweis (Editor), "Green Radio Communication Networks", Cambridge University Press, 2012. |

**REFERENCES:**

| | |
|---|---|
| 1. | F. Richard Yu, Yu, Zhang and Victor C. M. Leung "Green Communications and Networking", CRC press, 2012. |
| 2. | Ramjee Prasad and Shingo Ohmori, Dina Simunic, "Towards Green ICT", River Publishers,2010. |
| 3. | Jinsong Wu, Sundeep Rangan and Honggang Zhang, "Green Communications: Theoretical Fundamentals, Algorithms and Applications", CRC Press, 2012. |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | The student would be able to appreciate the necessity and the design aspects of cooperative communication | K3 |
| CO2 | The student would be able to appreciate the necessity and the design aspects of green wireless communication. | K4 |
| CO3 | The student would be able to appreciate the necessity and the design aspects of green wireless communication | K2 |
| CO4 | The student would be able to evolve new techniques in wireless | K2 |

| | | |
|---|---|---|
| | communication | |
| CO5 | The student would be able to demonstrate the impact of the green engineering solutions in a global, economic, environmental and societal context. | K2 |

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

# VERTICAL – VI- EMERGING TECHNOLOGIES AND IOT

## AEC527 - ARTIFICIAL INTELLIGENCE AND ITS APPLICATIONS

| Programme & Branch | BE & ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | - | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | The main objectives of this course are to learn the basic AI approaches, develop problem solving agents and perform logical and probabilistic reasoning. | |
| **Unit – I** | **INTELLIGENT AGENTS** | **9** |
| Introduction to AI – Agents and Environments – concept of rationality – nature of environments – structure of agents. Problem solving agents – search algorithms – uninformed search strategies. | | |
| **Unit – II** | **PROBLEM SOLVING** | **9** |
| Heuristic search strategies – heuristic functions. Local search and optimization problems – local search in continuous space – search with non-deterministic actions – search in partially observable environments – online search agents and unknown environments | | |
| **Unit – III** | **GAME PLAYING AND CSP** | **9** |
| Game theory – optimal decisions in games – alpha-beta search – monte-carlo tree search – stochastic games – partially observable games. Constraint satisfaction problems – constraint propagation – backtracking search for CSP – local search for CSP – structure of CSP | | |
| **Unit – IV** | **LOGICAL REASONING** | **9** |
| Knowledge-based agents – propositional logic – propositional theorem proving – propositional model checking – agents based on propositional logic. First-order logic – syntax and semantics – knowledge representation and engineering – inferences in first-order logic – forward chaining – backward chaining – resolution. | | |
| **Unit – V** | **PROBABILISTIC REASONING** | **9** |
| Acting under uncertainty – Bayesian inference – naïve Bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks. | | |
| | | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021 |

**REFERENCES:**

| | |
|---|---|
| 1. | Dan W. Patterson, “Introduction to AI and ES”, Pearson Education,2007 |
| 2. | Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008 |
| 3. | Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006 |
| 4. | Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013. |
| 5. | http://nptel.ac.in/ |

| COURSE OUTCOMES:<br>At the end of the course, learners will be able to | | Bloom's Taxonomy Level |
|---|---|---|
| CO1 | Explain intelligent agent frameworks | K2 |
| CO2 | Apply problem solving techniques | K3 |
| CO3 | Apply game playing and CSP techniques | K3 |
| CO4 | Perform logical reasoning | K3 |
| CO5 | Perform probabilistic reasoning under uncertainty | K3 |

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

## AEC528 - WIRELESS SENSOR NETWORK DESIGN

| Programme & Branch | BE & ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | - | PE | 3 | 0 | 0 | 3 |

| | |
|---|---|
| Preamble | This course provides the fundamentals of wireless sensor networks and helps the students gain knowledge on Routing Protocols and WSN applications |

| Unit – I | INTRODUCTION | 9 |
|---|---|---|

Principle of Wireless Sensor Network -Introduction to wireless sensor networks- Challenges, Comparison with ad hoc network, Node architecture and Network architecture, design principles, Service interfaces, Gateway, Short range radio communication standards-IEEE 802.15.4, Zigbee and Bluetooth. Physical layer and transceiver design considerations.

| Unit – II | MAC AND ROUTING PROTOCOLS | 9 |
|---|---|---|

MAC protocols – fundamentals, low duty cycle protocols and wakeup concepts, contention and Schedule-based protocols - SMAC, BMAC, TRAMA, Routing protocols – Requirements, Classification -SPIN, Directed Diffusion, COUGAR, ACQUIRE, LEACH, PEGASIS.

| Unit – III | 6LOWPAN | 9 |
|---|---|---|

6LoWPAN Architecture - protocol stack, Adaptation Layer, Link layers – Addressing, Routing - Mesh-Under - Route-Over, Header Compression - Stateless header compression - Context- based header compression, Fragmentation and Reassembly , Mobility – types, Mobile IPv6, Proxy Home Agent, Proxy MIPv6, NEMO –Routing – MANET, ROLL, Border routing.

| Unit – IV | APPLICATION | 9 |
|---|---|---|

Design Issues, Protocol Paradigms -End-to-end, Real-time streaming and sessions, Publish/subscribe, Web service paradigms, Common Protocols -Web service protocols, MQ telemetry transport for sensor networks (MQTT-S), ZigBee compact application protocol (CAP), Service discovery, Simple network management protocol (SNMP), Real-time transport and sessions, Industry- Specific protocols.

| Unit – V | TOOLS | 9 |
|---|---|---|
| TinyOS – Introduction, NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, TOSSIM, Contiki – Structure, Communication Stack, Simulation environment – Cooja simulator, Programming. | | |

**Total:45**

**REFERENCES:**


| | |
|---|---|
| 1. | Holger Karl , Andreas willig, “Protocol and Architecture for Wireless Sensor Networks”, John Wiley Publication, 2006. |
| 2. | Anna Forster, “Introduction to Wireless Sensor Networks”, Wiley, 2017. |
| 3. | Zach Shelby Sensinode and Carsten Bormann, “ 6LoWPAN: The Wireless Embedded Internet” John Wiley and Sons, Ltd, Publication, 2009. |
| 4. | Philip Levis, “TinyOS Programming”, 2006 –www.tinyos.net. |
| 5. | The Contiki Operating System.http://www.sics.se/contiki. |


| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom’s Taxonomy Level** |
|---|---|---|
| CO1 | To be able to design solutions for WSNs applications | K5 |
| CO2 | To be able to develop efficient MAC and Routing Protocols | K5 |
| CO3 | To be able to design solutions for 6LOWPAN applications | K5 |
| CO4 | To be able to develop efficient layered protocols in 6LOWPAN | K5 |
| CO5 | To be able to use Tiny OS and Contiki OS in WSNs and 6LOWPAN applications | K3 |

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

## AEC529 - IOT BASED SYSTEMS DESIGN

| Programme & Branch | BE & ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | - | PE | 3 | 0 | 0 | 3 |

| | |
|---|---|
| Preamble | This course will ensure that the students understand the fundamentals, basics, implementation and applications of IoT and the various services it provides. |

| Unit – I | INTRODUCTION TO INTERNET OF THINGS | 9 |
|---|---|---|
| Rise of the machines – Evolution of IoT – Web 3.0 view of IoT – Definition and characteristics of IoT – IoT Enabling Technologies – IoT Architecture -– Fog, Edge and Cloud in IoT – Functional blocks of an | | |

IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects - IoT levels and deployment templates – A panaromic view of IoT applications.

| **Unit – II** | **MIDDLEWARE AND PROTOCOLS OF IOT** | **9** |
|---|---|---|

Middleware technologies for IoT system (IoT Ecosystem Overview – Horizontal Architecture Approach for IoT Systems – SOA based IoT Middleware) Middleware architecture of RFID,WSN,SCADA,M2M –Interoperability challenges of IoT-Protocols for RFID,WSN,SCADA,M2M- Zigbee, KNX,BACNet, MODBUS - Challenges Introduced by 5G in IoT Middleware(Technological Requirements of 5G Systems - Perspectives and a Middleware Approach Toward 5G (COMPaaS Middleware) – Resource management in IoT.

| **Unit – III** | **COMMUNICATION AND NETWORKING** | **9** |
|---|---|---|

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition –Application Layer Protocols: CoAP and MQTT- Data aggregation & dissemination.

| **Unit – IV** | **IOT IMPLEMENTATION TOOLS** | **9** |
|---|---|---|

Introduction to Python, Introduction to different IoTtools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python, Implementation of IoT with Raspberry Pi.

| **Unit – V** | **APPLICATIONS AND CASE STUDIES** | **9** |
|---|---|---|

Home automations - Smart cities – Environment – Energy – Retail – Logistics – Agriculture – Industry - Health and life style – Case study.

**Total:45**

**TEXTBOOKS:**

| | |
|---|---|
| 1. | Honbo Zhou, “Internet of Things in the cloud:A middleware perspective”, CRC press, 2012. |
| 2. | Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-onApproach)”, VPT, 1st Edition, 2014. |

**REFERENCES:**

| | |
|---|---|
| 1. | Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017. |
| 2. | Constandinos X. Mavromoustakis, George Mastorakis, Jordi MongayBatalla, “Internet of Things (IoT) in 5G Mobile Technologies” Springer International Publishing Switzerland 2016. 149 |
| 3. | Dieter Uckelmann, Mark Harrison, Florian Michahelles, “Architecting the Internet of Things” Springer-Verlag Berlin Heidelberg, 2011. |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom’s Taxonomy Level** |
|---|---|---|
| CO1 | Articulate the main concepts, key technologies, strength and limitations | K2 |

| | | |
|---|---|---|
| | of IoT. | |
| CO2 | Identify the architecture, infrastructure models of IoT. | K2 |
| CO3 | Analyze the networking and how the sensors are communicated in IoT. | K4 |
| CO4 | Analyze and design different models for IoT implementation. | K4 |
| CO5 | Identify and design the new models for market strategic interaction. | K5 |

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO 9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 1 | 3 | - | - | - | - | 2 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 2 | 2 | 1 | - | - | - | - | - | 1 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 1 | 2 | - | - | - | - | 3 | 2 | 3 | 2 |
| CO4 | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | 1 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 3 | 2 | 1 | - | - | - | - | 2 | 1 | 3 | 2 |

## AEC530 - MEMS

| Programme & Branch | BE& ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | - | PE | 3 | 0 | 0 | 3 |

| | |
|---|---|
| Preamble | This course helps the students to understands about MEMS sensors and actuators and an introduction to RF and optical MEMS. |

| Unit – I | INTRODUCTION TO MEMS AND NEMS | 9 |
|---|---|---|

MEMS and Microsystems, Miniaturization, Typical products, Micro actuation, MEMS with micro actuators, Micro accelerometers and micro fluidics, Introduction to NEMS, Nano scaling, classification of nano structured materials, Applications of nanomaterials. Synthesis routers-Bottom up and Top-down approaches. Materials for MEMS: Silicon, Silicon compounds, Polymers, metals.

| Unit - II | MECHANICS FOR MEMS DESIGN | 9 |
|---|---|---|

Elasticity, Stress, strain and material properties, Bending of thin plates, Spring configuration, Tortional deflection, Mechanical vibration, Resonance, thermos mechanics-actuators, force and response time, Fracture and thin flim mechanics.

| Unit - III | MATERIALS AND FABRICATION TECHNIQUES | 9 |
|---|---|---|

Atomic structures and Quantum Mechanics, Molecular and Nanostructure Dynamics Photolithography, Ion Implantation, Diffusion, Oxidation, Dry and wet etching, Bulk Micromachining Surface Micromachining, LIGA.

| Unit - IV | DESIGN OF MEMS SENSORS AND ACTUATORS | 9 |
|---|---|---|

Acoustic sensor-Quartz crystal microbalance, surface acoustic wave, Flexural plate wave, shear horizontal; vibratory gyroscope, Pressure sensors, Electrostatic actuators, Piezoelectric actuators, Thermal actuators, Actuators using shape alloys, Micro grippers, Micro motors, Micro valves, Micro pumps, packaging.

| Unit - V | INTRODUCTION TO OPTICAL AND RF MEMS | 9 |
|---|---|---|

Optical MEMS,-System design basics-Gaussian optics, matrix operations, resolution, Case Studies, MEMS scanners and retinal scanning display, Digital Micro mirror devices, RF MEMS-design, RF MEMS switch, Performance issues, packaging.

| | |
|---|---|
| | **Total:45** |
| **TEXTBOOK:** | |
| 1. | Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata McGraw Hill, 2002 |
| 2. | Murty B.S. Shankar P.Raj B, Rath, B.B, Murday J, Textbook of Nanoscience and Nanotechnology, Springer publishing, 2013. |
| **REFERENCES:** | |
| 1. | Sergey Edward Lyshevski, "MEMS and NEMS Systems, Devices and Structures" CRC press, 2002. |
| 2. | Chang Liu, "Foundations of MEMs." Pearson education India Limited, 2006. |
| 3. | Vinod kumar khanna Nanosensors: physical, chemical, and Biological, CRC Press, 2012. |
| 4. | Mahalik. N. P. MEMS, Tata Mc-Graw Hill, 2007. |
| 5. | Manouchehr E Motamedi, MOEMS, Micro-Opto-Electro-Mechanical Systems, SPIE press, First Edition, 2005. |

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Recognize the basics of materials and fabrication of micro electromechanical systems. | K2 |
| CO2 | Devise the Fabrication techniques of nano electromechanical systems. | K2 |
| CO3 | Analyze the key performance aspects of micro electromechanical sensors and transducers. | K4 |
| CO4 | Analyze various aspects of nanomaterials and sensors. | K4 |
| CO5 | Identify the potential applications of MEMS in the RF optical domain. | K1 |

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

## AEC531 - ADVANCED MACHINE LEARNING

| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| | | **-** | **PE** | **3** | **0** | **0** | **3** |

| | | |
|---|---|---|
| Preamble | This subject aims to understand the basic concepts of machine learning and build supervised and unsupervised learning models. | |
| **Unit – I** | **INTRODUCTION TO MACHINE LEARNING** | **9** |
| Review of Linear Algebra for machine learning; Introduction and motivation for machine learning; Examples of machine learning applications, Vapnik- Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning, Hypothesis spaces, Inductive bias, Generalization, Bias variance trade-off. | | |
| **Unit – II** | **SUPERVISED LEARNING** | **9** |

Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naïve Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random Forests

| **Unit – III** | **ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING** | **9** |
|---|---|---|

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization.

| **Unit – IV** | **DEEP NETWORKS BASICS** | **9** |
|---|---|---|

Linear Algebra: Scalars -- Vectors -- Matrices and tensors; Probability Distributions -- Gradient-based Optimization – Machine Learning Basics: Capacity -- Overfitting and underfitting –Hyperparameters and validation sets -- Estimators -- Bias and variance -- Stochastic gradient descent – Challenges motivating deep learning; Deep Networks: Deep feedforward networks; Regularization -- Optimization

| **Unit – V** | **CONVOLUTIONAL NEURAL NETWORKS** | **9** |
|---|---|---|

Convolution Operation -- Sparse Interactions -- Parameter Sharing -- Equivariance -- Pooling -- Convolution Variants: Strided -- Tiled -- Transposed and dilated convolutions; CNN Learning: Nonlinearity Functions -- Loss Functions -- Regularization -- Optimizers --Gradient Computation

**Total:45**

**TEXTBOOK:**

| | |
|---|---|
| 1. | Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition, 2020. |
| 2. | Stephen Marsland, “Machine Learning: An Algorithmic Perspective, “Second Edition”, CRC Press, 2014. |
| 3. | Ian Goodfellow, Yoshua Bengio, Aaron Courville, ``Deep Learning", MIT Press, 2016. |
| 4. | Andrew Glassner, “Deep Learning: A Visual Approach”, No Starch Press, 2021. |

**REFERENCES:**

| | |
|---|---|
| 1. | Tom Mitchell, “Machine Learning”, McGraw Hill, 3rd Edition, 1997. |
| 2. | Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, “Foundations of Machine Learning”, Second Edition, MIT Press, 2018. |
| 3. | Salman Khan, Hossein Rahmani, Syed Afaq Ali Shah, Mohammed Bennamoun, ``A Guide to Convolutional Neural Networks for Computer Vision", Synthesis Lectures on Computer Vision, Morgan & Claypool publishers, 2018. |
| 4. | Charu C. Aggarwal, ``Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 2018. |
| 5. | Josh Patterson, Adam Gibson, ``Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017. |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom’s Taxonomy Level** |
|---|---|---|
| CO1 | Explain the basic concepts of machine learning. | K2 |
| CO2 | Construct supervised learning models. | K3 |
| CO3 | Construct unsupervised learning algorithms. | K3 |

| | | |
|---|---|---|
| CO4 | Apply model evaluation for various applications | K3 |
| CO5 | Apply autoencoders and generative models for suitable applications | K3 |

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

# VERTICAL – VII- SPACE TECHNOLOGIES

| AEC532 - SATELLITE COMMUNICATION | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Programme & Branch** | **BE -& ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **-** | **PE** | **3** | **0** | **0** | **3** |
| Preamble | This course helps to overview of launch vehicle and spacecraft technology. | | | | | | |
| **Unit – I** | **SATELLITE ORBITS** | | | | | | **9** |
| Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination- Limits of visibility – eclipse- Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles and propulsion | | | | | | | |
| **Unit – II** | **SPACE SEGMENT** | | | | | | **9** |
| Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders Antenna Subsystem. | | | | | | | |
| **Unit – III** | **SATELLITE LINK DESIGN** | | | | | | **9** |
| Basic link analysis, Uplink and Downlink Design equation, Free space loss-Atmospheric effects, Ionospheric scintillation, Rain induced attenuation and interference, system noise temperature, Link Design with and without frequency reuse. | | | | | | | |
| **Unit - IV** | **SATELLITE ACCESS AND CODING TECHNIQUES** | | | | | | **9** |
| Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, PAMA and DAMA Assignment Methods, compression – encryption, Coding Schemes | | | | | | | |
| **Unit - V** | **SATELLITE APPLICATIONS** | | | | | | **9** |
| INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, LEO, MEO, Satellite Navigational System. GPS-Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH). | | | | | | | |
| | | | | | | | **Total:45** |

**TEXTBOOK:**


| | |
|---|---|
| 1. | Dennis Roddy, "Satellite Communication", 4th Edition, Mc Graw Hill International, 2017. |
| 2. | Timothy Pratt, Charles, W.Bostain,Jeremy E.Allnutt,"SatelliteCommunication",3rd Edition, Wiley Publications,2021. |


**REFERENCES:**


| | |
|---|---|
| 1. | Tri T. Ha, "Digital Satellite Communications", 2nd edition, Mc Graw Hill education, 2017 |
| 2. | Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite Communications Systems Engineering", 2nd edition, Prentice Hall/Pearson, 2013. |
| 3. | M.Richharia, "Satellite Communication Systems-Design Principles", Macmillan, 1999. |
| 4. | Brian Ackroyd, "World Satellite Communication and earth station Design", BSP professional Books, 1990. |
| 5. | Bruce R. Elbert, "The Satellite Communication Applications", HandBook, Artech House Bostan London, 2003 |

| COURSE OUTCOMES:<br>At the end of the course, learners will be able to | | Bloom's Taxonomy Level |
|---|---|---|
| CO1 | Understand the basics of satellite orbits | K2 |
| CO2 | Understand the satellite segment and earth segment | K2 |
| CO3 | Understand Link Power budget calculation | K2 |
| CO4 | Understand the various satellite access and coding technology | K2 |
| CO5 | Understand the applications of satellite | K2 |

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

## AEC533 - RADAR ENGINEERING

| Programme & Branch | BE & ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | - | PE | 3 | 0 | 0 | 3 |

| | |
|---|---|
| Preamble | This Course helps to learn about Systematic design of Radar Detection and Radar Communication System |

| **Unit - I** | **INTRODUCTION TO RADAR EQUATION** | **9** |
|---|---|---|

The Origins of Radar ,Radar principles, Basic Block Diagram, Radar classifications based on Frequencies, Wave form and application, Radar Fundamentals: Detection, Range, velocity, The simple form of the Radar Equation, Pulsed Radar equation, Detection of Signals in Noise- Receiver Noise, Signal-to-Noise Ratio, Probabilities of Detection and False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets, Transmitter Power, Pulse Repetition Frequency, Antenna Parameters, System losses.

| **Unit - II** | **CW, MTI AND PULSE DOPPLER RADAR** | **9** |
|---|---|---|

CW and Frequency Modulated Radar, Doppler and MTI Radar- Delay Line Cancellers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance, MTI from a Moving Platform (AMIT), Pulse Doppler Radar.

| **Unit - III** | **TRACKING RADAR** | **9** |
|---|---|---|

Tracking with Radar, Monopulse Tracking, Conical Scan, Sequential Lobing, Limitations to Tracking Accuracy, Low-Angle Tracking - Comparison of Trackers, Track while Scan (TWS) Radar- Target prediction, state estimation, Measurement models, alpha – beta tracker, Kalman Filtering, Extended Kalman filtering.

| **Unit - IV** | **RADAR SIGNAL PROCESSING** | **9** |
|---|---|---|

Radar Signal Processing Fundamentals, Detection strategies, Optimal detection, Threshold detection, Constant False alarm rate detectors, Adaptive CFAR, pulse compression waveforms, compression gain, LFM waveforms matched filtering, radar ambiguity functions, radar resolution, Detection of radar signals in Noise and clutter, detection of non fluctuating target in noise, Doppler spectrum of fluctuating targets,

| | | |
|---|---|---|
| Range Doppler spectrum of stationary and moving radar | | |
| **Unit - V** | **RADAR TRANSMITTERS AND RECEIVERS** | **9** |
| Radar Transmitter, Linear Beam Power Tubes, Solid State RF Power Sources, Magnetron, CrossedField Amplifiers, Other RF Power Sources. The Radar Receiver, Receiver noise power, Super heterodyne Receiver, Duplexers and Receiver Protectors- Radar Displays. Radar Antenna - Reflector Antennas - Electronically Steered Phased Array Antennas – Phase Shifters | | |
| | | **Total:45** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | Merrill Ivan. Skolnik, Introduction to Radar Systems, Third Edition, 2008. |
| 2. | Habibur Rahman, Fundamental Principles of Radar, CRC press, Taylor and Francis, 2019 |
| 3. | M. R. Richards, J. A. Scheer, W. A. Holm, Editors "Principles of Modern Radar, Basic Principles", SciTech Publishing, 2012 |

**REFERENCES:**

| | |
|---|---|
| 1. | Nathansan, "Radar design principles-Signal processing and environment", PHI, 2ndEdition,2007. |
| 2. | M.I.Skolnik , "Introduction to Radar Systems", Tata McGraw Hill 2006. |
| 3. | Mark A. Richards, "Fundamentals of Radar Signal Processing", McGraw-Hill, 2005. |

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Identify the Radar parameters | K2 |
| CO2 | Differentiate various radar types | K3 |
| CO3 | Evaluate different tracking and filtering schemes | K5 |
| CO4 | Apply signal processing in target detection | K3 |
| CO5 | Design Radar transmitter and receiver blocks | K4 |

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

| **AEC534 - REMOTE SENSING** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **-** | **PE** | **3** | **0** | **0** | **3** |
| Preamble | This Course helps to learn the Remote Sensing Image Data Analysis and Monitoring system | | | | | | |
| **Unit - I** | **REMOTE SENSING AND ELECTROMAGNETIC RADIATION** | | | | | | **9** |

| | | |
|---|---|---|
| Definition – components of RS – History of Remote Sensing – Merits and demerits of Data Collation between conventional and remote sensing methods - Electromagnetic Spectrum – Radiation principles - Wave theory, Planck's law, Wien's Displacement Law, Stefan's Boltzmann law, Kirchoff's law – Radiation sources: active & passive – Radiation Quantities. | | |
| **Unit - II** | **EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL** | **9** |
| Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows – Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance– Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region | | |
| **Unit - III** | **ORBITS AND PLATFORMS** | **9** |
| Motions of planets and satellites – Newton 's law of gravitation – Gravitational field and potential - Escape velocity - Kepler 's law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Air borne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Legrange Orbit | | |
| **Unit - IV** | **SENSING TECHNIQUES** | **9** |
| Classification of remote sensors – Resolution concept: spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors – High Resolution Sensors - LIDAR, UAV – Orbital and sensor characteristics of live Indian earth observation satellites | | |
| **Unit - V** | **DATA PRODUCTS AND INTERPRETATION** | **9** |
| Photographic and digital products – Types, levels and open-source satellite data products – selection and procurement of data – Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification. | | |
| | | **Total:45** |

**TEXTBOOK:**


| | |
|---|---|
| 1. | Thomas M. Lillesand, Ralph W. Kieferand Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc., New York, 2015. |
| 2. | George Joseph and C Jeganathan, Fundamentals of Remote Sensing, Third Edition Universities Press (India) Private limited, Hyderabad, 2018 |


**REFERENCES:**


| | |
|---|---|
| 1. | Stanley A Morain; Amelia M Budge; Michael S Renslow. Manual of Remote Sensing. Vol. I, American Society for Photogrammetry and Remote Sensing, Virginia, USA,2019, 4th edition |
| 2. | Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press,2022 first edition. |
| 3. | Paul Curran P. J. Principles of Remote Sensing Longman, RLBS, 1996. |

| | |
|---|---|
| 4. | Introduction to Physics and Techniques of Remote Sensing, Charles Elachi and Jacob Van Zyl, 2021 Edition3, Wiley Publication. |
| 5. | Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press, 2020 third edition. |

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Understand the principles of electromagnetic radiation. | K2 |
| CO2 | Learn the atmospheric radiation interactions. | K2 |
| CO3 | Study the laws of planetary motion. | K1 |
| CO4 | Classify the different types of resolution. | K2 |
| CO5 | To know the concepts of digital interpretation | K2 |

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

## AEC535 - POSITIONING AND NAVIGATION SYSTEMS

| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| | | **-** | **PE** | **3** | **0** | **0** | **3** |

| | | |
|---|---|---|
| Preamble | This Course helps to gain the knowledge of Position and Navigation System | |
| **Unit - I** | **NAVIGATION CONCEPTS** | **9** |

Fundamentals of navigation systems and Position Fixing – Categories of navigation - Geometric concepts of Navigation – The Earth in inertial space - Different Coordinate Systems – Coordinate Transformation - Euler angle formulations - Direction cosine matrices formulation - Quaternion formulation

| | | |
|---|---|---|
| **Unit - II** | **INERTIAL NAVIGATION SYSTEMS** | **9** |

Inertial sensors - Gyroscopes -Types - Mechanical - Electromechanical-Optical Gyro -Ring Laser gyro- Fiber optic gyro- Accelerometers – Pendulous type – Force Balance type – MEMs - Basic Principles of Inertial Navigation – Types - Platform and Strap down - Mechanization INS system - Rate Corrections - Acceleration errors – Schuler Tuning.

| | | |
|---|---|---|
| **Unit - III** | **RADIO NAVIGATION & AIR TRAFFIC MANAGEMENT** | **9** |

Different types of radio navigation- ADF, VOR, DME, TACAN,VORTAC - Doppler – Hyperbolic Navigations – Air Traffic Management – RADAR Surveillance - Airborne Collision AvoidanceSystems.

| | | |
|---|---|---|
| **Unit - IV** | **GLOBAL POSITIONING SYSTEM** | **9** |

.Overview of GPS: Basic concept, system architecture, , GPS Signals Signal structure, anti-spoofing (AS), selective availability, GPS for position and velocity determination, GPS aided Geo-augmented navigation (GAGAN) architecture -GPS error sources-clock error, ionospheric error, tropospheric error, multipath, ionospheric error estimation using dual frequency GPS receiver.

| | | |
|---|---|---|
| **Unit - V** | **HYBRID NAVIGATION & RELATIVE NAVIGATION SYSTEMS** | **9** |

| |
|---|
| Hybrid Navigation - Introduction to Kalman filtering – Case Studies -Integration of GPS and INS using Kalman Filter - Relative Navigation – fundamentals – Equations of Relative Motion for circular orbits (Clohessy_Wiltshire Equations) - Sensors for Rendezvous Navigation - Relative positioning - Point positioning and differential positioning - Differential GPS (DGPS) and Space based Augmentation system (SBAS)- Concepts - Relative GPS -Formation Flying - Figure of Merit (FOM) |
| **Total:45** |

**TEXT BOOK:**

| | |
|---|---|
| 1. | Myron Kyton, Walfred Fried, 'Avionics Navigation Systems', John Wiley & Sons,2 edition,1997 |
| 2. | Nagaraja, N.S. "Elements of Electronic Navigation", Tata McGraw-Hill Pub. Co., New Delhi, 2nd edition, 1975. |

**REFERENCES:**

| | |
|---|---|
| 1. | George M Siouris, 'Aerospace Avionics System; A Modern Synthesis', Academic Press Inc., 1993 |
| 2. | Albert Helfrick, 'Practical Aircraft Electronic Systems', Prentice Hall Education, Career & Technology, 1995. |
| 3. | Albert D. Helfrick, 'Modern Aviation Electronics', Second Edition, Prentice Hall Career & Technology, 1994. |
| 4. | Paul. D. Groves. 'Principles of GNSS, Inertial, and Multisensor Integrated Navigation Systems', Artech House, 2013. |
| 5. | Maxwell Noton," Spacecraft navigation and guidance", Springer (London, New York), 1998 |

| **COURSE OUTCOMES:** At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Understand the advanced concepts of Positioning and Navigation systems and exposure onvarious Navigation systems | K2 |
| CO2 | Know about Gyroscopes and accelerometers and Inertial Navigation systems and its typesand Mechanisation | K3 |
| CO3 | Explain the different Radio Navigation aids and its usage for civil and military aircrafts andsatellites | K3 |
| CO4 | Explain the Satellite Navigation – GPS and its usage in aircraft and spacecraft applications | K3 |
| CO5 | Deploy these skills effectively in the analysis and understanding of hybrid navigation systemsand Relative navigation in a spacecraft. | K3 |

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | 3 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | 2 | 3 | 2 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO4 | 3 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | 2 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 2 | 2 | 2 |

| AEC536 - ROCKETRY SPACE MECHANICS | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Programme & Branch** | **BE& ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **-** | **PE** | **3** | **0** | **0** | **3** |
| **Preamble** | **This Course helps to Aware of Rockets and Space Launch Vehicle** | | | | | | |
| **Unit - I** | **ORBITAL MECHANICS** | | | | | | **9** |
| Description of solar system – Kepler's Laws of planetary motion – Newton's Law of Universal gravitation – Two body and Three-body problems – Jacobi's Integral, Librations points – Estimation of orbital and escape velocities. | | | | | | | |
| **Unit - II** | **SATELLITE DYNAMICS** | | | | | | **9** |
| Geosynchronous and geostationary satellites- factors determining lifetime of satellites – satellite perturbations – orbit transfer and examples –Hohmann orbits – calculation of orbit parameters– Determination of satellite rectangular coordinates from orbital elements. | | | | | | | |
| **Unit - III** | **ROCKET MOTION** | | | | | | **9** |
| Principle of operation of rocket motor – thrust equation – one dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields – Description of vertical, inclined and gravity turn trajectories – determinations of range and altitude – simple approximations to burnout velocity. | | | | | | | |
| **Unit - IV** | **ROCKET AERODYNAMICS** | | | | | | **9** |
| Description of various loads experienced by a rocket passing through atmosphere – drag estimation– wave drag, skin friction drag, form drag and base pressure drag – Boat-tailing in missiles – performance at various altitudes – rocket stability – rocket dispersion – launching problems. | | | | | | | |
| **Unit - V** | **STAGING AND CONTROL OF ROCKET VEHICLES** | | | | | | **9** |
| Need for multi staging of rocket vehicles – multistage vehicle optimization – stage separation dynamics and separation techniques- aerodynamic and jet control methods of rocket vehicles – SITVC. | | | | | | | |
| | | | | | | | **Total:45** |

**TEXTBOOK:**


1. Cornelisse,JW, "Rocket Propulsion and Space Dynamics", J.W. Freeman & Co., Ltd.,London, 1982.
2. Parker,ER, "Materials for Missiles and Spacecraft", McGraw-Hill Book Co., Inc., 1982


**REFERENCES:**


1. Suresh. B N & Sivan. K, "Integrated Design for Space Transportation System", SpringerIndia, 2015.
2. Sutton,GP, "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 8th Edition, 2010.
3. Van de Kamp, "Elements of Astromechanics", Pitman Publishing Co., Ltd., London, 1980

| **COURSE OUTCOMES:**<br>At the end of the course, learners will be able to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Knowledge on the fundamental laws of orbital mechanics with particular emphasis oninterplanetary trajectories. | K1 |
| CO2 | Calculate orbital parameters and perform conceptual trajectory designs for geocentric orinterplanetary missions. | K3 |
| CO3 | Familiarize themselves with trajectory calculations for planar motion of rockets. | K3 |
| CO4 | Determine forces and moments acting on airframe of a missile. | K4 |
| CO5 | Acquire knowledge on the need for staging and stage separation dynamics of rocket vehicles. | K3 |

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

JEPPIAAR INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

Self-Belief | Self Discipline | Self Respect

Kunnam, Sunguvarchatram, Sriperumbudur-631604

**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**AUTONOMOUS SYLLABUS R2024 (CBCS)**

# OPEN ELECTIVES

# DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

## AUTONOMOUS SYLLABUS R2024 (CBCS)

**Open Elective Courses**

| S.No | Course Code | Course Title | Offering Department | Periods | | | Total Contact Periods | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1 | AME701 | DRONE TECHNOLOGIES | MECH | 3 | 0 | 0 | 3 | 3 |
| 2 | AME702 | ADDITIVE MANUFACTURING | MECH | 3 | 0 | 0 | 3 | 3 |
| 3 | AME703 | ELECTRIC AND HYBRID VEHICLE TECHNOLOGY | MECH | 3 | 0 | 0 | 3 | 3 |
| 4 | AEC701 | Sensors and Actuators | ECE | 3 | 0 | 0 | 3 | 3 |
| 5 | AEC702 | Applied Design Thinking | ECE | 3 | 0 | 0 | 3 | 3 |
| 6 | AEC703 | Project Report Writing | ECE | 3 | 0 | 0 | 3 | 3 |
| 7 | ACS701 | SYSTEMS ENGINEERING | CSE | 3 | 0 | 0 | 3 | 3 |
| 8 | ACS702 | GREEN COMPUTING | CSE | 3 | 0 | 0 | 3 | 3 |
| 9 | ACS703 | FINTECH REGULATION | CSE | 3 | 0 | 0 | 3 | 3 |
| 10 | AMB701 | CORPORATE GOVERNANCE | MBA | 3 | 0 | 0 | 3 | 3 |
| 11 | AMB702 | DIGITAL MARKETING | MBA | 3 | 0 | 0 | 3 | 3 |
| 12 | AMB703 | RURAL MARKETING | MBA | 3 | 0 | 0 | 3 | 3 |
| 13 | AIT701 | NETWORKING ESSENTIALS | IT | 3 | 0 | 0 | 3 | 3 |
| 14 | AIT702 | SOFT COMPUTING METHODOLOGIES | IT | 3 | 0 | 0 | 3 | 3 |
| 15 | AIT703 | KNOWLEDGE ENGINEERING | IT | 3 | 0 | 0 | 3 | 3 |
| 16 | ACB701 | BUSINESS RESEARCH METHODS | CSBS | 3 | 0 | 0 | 3 | 3 |
| 17 | ACB702 | AUTOMATION TESTING TOOLS | CSBS | 3 | 0 | 0 | 3 | 3 |
| 18 | ACB703 | SOCIAL NETWORK ANALYSIS | CSBS | 3 | 0 | 0 | 3 | 3 |
| 19 | AAI701 | DRINKING WATER SUPPLY AND TREATMENT | AIDS | 3 | 0 | 0 | 3 | 3 |
| 20 | AAI702 | GEOGRAPHICAL INFORMATION SYSTEM | AIDS | 3 | 0 | 0 | 3 | 3 |
| 21 | AAI703 | IT IN AGRICULTURAL SYSTEM | AIDS | 3 | 0 | 0 | 3 | 3 |

| AME701 - DRONE TECHNOLOGIES | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE & MECH** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | | **OE** | **3** | **0** | **0** | **3** |
| Preamble | ➢ To understand the basics of drone concepts.<br>➢ To learn and understand the fundaments of design, fabrication and programming of drone.<br>➢ To impart the knowledge of a flying and operation of drone.<br>➢ To know about the various applications of drone.<br>➢ To understand the safety risks and guidelines of fly safely. | | | | | | |
| **Unit 1** | **INTRODUCTION TO DRONE TECHNOLOGY** | | | | | | **9** |
| Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability | | | | | | | |
| **Unit 2** | **DRONE DESIGN, FABRICATION AND PROGRAMMING** | | | | | | **9** |
| Classifications of the UAV -Overview of the main drone parts- Technical characteristics - Function of the components -Assembling a drone- The energy sources- Level of autonomy- Drones configurations - The methods of programming drone- Download program -Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection. | | | | | | | |
| **Unit 3** | **DRONE FLYING AND OPERATION** | | | | | | **9** |
| Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment. Drone controls Flight operations –management tool –Sensors-Onboard storage capacity - Removable storage devices- Linked mobile devices and applications. | | | | | | | |
| **Unit 4** | **DRONE COMMERCIAL APPLICATIONS** | | | | | | **9** |
| Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing. | | | | | | | |
| **Unit 5** | **FUTURE DRONES AND SAFETY** | | | | | | **9** |
| The safety risks- Guidelines to fly safely - Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms. | | | | | | | |
| | | | | | | | **Total: 45** |

**TEXTBOOKS**


| | |
|---|---|
| 1 | Daniel Tal and John Altschuld, “Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation”, John Wiley & Sons, Inc, 2021. |
| 2 | Terry Kilby and Belinda Kilby, “Make: Getting Started with Drones “, Maker Media, 1st Edition, 2016. |


**REFERENCES**


| | |
|---|---|
| 1 | John Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, Que Publishing, 2016 |
| 2 | Zavrsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance”, Springer, 2018. |

| COURSE OUTCOMES:<br>At the end of the course, learners will be able to | | Bloom's Taxonomy Level |
|---|---|---|
| CO1 | Know about a various type of drone technology, drone fabrication and programming. | K2 |
| CO2 | Execute the suitable operating procedures for functioning a drone. | K3 |
| CO3 | Select appropriate sensors and actuators for Drones. | K3 |
| CO4 | Develop a drone mechanism for specific applications. | K4 |
| CO5 | Create the programs for various drones. | K6 |

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 2 | 3 | 1 | 3 | 2 | | | | | | 1 | 2 | 1 | 3 |
| CO2 | 1 | 2 | 3 | 1 | 3 | 2 | | | | | | 1 | 2 | 1 | 3 |
| CO3 | 1 | 2 | 3 | 1 | 3 | 2 | | | | | | 1 | 2 | 1 | 3 |
| CO4 | 1 | 2 | 3 | 1 | 3 | 2 | | | | | | 1 | 2 | 1 | 3 |
| CO5 | 1 | 2 | 3 | 1 | 3 | 2 | | | | | | 1 | 2 | 1 | 3 |

| AME702 - ADDITIVE MANUFACTURING | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Programme & Branch** | **BE & MECH** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | | **OE** | **3** | **0** | **0** | **3** |
| Preamble | ➢ To introduce the development, capabilities, applications, of Additive Manufacturing (AM), and its business opportunities.<br>➢ To be acquainted with vat polymerization and material extrusion processes<br>➢ To be familiar with powder bed fusion and binder jetting processes.<br>➢ To gain knowledge on applications of direct energy deposition, and material jetting processes.<br>➢ To impart knowledge on sheet lamination and direct write technologies. | | | | | | |
| **Unit 1** | **INTRODUCTION** | | | | | | **9** |
| Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping - Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain - ASTM/ISO 52900 Classification - Benefits - AM File formats: STL, AMF – Applications - Business Opportunities in AM. | | | | | | | |
| **Unit 2** | **VAT POLYMERIZATION AND MATERIAL EXTRUSION** | | | | | | **9** |
| Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process - top down and bottom-up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Material Extrusion: Fused Deposition Modeling (FDM) - Process-Materials -Applications and Limitations. | | | | | | | |

| Unit 3 | POWDER BED FUSION AND BINDER JETTING | 9 |
|---|---|---|
| Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits - Limitations -Applications. | | |
| **Unit 4** | **MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION** | **9** |
| Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications. Directed Energy Deposition: Laser Engineered Net Shaping (LENS) - Process – Material Delivery - Materials -Benefits -Applications. | | |
| **Unit 5** | **SHEET LAMINATION AND DIRECT WRITE TECHNOLOGY** | **9** |
| Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding - Materials - Application and Limitation. Ink-Based Direct Writing (DW): Nozzle Dispensing Processes, Inkjet Printing Processes, Aerosol DW - Applications of DW. | | |
| | | **Total: 45** |

| **TEXTBOOKS** | |
|---|---|
| 1 | Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani, "Additive manufacturing technologies", Springer Cham, 3rd edition, 2021. |
| 2 | Andreas Gebhardt and Jan-Steffen Hotter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, 2016. |
| **REFERENCES** | |
| 1 | Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, 1st Edition, 2012. |
| 2 | Milan Brandt, "Laser Additive Manufacturing: Materials, Design, Technologies, and Applications", Woodhead Publishing, 1st Edition, 2016. |
| 3 | Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 2nd Edition, CRC Press, 2021. |
| 4 | Kamrani A.K. and Nasr E.A, "Rapid Prototyping: Theory and practice", Springer, 2006. |
| 5 | Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A toolbox for prototype development", CRC Press, 2019. |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities. | K2 |
| CO2 | Acquire knowledge on process vat polymerization and material extrusion processes and its applications. | K2 |
| CO3 | Elaborate the process and applications of powder bed fusion and binder jetting. | K2 |

| | | |
|---|---|---|
| CO4 | Evaluate the advantages, limitations, applications of material jetting and directed energy deposition processes. | K2 |
| CO5 | Acquire knowledge on sheet lamination and direct write technology. | K2 |

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | 2 | 2 | | | | | | | 2 | 2 | 2 | 2 |
| CO2 | 2 | 2 | 2 | 2 | 2 | | | | | | | 2 | 2 | 2 | 2 |
| CO3 | 2 | 2 | 2 | 2 | 2 | | | | | | | 2 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 2 | 2 | | | | | | | 2 | 2 | 2 | 2 |
| CO5 | 2 | 2 | 2 | 2 | 2 | | | | | | | 2 | 2 | 2 | 2 |

**AME703 - ELECTRIC AND HYBRID VEHICLE TECHNOLOGY**

| **Programme & Branch** | **BE & MECH** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| | | | **OE** | **3** | **0** | **0** | **3** |

| | |
|---|---|
| Preamble | ➢ To introduce the concept of hybrid and electric drive trains.<br>➢ To elaborate on the types and utilisation of hybrid and electric drive trains.<br>➢ To expose on different types of AC and DC drives for electric vehicles.<br>➢ To learn and utilise different types of energy storage systems.<br>➢ To introduce concept of energy management strategies and drive sizing. |

| **Unit 1** | **INTRODUCTION** | **9** |
|---|---|---|

Basics of vehicle performance, vehicle power source characterization, transmission characteristics, History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drivetrains on energy supplies.

| **Unit 2** | **HYBRID ELECTRIC DRIVE TRAINS** | **9** |
|---|---|---|

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drivetrains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

| **Unit 3** | **CONTROL OF AC & DC DRIVES** | **9** |
|---|---|---|

Introduction to electric components used in hybrid and electric vehicles, Configuration, and control - DC Motor drives, Induction Motor drives, Permanent Magnet Motor drive, and Switch Reluctance Motor drives, drive system efficiency.

| **Unit 4** | **ENERGY STORAGE** | **9** |
|---|---|---|

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Energy storage and its analysis - Battery based, Fuel Cell based, and Super Capacitor based, Hybridization of different energy storage devices.

| **Unit 5** | **DRIVE SIZING AND ENERGY MANAGEMENT STRATEGIES** | **9** |
|---|---|---|

| | |
|---|---|
| Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selection of appropriate energy storage technology, Energy Management Strategies: Energy management strategies used in hybrid and electric vehicles, classification, and comparison of energy management strategies, Implementation issues. | |
| | **Total: 45** |
| **TEXTBOOKS** | |
| 1 | Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", Routledge publications, 3rd Edition, 2021 |
| 2 | James Larminie and John Lowry, "Electric Vehicle Technology Explained", Wiley, 2nd Edition, 2012. |
| **REFERENCES** | |
| 1 | Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 3rd Edition 2018. |
| 2 | Rand D.A.J, Woods, R & Ronald Dell, "Batteries for Electric vehicles", John Wiley & Sons, 1998. |
| 3 | Jack Erjavec, "Hybrid, Electric and Fuel-Cell Vehicles", Delmar Cengage Learning, 2nd Edition, 2012. |
| 4 | Christian Paar, "Energy Management in Hybrid Electric Vehicles using Co-Simulation", VDM Verlag, 2011. |
| 5 | Yangsheng Xu, Jingyu Yan, Huihuan Qian and Tin Lun Lam, "Hybrid Electric Vehicle Design and Control: Intelligent Omnidirectional Hybrids", McGraw Hill Eductaion, 1st Edition, 2014. |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Discuss, categorize and configure hybrid drivetrains requirement for a vehicle. | K2 |
| CO2 | Design and apply appropriate hybrid and electric drive trains in a vehicle. | K5 |
| CO3 | Design and install suitable AC and DC drives for electric vehicles. | K5 |
| CO4 | Discuss arrive at a suitable energy storage system for a hybrid / electric vehicle. | K2 |
| CO5 | Apply energy management strategies to ensure better economy and efficiency. | K3 |

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | | 2 | | | | | | 1 | 2 | 3 |
| CO2 | 3 | 2 | 1 | 1 | 1 | | 2 | | | | | | 1 | 2 | 3 |
| CO3 | 3 | 2 | 1 | 1 | 1 | | 2 | | | | | | 1 | 2 | 3 |
| CO4 | 3 | 2 | 1 | 1 | 1 | | 2 | | | | | | 1 | 2 | 3 |
| CO5 | 3 | 2 | 1 | 1 | 1 | | 2 | | | | | | 1 | 2 | 3 |

| AEC701 - SENSORS AND ACTUATORS | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **BE & ECE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | **-** | **OE** | **3** | **0** | **0** | **3** |

| | | |
|---|---|---|
| Preamble | The course is to make the students to list common types of sensor and actuators used in automotive vehicles. | |
| **Unit – I** | **INTRODUCTION TO MEASUREMENTS AND SENSORS** | **9** |
| Sensors: Functions- Classifications- Main technical requirement and trends Units and standards Calibration methods- Classification of errors- Error analysis- Limiting error- Probable error Propagation of error- Odds and uncertainty- principle of transduction-Classification. Static characteristics- mathematical model of transducers- Zero, First and Second order transducers Dynamic characteristics of first and second order transducers for standard test | | |
| **Unit – II** | **VARIABLE RESISTANCE AND INDUTANCE SENSORS** | **9** |
| Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer- Variable reluctance transducers: - EI pick up and LVDT | | |
| **Unit – III** | **VARIABLE AND OTHER SPECIAL SENSORS** | **9** |
| Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magneto strictive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor. | | |
| **Unit – IV** | **AUTOMOTIVE ACTUATORS** | **9** |
| Electromechanical actuators- Fluid-mechanical actuators- Electrical machines- Direct-current machines- Three-phase machines- Single-phase alternating-current Machines - Duty-type ratings for electrical machines. Working principles, construction and location of actuators viz. Solenoid, relay, stepper motor etc. | | |
| **Unit – V** | **AUTOMATIC TEMPERATURE CONTROL ACTUATORS** | **9** |
| Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system. | | |
| | | **Total:45** |

**TEXTBOOK:**


| | |
|---|---|
| 1. | Doebelin's Measurement Systems: 7th Edition (SIE), Ernest O. Doebelin DhaneshN.Manik McGraw Hill Publishers, 2019. |
| 2. | Robert Brandy, “Automotive Electronics and Computer System”, Prentice Hall,2001 |
| 3. | William Kimberley,” Bosch Automotive Handbook”, 6th Edition, Robert Bosch GmbH, 2004. |
| 4. | Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th Edition, 2007, ISBN No: 978-3-658-01783-5 |

| REFERENCES: | |
|---|---|
| 1. | James D Halderman, “Automotive Electrical and Electronics” , Prentice Hall, USA, 2013 |
| 2. | Tom Denton, “Automotive Electrical and Electronics Systems,” Third Edition, 2004, SAE International. |
| 3. | Patranabis.D, “Sensors and Transducers”, 2nd Edition, Prentice Hall India Ltd,2003 |
| 4. | William Ribbens, "Understanding Automotive Electronics -An Engineering Perspective," 7th Edition, Elsevier Butterworth-Heinemann Publishers, 2012 |

| COURSE OUTCOMES:<br>At the end of the course, learners will be able to | | Bloom’s Taxonomy Level |
|---|---|---|
| CO1 | List common types of sensor and actuators used in vehicles | K2 |
| CO2 | Design measuring equipment’s for the measurement of pressure force, temperature and flow | K4 |
| CO3 | Generate new ideas in designing the sensors and actuators for automotive application. | K3 |
| CO4 | Understand the operation of the sensors, actuators and electronic control. | K2 |
| CO5 | Design temperature control actuators for vehicles. | K4 |

| CO/PO | PO 1 | PO2 | PO 3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO 9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 2 | - | - | - | 1 | - | - | - | - | 1 | 1 |
| CO2 | 3 | 3 | 3 | 2 | 2 | - | - | 1 | - | - | - | - | 1 | 1 |
| CO3 | 3 | 3 | 2 | 2 | 2 | - | - | 1 | - | - | - | - | 2 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 2 | - | - | 1 | - | - | - | - | 3 | 2 |
| CO5 | 3 | 2 | 3 | 3 | 2 | - | - | 1 | - | - | - | - | 2 | 2 |

## AEC702 - APPLIED DESIGN THINKING

| Programme & Branch | BE & ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | - | OE | 3 | 0 | 0 | 3 |

| | |
|---|---|
| Preamble | ➢ This course aims to provide to make the students Introduce tools & techniques of design thinking for innovative product, development.<br>➢ Illustrate customer-centric product innovation using simple, use cases.<br>➢ Demonstrate development of Minimum usable Prototypes, Outline principles of solution concepts & their evaluation.<br>➢ Describe system thinking principles as applied to complex systems |

| Unit – I | DESIGN THINKING PRINCIPLES | 9 |
|---|---|---|

Exploring Human-centered Design - Understanding the Innovation process, discovering areas of opportunity, Interviewing & empathy-building techniques, Mitigate validation risk with FIR [Forge Innovation rubric] - Case studies

| Unit – II | ENDUSER-CENTRIC INNOVATION | 9 |
|---|---|---|
| Importance of customer-centric innovation - Problem Validation and Customer Discovery - Understanding problem significance and problem incidence - Customer Validation. Target user, User persona & user stories. Activity: Customer development process - Customer interviews and field visit | | |
| **Unit – III** | **APPLIED DESIGN THINKING TOOLS** | **9** |
| Concept of Minimum Usable Prototype [MUP] - MUP challenge brief - Designing & Crafting the value proposition - Designing and Testing Value Proposition; Design a compelling value proposition; Process, tools and techniques of Value Proposition Design | | |
| **Unit – IV** | **CONCEPT GENERATION** | **9** |
| Solution Exploration, Concepts Generation and MUP design- Conceptualize the solution concept; explore, iterate and learn; build the right prototype; Assess capability, usability and feasibility. Systematic concept generation; evaluation of technology alternatives and the solution concepts | | |
| **Unit – V** | **SYSTEM THINKING** | **9** |
| System Thinking, Understanding Systems, Examples and Understandings, Complex Systems. | | |
| | | **Total:45** |

**TEXTBOOK:**


| | |
|---|---|
| 1. | Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley. |
| 2. | Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley. |
| 3. | Proposition Design: How to Create Products and Services Customers Want, Wiley |
| 4. | Donella H. Meadows, (2015), “Thinking in Systems -A Primer”, Sustainability Institute |
| 5. | Tim Brown, (2012) “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”, Harper Business. |


**REFERENCES:**


| | |
|---|---|
| 1. | https://www.ideou.com/pages/design-thinking#process |
| 2. | https://blog.forgeforward.in/valuation-risk-versus-validation-risk-in-product-innovations49f253ca86 24 |
| 3. | https://blog.forgefor ward.in/product-innovation-rubric-adf5ebdfd356 4. https |
| 4. | https://blog.forgefor ward.in/evaluating-product-innovations-e8178e58b86e |
| 5. | https://blog.forgeforward.in/user-guide-for-product-innovation-rubric-857181b253dd |
| 6. | https://blog.forgeforward.in/startup-failure-is-like-true-lie-7812cdfe9b85 |


| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom’s Taxonomy Level** |
|---|---|---|
| CO1 | Define & test various hypotheses to mitigate the inherent risks in product innovations | K2 |
| CO2 | Design the solution concept based on the proposed value by exploring alternate solutions to achieve value-price fit. | K4 |

| | | |
|---|---|---|
| CO3 | Develop skills in empathizing, critical thinking, analyzing, storytelling & pitching | K4 |
| CO4 | Develop skills in storytelling & pitching | K3 |
| CO5 | Apply system thinking in a real-world scenario | K3 |

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

## AEC703 - PROJECT REPORT WRITING

| Programme & Branch | BE & ECE | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | - | OE | 3 | 0 | 0 | 3 |

| | |
|---|---|
| Preamble | ➢ This course aims to provide essentials of project writing, Perceive the difference between general writing and technical writing.<br>➢ Assimilate the fundamental features of report writing, Learn the structure of a technical and project report. |

| | |
|---|---|
| **Unit – I** | **9** |
| Writing Skills – Essential Grammar and Vocabulary – Passive Voice, Reported Speech, Concord, Signpost words, Cohesive Devices – Paragraph writing - Technical Writing vs. General Writing. | |
| **Unit – II** | **9** |
| Project Report – Definition, Structure, Types of Reports, Purpose – Intended Audience – Plagiarism – Report Writing in STEM fields – Experiment – Statistical Analysis. | |
| **Unit – III** | **9** |
| Structure of the Project Report: (Part 1) Framing a Title – Content – Acknowledgement – Funding Details -Abstract – Introduction – Aim of the Study – Background - Writing the research question - Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework. | |
| **Unit – IV** | **9** |
| Structure of the Project Report: (Part 2) – Literature Review, Research Design, Methods of Data Collection - Tools and Procedures - Data Analysis - Interpretation - Findings –Limitations - Recommendations – Conclusion – Bibliography. | |
| **Unit – V** | **9** |
| Proof reading a report – Avoiding Typographical Errors – Bibliography in required Format – Font – Spacing – Checking Tables and Illustrations – Presenting a Report Orally – Techniques. | |
| | **Total:45** |

**REFERENCES:**


| | |
|---|---|
| 1. | Gerson and Gerson - Technical Communication: Process and Product, 7th Edition, Prentice Hall(2012) |

| | |
|---|---|
| 2. | Virendra K. Pamecha - Guide to Project Reports, Project Appraisals and Project Finance(2012) |
| 3. | Daniel Riordan - Technical Report Writing Today (1998) Darla-Jean Weatherford - Technical Writing for Engineering Professionals (2016) Penwell Publishers. |
| | |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Write effective project reports. | K2 |
| CO2 | Use statistical tools with confidence | K2 |
| CO3 | Explain the purpose and intension of the proposed project coherently and with clarity. | K2 |
| CO4 | Create writing texts to suit achieve the intended purpose. | K2 |
| CO5 | Master the art of writing winning proposals and projects. | K2 |

| POs/ COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | 1 | 1 | 1 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | - | - | |
| CO2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 2 | 3 | - | - | |
| CO3 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | - | - | |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - | |
| CO5 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - | |

| **ACS701 - SYSTEMS ENGINEERING** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **B.E &CSE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | | **PE** | **3** | **0** | **0** | **3** |
| Preamble | To introduce system engineering concepts to design the manufacturing system for optimum utilization of source for effective functioning. | | | | | | |
| **UNIT I** | **INTRODUCTION** | | | | | **9** | |
| Definitions of Systems Engineering, Systems Engineering Knowledge, Life cycles, Life-cycle phases, logical steps of systems engineering, Frame works for systems engineering. | | | | | | | |
| **Unit 2** | **SYSTEMS ENGINEERING PROCESSES** | | | | | **9** | |
| Formulation of issues with a case study, Value system design, Functional analysis, Business Process Reengineering, Quality function deployment, System synthesis, Approaches for generation of alternatives. | | | | | | | |
| **Unit 3** | **ANALYSIS OF ALTERNATIVES- I** | | | | | **9** | |
| Cross-impact analysis, Structural modeling tools, System Dynamics models with case studies, Economic models: present value analysis – NPV, Benefits and costs over time, ROI, IRR; Work and Cost breakdown structure. | | | | | | | |
| **Unit 4** | **ANALYSIS OF ALTERNATIVES–II** | | | | | **9** | |
| Reliability, Availability, Maintainability, and Supportability models; Stochastic networks and Markov | | | | | | | |

| | | |
|---|---|---|
| models, Queuing network optimization, Time series and Regression models, Evaluation of large scale models. | | |
| **Unit 5** | **DECISION ASSESSMENT** | **9** |
| Decision assessment types, Five types of decision assessment efforts, Utility theory, Group decision making and Voting approaches, Social welfare function; Systems Engineering methods for Systems Engineering Management. | | |
| | | **Total: 45** |
| **TEXTBOOKS** | | |
| 1 | Andrew P. Sage, James E. Armstrong Jr. "Introduction to Systems Engineering", John Wiley and Sons, Inc,2000. | |

| **COURSEOUTCOMES: At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | The Student must be able to apply systems engineering principles to make decision for optimization. | K2 |
| CO2 | Hence an understanding of the systems engineering discipline and be able to use the core principles and processes for designing effective system. | K2 |
| CO3 | Analyze the various method to impact on system engineering | K2 |
| CO4 | Decision capabilities identified with various analysis. | K2 |
| CO5 | Management the system based on decision results. | K2 |

| POs/ COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | 1 | 1 | - | - | - | 3 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO2 | 2 | 3 | 2 | 1 | 1 | - | - | - | 3 | 2 | 3 | 2 | 2 | 2 | 2 |
| CO3 | 2 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 2 | 3 | 2 |
| CO4 | 2 | - | - | 2 | 3 | - | - | - | - | - | - | - | 2 | 2 | - |
| CO5 | 2 | 2 | - | 3 | 3 | - | 1 | 2 | 3 | 2 | 1 | 3 | 2 | 3 | - |

| **ACS702- GREEN COMPUTING** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Programme & Branch** | **B.E & CSE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | | **OE** | **3** | **0** | **0** | **3** |
| Preamble | ➢ To learn the fundamentals of Green Computing.<br>➢ To analyze the Green computing Grid Framework.<br>➢ To understand the issues related with Green compliance.<br>➢ To study and develop various case studies. | | | | | | |
| **UNIT I** | **FUNDAMENTALS** | | | | | | **9** |

| | | |
|---|---|---|
| Green IT Fundamentals: Business, IT, and the Environment – Green computing: carbon foot print, scoop on power – Green IT Strategies: Drivers, Dimensions, and Goals – Environmentally Responsible Business: Policies, Practices, and Metrics. | | |
| **Unit 2** | **GREEN ASSETS AND MODELING** | **9** |
| Green Assets: Buildings, Data Centers, Networks, and Devices – Green Business Process Management: Modeling, Optimization, and Collaboration – Green Enterprise Architecture – Environmental Intelligence – Green Supply Chains – Green Information Systems: Design and Development Models | | |
| **Unit 3** | **GRID FRAMEWORK** | **9** |
| Virtualization of IT systems – Role of electric utilities, Telecommuting, teleconferencing and teleporting – Materials recycling – Best ways for Green PC – Green Data center – Green Grid framework. | | |
| **Unit 4** | **GREEN COMPLIANCE** | **9** |
| Socio-cultural aspects of Green IT – Green Enterprise Transformation Roadmap – Green Compliance: Protocols, Standards, and Audits – Emergent Carbon Issues: Technologies and Future. . | | |
| **Unit 5** | **CASE STUDIES** | **9** |
| The Environmentally Responsible Business Strategies (ERBS) – Case Study Scenarios for Trial Runs – Case Studies – Applying Green IT Strategies and Applications to a Home, Hospital, Packaging Industry and Telecom Sector. | | |
| | | **Total: 45** |

| | |
|---|---|
| **TEXTBOOKS** | |
| 1 | Bhuvan Unhelkar, "Green IT Strategies and Applications-Using Environmental Intelligence", CRC Press, June 2014 |
| 2 | Woody Leonhard, Katherine Murray, "Green Home computing for dummies", August 2012. |
| **REFERENCES** | |
| 1 | Alin Gales, Michael Schaefer, Mike Ebbers, "Green Data Center: steps for the Journey", Shroff/IBM rebook, 2011. |
| 2 | John Lamb, "The Greening of IT", Pearson Education, 2009. |
| 3 | Jason Harris, "Green Computing and Green IT- Best Practices on regulations & industry", Lulu.com, 2008 |
| 4 | .Carl speshocky, "Empowering Green Initiatives with IT", John Wiley & Sons, 2010. 5. Wu Chun Feng (editor), "Green computing: Large Scale energy efficiency", CRC Press |

| **COURSEOUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Acquire knowledge to adopt green computing practices to minimize negative impacts on the environment | K2 |
| CO2 | Enhance the skill in energy saving practices in their use of hardware. | K2 |
| CO3 | Evaluate technology tools that can reduce paper waste and carbon footprint by the stakeholders. | K2 |
| CO4 | Understand the ways to minimize equipment disposal requirements. | K2 |

| | | |
|---|---|---|
| CO5 | Discuss briefly about the use cases in various applications. | K2 |

| POs/ COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | 2 | | | | | | 2 | | 2 | | | 2 | 2 | |
| CO2 | | 2 | | 2 | 2 | 2 | | | | | | | 3 | 2 | |
| CO3 | | | | 2 | | 2 | | | | | | | 3 | 2 | 3 |
| CO4 | 3 | 2 | | | 2 | | | 2 | 2 | 2 | 2 | | 3 | 2 | 3 |
| CO5 | | 2 | 3 | 2 | | | 1 | | | | | 1 | | 2 | |

| ACS703 - FINTECH REGULATION | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **B.E & CSE** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | | **OE** | **3** | **0** | **0** | **3** |
| Preamble | ➢ To learn about Laws and Regulation<br>➢ To acquire the knowledge of Regulations of Fintech firm and their role in Market | | | | | | |
| **UNIT I** | **INTRODUCTION** | | | | | | **9** |
| The Role of the Regulators, Equal Treatment and Competition, Need for a regulatory assessment of Fintech, India Regulations, The Risks to Consider, Regtech and SupTech, The rise of TechFins, Regulatory sandboxes, compliance and whistle blowing | | | | | | | |
| **Unit 2** | **INNOVATION AND REGULATION** | | | | | | **9** |
| The technology, market and the law, Regulation and Innovation in Banking and Finance, Regulations of Fintech Firms and their role in Market-Based Chains, Current Regulatory Approach, Fintech Innovations in Banking, Asset Management, Insurance, Pensions and Healthcare Schemes, Patentability of FinTech inventions. | | | | | | | |
| **Unit 3** | **CROWDFUNDING AND DIGITAL ASSETS** | | | | | | **9** |
| Types of crowd funding, The Jobs Act, Regulation crowd funding, Regulation A+, Regulation D crowd funding, Intrastate offerings, Digital Assets – Three uses of Digital Assets, A world of Altcoins, Stablecoins, Digital Asset Forks, Initial Coin Offerings, Regulatory Framework for Digital and Crypto Assets, Central Bank Digital Currencies | | | | | | | |
| **Unit 4** | **MARKETPLACE LENDING AND MOBILE PAYMENTS** | | | | | | **9** |
| Online Lending Business Models, Payday Loans, Consumer Protection Laws, Debt Collection, Equal Credit Opportunity Act, Contract Formation and the E-Sign Act, Military Lending Act, Securities Laws Considerations, Mobile Devices, Payment Cards and the Law, Truth in Lending Act and Regulation Z, Card Act, Electronic Fund Transfer Act and Regulation E, Fair Credit Reporting Act, Federal Bank Secrecy Act, State Money Transmitter Laws. | | | | | | | |
| **Unit 5** | **ANTI-MONEY LAUNDERING AND CYBERSECURITY** | | | | | | **9** |
| Reporting requirements under the Bank Secrecy Act, Patriot Act, Panalties for violating the BSA, Virtual | | | | | | | |

| | |
|---|---|
| currencies and the Bank Secrecy Act, Cybersecurity Frameworks, Cybersecurity Act of 2015, Contractual and Self Regulatory obligations | |
| | **Total: 45** |
| **REFERENCES** | |
| 1 | Jelena Madir, FinTech – Law and Regulation, Edward Elgar Publishing Limited, 2019 |
| 2 | Valerio Lemma, Fintech Regulation: Exploring New Challenges of the Capital Markets Union, Palgrave Macmillan, 2020 |
| 3 | Chris Brummer, Fintech Law in a Nutshell, West Academic Publishing, 2020 |
| 4 | Bernardo Nicoletti, The Future of Fintech, Integrating Finance and Technology in Financial Services, Springer Nature, 2017 |
| 5 | Kevin C. Taylor, FinTech Law: A Guide to Technology Law in the Financial Services Industry, BNA Books, 2014 |
| 6 | Lee Reiners, FinTech Law and Policy, 2018 |

| **COURSEOUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Understand the role that financial regulation plays in key FinTech developments such as mobile payments, crowdfunding, crypto assets, private digital currencies, and decentralized finance. | K2 |
| CO2 | Know the role that law and technology play in facilitating international transactions such as syndicated lending and international bond issues. | K2 |
| CO3 | Be able to critically engage with the major theoretical legal debates surrounding international financing, financial markets and financial technology. | K2 |
| CO4 | Be able to deal with policy arguments on international financing, financial markets and financial technology law | K2 |
| CO5 | Demonstrate ability to apply critical and contextual approaches to the developing legal issues emanating from international financing, regulation of financial markets and financial technology. | K2 |

| POs/ COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | 2 | | | | | | 2 | | 2 | | | 2 | 2 | |
| CO2 | | 2 | | 2 | 2 | 2 | | | | | | | 3 | 2 | |
| CO3 | | | | 2 | | 2 | | | | | | | 3 | 2 | 3 |
| CO4 | 3 | 2 | | | 2 | | | 2 | 2 | 2 | 2 | | 3 | 2 | 3 |
| CO5 | | 2 | 3 | 2 | | | 1 | | | | | 1 | | 2 | |

| AMB701-CORPORATE GOVERNANCE | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **MBA** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | | **OEC** | **3** | **0** | **0** | **3** |
| Preamble | ➢ To understand the concepts, need and importance of Corporate Governance.<br>➢ To understand the relationship between Business, government and Society.<br>➢ To provide the learners with different organization structures.<br>➢ To provide the learners to integrate with business and society.<br>➢ To formulate and execute the plans at various levels of management. | | | | | | |
| **Unit 1** | **CORPORATE GOVERNANCE** | | | | | | **9** |
| **Corporate governance:** The concept, need and importance of corporate governance, The role and purpose of the corporation, separation of ownership and control, benefits of good corporate governance, OECD (Organization for economic co-operation and development) on corporate governance, Theoretical basis for corporate governance, environmental Concerns and Corporations, environmental preservation-role of stakeholders, sustainable development, industrial pollution, role of corporate in environmental management, waste management, pollution control and environmental audit. | | | | | | | |
| **Unit 2** | **BUSINESS, GOVERNMENT AND SOCIETY** | | | | | | **9** |
| **An introduction to Business, Government, and Society:** The Connect between Business, Government, and Society, Importance of BGS relationship in management, models of BGS relationships-Market capitalism model, dominance model, countervailing forcer's model and stakeholder model. | | | | | | | |
| **Unit 3** | **BUSINESS STRUCTURES** | | | | | | **9** |
| **Business structures:** Meaning and nature of business structures, types, nature, advantages, limitations and applicability of - single ownership, partnerships, private limited companies, public limited companies, co-operative societies. | | | | | | | |
| **Unit 4** | **BUSINESS ETHICS AND CSR** | | | | | | **9** |
| **Business Ethics and Corporate Social Responsibility:** Meaning of business ethics, need and purpose, importance, approaches to business ethics, roots of unethical behavior, ethical decision making some unethical issues, benefits from managing ethics at workplace. Nature of CSR, arguments for and against CSR, models of CSR, best practices of CSR-Indian examples. | | | | | | | |
| **Unit 5** | **BOARD OF DIRECTORS** | | | | | | **9** |
| Role of Board of Directors in Corporate Governance, Corporate board of Management, structure and composition of the board, Types of board and directors, Size of the board, Powers of the board of directors, responsibilities, functions of the board, code of conduct for board members, training for the board of directors, effectiveness of the board members, effectiveness and powers of the board. | | | | | | | |
| | | | | | | | **Total: 45** |

| **REFERENCE BOOK** | |
|---|---|
| 1 | Corporate Governance: Principles, policies and Practices by Fernando A.c. Pub: Pearson, 2014. |
| 2 | Business and Government by Francis Cherunilam, Pub: Himalayan Publishing House. |
| 3 | Corporate Governance, Ethics & Social Responsibility by Balachandran C.H, Pub: PHI Pvt Ltd, 2015. |
| 4 | Business Ethics and Corporate Governance: Ghosh B.N., TMH, 2015 |

| COURSE OUTCOMES: At the end of the course, learners will be able to | | Bloom's Taxonomy Level |
|---|---|---|
| CO1 | Understand to connect between the corporate, ethics and society. | K1 |
| CO2 | Decide about the appropriateness of various business structures. | K2 |
| CO3 | Understand the need for and importance of corporate governance with reference to Environment protection | K3 |
| CO4 | Make the students to understand the essence of business and how business could be mutually beneficial to the businessman and the society. | K4 |
| CO5 | Decide on the role and functions of Board of Directors in an Organization. | K5 |

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

| AMB702- DIGITAL MARKETING | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **MBA** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | | **OE** | **3** | **0** | **0** | **3** |
| Preamble | ➢ To understand the concepts of Digital Marketing.<br>➢ To understand the Online Advertising and SEO.<br>➢ To analyse the Social media and email Marketing.<br>➢ To evaluate the concepts of email marketing.<br>➢ To formulate mobile marketing and e-marketing strategies. | | | | | | |
| **Unit 1** | **OVERVIEW OF DIGITAL MARKETING** | | | | | | **9** |
| Digital marketing overview and meaning- benefits – platform & strategies- comparing digital with traditional marketing- latest digital marketing trends- case studies of digital marketing trends. Content Marketing, Handling Traffic. | | | | | | | |
| **Unit 2** | **ONLINE ADVERTISING AND SEO** | | | | | | **9** |
| Internet and Search Engine Basics, online Advertising, Importance of online Advertising, Types of online Marketing and advertising Methods. Importance of Search Engines, How the search engine works, Understanding the SERP, Using Search Operators, Search Engine Algorithms. | | | | | | | |
| **Unit 3** | **SOCIAL MEDIA AND EMAIL MARKETING** | | | | | | **9** |
| What is Social Media, SMM Vs. SMO, Benefits of using SMM, Social Media Strategy, and Impact of Social Media on SEO. Marketing strategy, Benefits, Promotional tools for- Facebook, YouTube, Twitter, Google, Linkedn. Email Marketing- Email Marketing concept, Importance, Popular Email Marketing Softwares, Email Marketing Goals and strategies, Types of Email marketing campaigns, Creating an Email Campaign, What is Newsletter, Design a Newsletter. Micro Blogging. | | | | | | | |
| **Unit 4** | **E COMMERCE** | | | | | | **9** |
| Ecommerce Business Planning, eCommerce Website, Product Placements, Product Grouping, Promoting eCommerce Website, Remarketing Products: Re-Marketing Flow, Email, Facebook Re-Marketing. Understanding Coupon System, Appointing Affiliates for Products, Cross/Up/Down Selling, Introduction to payment gateway- Application and Documentation. | | | | | | | |
| **Unit 5** | **MOBILE MARKETING AND REMARKETING** | | | | | | **9** |
| Overview of the B2B and B2C Mobile Marketing, Mobile Sites, Apps (Applications) and Widgets and their relevant to marketing, opportunities and pitfalls of Mobile Marketing, user interfaces and architectures. Trends in Mobile social media, Mobile Commerce, Mobile Payments and Billing, integration of mobile marketing into marketing plan. | | | | | | | |
| | | | | | | | **Total: 45** |

**REFERENCE BOOK**


| | |
|---|---|
| 1 | Digital Marketing: Strategy, Implementation & Practice, Dave Chaffey & Fiona Ellis-Chadwick, 2019 |
| 2 | Convert!: Designing Websites For Traffic and Conversions, Ben Hunt, 2020 |
| 3 | The Social Media Bible: Tactics, Tools, & Strategies for Business Success, Lon Safko, 2018 |
| 4 | Digital Marketing: Strategies for Online Success ,Godfrey Parkin, 2015 |

| | |
|---|---|
| 5 | Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Damian Ryan, 2018 |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Understand how and why to use digital marketing for multiple goals within a larger marketing and/or media strategy. | K1 |
| CO2 | Understand the major digital marketing channels - online advertising: Digital display, video, mobile, search engine, email and social media. | K2 |
| CO3 | Learn to develop, evaluate, and execute a comprehensive digital marketing strategy and plan. | K3 |
| CO4 | Explore the concepts of Remarketing strategies | K4 |
| CO5 | Develop various payment and billing gateways in digital marketing. | K5 |

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

| AMB703- RURAL MARKETING | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **MBA** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | | **OE** | **3** | **0** | **0** | **3** |
| Preamble | ➢ To understand the concepts of Rural Marketing<br>➢ To understand the types of Agricultural products for marketing.<br>➢ To analyse the issues in Rural Marketing.<br>➢ To evaluate the Rural Marketing Regulations.<br>➢ To formulate the strategies to satisfy rural consumers. | | | | | | |
| **Unit 1** | **INTRODUCTION TO RURAL MARKETING** | | | | | | **9** |
| Concept- Nature- Scope- Significance of Rural Marketing- Factors contributing to Growth of rural markets -Components and classification of Rural markets- Rural Market VS Urban Market- e.rural marketing. | | | | | | | |
| **Unit 2** | **AGRICULTURAL MARKETING** | | | | | | **9** |
| Concept-Nature and Types of Agriculture produce- concept and types of Agricultural Markets- Marketing channels -Methods of Sales - Market functions | | | | | | | |
| **Unit 3** | **ISSUES IN RURAL MARKETING** | | | | | | **9** |
| Rural Consumer behaviour- features- factors influencing- Lifestyle of rural consumer - FMCG sector in Rural India- concept and classification of consumer goods- Marketing Channels for FMCG – Fast growing FMCG -Marketing of consumer durables- The role of Advertising. | | | | | | | |
| **Unit 4** | **RURAL MARKETING AND MARKETING REGULATION** | | | | | | **9** |
| Regulated Market- APMC Act 1963- Model bill Standardization and Grading - Inspection of quality control -Inspection of AGMARK - Indian Standers and Grade Specifications- Food Products order (FPO) 1955 –Consumer Protection Act 1986. The National Council for State Marketing Boards (NCOSAMB) State Trading corporation (STC), Public Distribution System (PDS). | | | | | | | |
| **Unit 5** | **INSTITUIONAL SUPPORT TO RURAL MARKETING** | | | | | | **9** |
| Commission on Agriculture Costs and Prices (CACP), National Agriculture Co-operative Marketing Federation (NAFED), Agriculture and Processed Food Exports Development Authority (APEDA) | | | | | | | |
| | | | | | | | **Total: 45** |

| **REFERENCE BOOK** | |
|---|---|
| 1 | Badi R.V. Badi N.V.Rural Marketing Himalaya Publishing House – 2010 |
| 2 | Rural Marketing- Gopalaswamy Vikas Publishing House, 2020. |
| 3 | Kashyp Pradeep, Rant Siddhartha The Rural Marketing, Biztantra, 2015. |
| 4 | Mishra and Puri Development Issues of Indian Economy Himalaya Publishing House, 2018 |

| **COURSE OUTCOMES:**<br>**At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Understand the concepts of Rural Marketing | K1 |
| CO2 | Understand the nature of Rural Consumer Behaviour | K2 |

| | | |
|---|---|---|
| CO3 | Analyse the nature of marketing rural products | K3 |
| CO4 | Identify the problems and issues in Rural Marketing | K4 |
| CO5 | Formulate the marketing strategies to satisfy the rural consumers. | K5 |

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

| **AIT701 - NETWORKING ESSENTIALS** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **B.Tech & IT** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | | **OE** | **3** | **0** | **0** | **3** |
| Preamble | ➢ Understand the division of network functionalities into layers.<br>➢ Be familiar with the components required to build different types of networks<br>➢ Be exposed to the required functionality at each layer<br>➢ Learn the flow control and congestion control algorithms.<br>➢ Learn the Classify the various soft computing frame works | | | | | | |
| **UNIT I** | **FUNDAMENTALS & LINK LAYER** | | | | | | **9** |
| Building a network – Requirements – Layering and protocols – Internet Architecture – Network software – Performance ; Link layer Services – Framing – Error Detection – Flow control | | | | | | | |
| **Unit 2** | **MEDIA ACCESS & INTERNETWORKING** | | | | | | **9** |
| Media access control – Ethernet (802.3) – Wireless LANs – 802.11 – Bluetooth – Switching and bridging – Basic Internetworking (IP, CIDR, ARP, DHCP, ICMP) | | | | | | | |
| **Unit 3** | **ROUTING** | | | | | | **9** |
| Routing (RIP, OSPF, metrics) – Switch basics – Global Internet (Areas, BGP, IPv6), Multicast – addresses – multicast routing (DVMRP, PIM), Unicast Routing Algorithms | | | | | | | |
| **Unit 4** | **TRANSPORT LAYER** | | | | | | **9** |
| Overview of Transport layer – UDP – Reliable byte stream (TCP) – Connection management – Flow control – Retransmission – TCP Congestion control – Congestion avoidance (DECbit, RED) – QoS – Application requirements | | | | | | | |
| **Unit 5** | **APPLICATION LAYER** | | | | | | **9** |
| Traditional applications -Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – Web Services – DNS – SNMP, Telnet –SSH | | | | | | | |
| | | | | | | | **Total: 45** |
| **TEXTBOOKS** | | | | | | | |
| 1 | Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers, 2011. | | | | | | |
| 2 | Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013. | | | | | | |
| **REFERENCES** | | | | | | | |

| | |
|---|---|
| 1 | James F. Kurose, Keith W. Ross, "Computer Networking – A Top-Down Approach Featuring the Internet", Fifth Edition, Pearson Education, 2009 |
| 2 | Nader. F. Mir, "Computer and Communication Networks", Pearson Prentice Hall Publishers, 2010 |
| 3 | Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach",McGraw Hill Publisher, 2011 |
| 4 | Behrouz A. Forouzan, "Data communication and Networking", Fourth Edition, Tata McGraw – Hill, 2011. |

**COURSEOUTCOMES:**

| **At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Identify the components required to build different types of networks | K2 |
| CO2 | Choose the required functionality at each layer for given application | K3 |
| CO3 | Identify solution for each functionality a t each layer | K1 |
| CO4 | Trace the flow of information from one node to another node in the network. | K2 |
| CO5 | Design protocols for various functions in the network and understand the working of various application layer protocols | K2 |

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

| **AIT702 - SOFT COMPUTING METHODOLOGIES** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Programme & Branch** | **B.Tech & IT** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| | | | **OE** | **3** | **0** | **0** | **3** |
| Preamble | ➢ Classify the various soft computing frame works<br>➢ Be familiar with the design of neural networks, fuzzy logic and fuzzy systems<br>➢ Learn mathematical background for optimized genetic programming<br>➢ Be exposed to neuro-fuzzy hybrid systems and its applications | | | | | | |
| **UNIT I** | **INTRODUCTION TO SOFT COMPUTING** | | | | | | **9** |
| Soft Computing Constituents-From Conventional AI To Computational Intelligence- Artificial Neural Network: Introduction, Characteristics- Evolution Of Neural Networks - Basic Models - Important Technologies - Applications. Fuzzy Logic: Introduction - Crisp Sets- Fuzzy Sets - Crisp Relations And Fuzzy Relations: Cartesian Product Of Relation - Classical Relation, Fuzzy Relations, Tolerance And Equivalence Relations. Genetic Algorithm-Introduction - Biological Background - Traditional Optimization And Search Techniques – Genetic Basic Concepts. | | | | | | | |

| Unit 2 | NEURAL NETWORKS | 9 |
|---|---|---|
| Mcculloch-Pitts Neuron - Linear Separability - Hebb Network - Supervised Learning Network: Perceptron Networks - Adaptive Linear Neuron, Multiple Adaptive Linear Neuron, BPN, RBF - Associative Memory Network: Auto- Associative Memory Network, Hetero-Associative Memory Network, Hopfield Networks, Iterative Auto Associative Memory Network – Unsupervised Learning Networks: Kohonen Self-Organizing Feature Maps, LVQ – CP Networks, ART Network. | | |
| **Unit 3** | **FUZZY LOGIC** | **9** |
| Membership Functions: Features, Fuzzification, Methods Of Membership Value Assignments- Defuzzification: Lambda Cuts - Methods - Fuzzy Arithmetic And Fuzzy Measures: Fuzzy Arithmetic - Extension Principle - Fuzzy Measures - Measures Of Fuzziness -Fuzzy Integrals - Fuzzy Rule Base And Approximate Reasoning : Truth Values And Tables, Fuzzy Propositions, Formation Of Rules- Decomposition Of Rules, Aggregation Of Fuzzy Rules, Fuzzy Reasoning-Fuzzy Inference Systems Overview Of Fuzzy Expert System- Fuzzy Decision Making | | |
| **Unit 4** | **GENETIC ALGORITHM** | **9** |
| Genetic Algorithm- Operators – Encoding Scheme – Fitness Evaluation –Crossover - Mutation – Classification Of Gnetic Algorithms- Genetic Programming – Advances In GA . | | |
| **Unit 5** | **HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS** | **9** |
| Neuro-Fuzzy Hybrid Systems - Genetic Neuro Hybrid Systems - Genetic Fuzzy Hybrid And Fuzzy Genetic Hybrid Systems - Simplified Fuzzy ARTMAP - Applications: A Fusion Approach Of Multispectral Images With SAR, Optimization Of Traveling Salesman Problem Using Genetic Algorithm Approach, Soft Computing Based Hybrid Fuzzy Controllers. | | |
| | | **Total: 45** |

**TEXTBOOKS**

| | |
|---|---|
| 1 | S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd, 2011 |
| 2 | J.S.R.Jang, C.T. Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI |

**REFERENCES**

| | |
|---|---|
| 1 | S.Rajasekaran and G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications", Prentice-Hall of India Pvt. Ltd., 2006. |
| 2 | George J. Klir, Ute St. Clair, Bo Yuan, “Fuzzy Set Theory: Foundations and Applications” Prentice Hall, 1997. |
| 3 | David E. Goldberg, “Genetic Algorithm in Search Optimization and Machine Learning” Pearson Education India, 2013. |
| 4 | James A. Freeman, David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Education India, 1991. |

**COURSEOUTCOMES:**

| **At the end of the course, learners will be able to** | | **Bloom’s Taxonomy Level** |
|---|---|---|
| CO1 | Apply various soft computing concepts for practical applications | K2 |
| CO2 | Choose and design suitable neural network for real time problems | K2 |
| CO3 | Use fuzzy rules and reasoning to develop decision making and expert system | K2 |

| | | |
|---|---|---|
| CO4 | Explain the importance of optimization techniques and genetic programming | K2 |
| CO5 | Review the various hybrid soft computing techniques and apply in real time problems | K2 |

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

**AIT703 - KNOWLEDGE ENGINEERING**

| Programme & Branch | B.Tech & IT | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | | OE | 3 | 0 | 0 | 3 |

| | |
|---|---|
| Preamble | ➢ To understand the basics of Knowledge Engineering.<br>➢ To discuss methodologies and modeling for Agent Design and Development.<br>➢ To design and develop ontologies.<br>➢ To apply reasoning with ontologies and rules.<br>➢ To understand learning and rule learning |

| UNIT I | REASONING UNDER UNCERTAINTY | 9 |
|---|---|---|

Introduction – Abductive reasoning – Probabilistic reasoning: Enumerative Probabilities – Subjective Bayesian view – Belief Functions – Baconian Probability – Fuzzy Probability – Uncertainty methods - Evidence-based reasoning – Intelligent Agent – Mixed-Initiative Reasoning- Knowledge Engineering.

| Unit 2 | METHODOLOGY AND MODELING | 9 |
|---|---|---|

Conventional Design and Development – Development tools and Reusable Ontologies – Agent Design and Development using Learning Technology – Problem Solving through Analysis and Synthesis – Inquiry-driven Analysis and Synthesis – Evidence-based Assessment – Believability Assessment – Drill-Down Analysis, Assumption-based Reasoning, and What-If Scenarios.

| Unit 3 | ONTOLOGIES – DESIGN AND DEVELOPMENT | 9 |
|---|---|---|

Concepts and Instances – Generalization Hierarchies – Object Features – Defining Features – Representation – Transitivity – Inheritance – Concepts as Feature Values – Ontology Matching. Design and Development Methodologies – Steps in Ontology Development – Domain Understanding and Concept Elicitation – Modelling-based Ontology Specification.

| Unit 4 | REASONING WITH ONTOLOGIES AND RULES | 9 |
|---|---|---|

Production System Architecture – Complex Ontology-based Concepts – Reduction and Synthesis rules and the Inference Engine – Evidence-based hypothesis analysis – Rule and Ontology Matching – Partially Learned Knowledge – Reasoning with Partially Learned Knowledge.

| Unit 5 | LEARNING AND RULE LEARNING | 9 |
|---|---|---|

Machine Learning – Concepts – Generalization and Specialization Rules – Types – Formal definition of Generalization. Modelling, Learning and Problem Solving – Rule learning and Refinement – Overview – Rule Generation and Analysis – Hypothesis Learning

| | |
|---|---|
| | **Total: 45** |
| **TEXTBOOKS** | |
| 1 | Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning, Cambridge University Press, First Edition, 2016. (Unit 1 – Chapter 1 / Unit 2 – Chapter 3,4 / Unit 3 – Chapter 5, 6 / Unit 4 - 7 , Unit 5 Chapter 8, 9 ) |
| 2 | Jiawei Han and MichelineKamber, "Data Mining Concepts and Techniques", Third Edition, Elsevier, 2012. |
| **REFERENCES** | |
| 1 | Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004. |
| 2 | Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018. |
| 3 | Behrouz A. Forouzan, "Data communication and Networking", Fourth Edition, Tata McGraw – Hill, 2011. |
| 4 | Jay Liebowitz, Knowledge Management Learning from Knowledge Engineering, 1st Edition,2001 |
| | |

**COURSEOUTCOMES:**

| **At the end of the course, learners will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Understand the basics of Knowledge Engineering. | K2 |
| CO2 | Apply methodologies and modelling for Agent Design and Development. | K3 |
| CO3 | Design and develop ontologies. | K3 |
| CO4 | Apply reasoning with ontologies and rules. | K3 |
| CO5 | Understand learning and rule learning. | K2 |

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

| **ACB701 - BUSINESS RESEARCH METHODS** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Programme & Branch** | **B.TECH & CSBS** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| **Prerequisites** | | | **OE** | **3** | **0** | **0** | **3** |
| | | | | | | | |
| **Preamble** | ➢ To make the students of tourism understand the principles of scientific methodology in business enquiry, develop analytical skills of business research and to prepare scientific business reports. | | | | | | |

| | | |
|---|---|---|
| **UNIT I** | **INTRODUCTION** | **9** |
| Business Research – Definition and Significance – the research process – Types of Research – Exploratory and causal Research – Theoretical and empirical Research – Cross –Sectional and time – series Research – Research questions / Problems – Research objectives – Research hypotheses – characteristics – Research in an evolutionary perspective – the role of theory in research. | | |
| **UNIT II** | **RESEARCH DESIGN AND MEASUREMENT** | **9** |
| Research design – Definition – types of research design – exploratory and causal research design – Descriptive and experimental design – different types of experimental design – Validity of findings – internal and external validity – Variables in Research – Measurement and scaling – Different scales – Construction of instrument – Validity and Reliability of instrument. | | |
| **UNIT III** | **DATA COLLECTION** | **9** |
| Types of data – Primary Vs Secondary data – Methods of primary data collection – Survey Vs Observation – Experiments – Construction of questionnaire and instrument – Types of Validity – Sampling plan – Sample size – determinants optimal sample size – sampling techniques – Sampling methods | | |
| **UNIT IV** | **DATA PREPARATION AND ANALYSIS** | **9** |
| Data Preparation – editing – Coding –Data entry – Validity of data – Qualitative Vs Quantitative data analyses – Applications of Bivariate and Multivariate statistical techniques, Factor analysis, Discriminant analysis, Cluster analysis, Multiple regression and Correlation, Multidimensional scaling – Conjoint Analysis – Application of statistical software for data analysis. | | |
| **UNIT V** | **REPORT DESIGN, WRITING AND ETHICS IN BUSINESS RESEARCH** | **9** |
| Research report –Types – Contents of report – need for executive summary – chapterization – contents of chapter – report writing – the role of audience – readability – comprehension –tone – final proof – report format – title of the report – ethics in research – Ethics in research Subjectivity and Objectivity in research. | | |
| | | **Total:45 Periods** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | Donald R. Cooper, Pamela S. Schindler and J K Sharma, Business Research methods,11th Edition, Tata Mc Graw Hill, New Delhi, 2012. |

**REFERENCES:**

| | |
|---|---|
| 1. | Alan Bryman and Emma Bell, Business Research methods, 3rd Edition, Oxford University Press, New Delhi, 2011. |
| 2. | Uma Sekaran and Roger Bougie, Research methods for Business, 5th Edition, Wiley India, New Delhi, 2012. |
| 3 | William G Zikmund, Barry J Babin, Jon C.Carr, AtanuAdhikari,Mitch Griffin, Business Research methods, A South Asian Perspective, 8th Edition, Cengage Learning, New Delhi, 2012. |
| 4 | Panneerselvam. R, Research Methodology, 2nd Edition, PHI Learning, 2014. |

| **COURSE OUTCOMES:**<br>**Upon successful completion of the course the student will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Understand and appreciate the scientific inquiry | K2 |

| | | |
|---|---|---|
| CO2 | Undertake a systematic outlook towards business situations for the purpose of objective decision making. | K3 |
| CO3 | Ability to conduct a scientific inquiry to solve organizational problems | K3 |
| CO4 | Analyze data and find solutions to the problems. | K3 |
| CO5 | Prepare research reports | K4 |

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

## ACB702 - AUTOMATION TESTING TOOLS

| Programme & Branch | B.TECH & CSBS | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| Prerequisites | | | OE | 3 | 0 | 0 | 3 |

**Preamble**

- To understand the basics of software testing and test planning
- To build test cases and execute them
- To focus on automation testing using selenium
- To automate the testing using TestNG
- To get an insight about test automation using Cucumber

| UNIT I | INTRODUCTION TO SOFTWARE TESTING AND TEST PLANNING | 9 |
|---|---|---|

Why do we test Software?, Black-Box Testing and White-Box Testing, Software Testing Life Cycle, V-model of Software Testing, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults (Defects), Software Testing Principles, Program Inspections, Stages of Testing: Unit Testing, Integration Testing, System Testing-Performance Testing-The Goal of Test Planning, High Level Expectations, Intergroup Responsibilities, Test Phases, Test Strategy, Resource Requirements, Tester Assignments, Test Schedule, Test Cases, Bug Reporting, Metrics and Statistics.

| UNIT II | TEST DESIGN AND EXECUTION | 9 |
|---|---|---|

Test Objective Identification, Test Design Factors, Requirement identification, Testable Requirements, Modeling a Test Design Process, Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case Organization and Tracking, Bug Reporting, Bug Life Cycle.

| UNIT III | SELENIUM | 9 |
|---|---|---|

me browsers, Identifying Web Elements using id, name, linkname, class, xpath, tagname- Handling Input box/buttons, list/selection/drop down boxes, radio buttons, check boxes- Extracting links and other Web-Elements-Extracting Data from WebTable-Capturing screenshots-Handling pop-ups, frames, and windows- Exceptions in Selenium - Data driving from csv and excel using Java APIs-Debugging Tests-Page Object Model

| UNIT IV | TESTNG | 9 |
|---|---|---|

| | | |
|---|---|---|
| Introduction to TestNg-Advantages over Junit-Annotations in TestNg-Understand and Read TestNg Reports-Testng and its configuration-Grouping the testcases, Exclusion of groups, Partial Groups - TestSuite.xml/Suite creation-Types of parameterization-Parameter from TestNg.xml ( pass value at Suite and Test level) - Assertion, Verification | | |
| **UNIT V** | **CUCUMBER** | **9** |
| Introduction to Behavior Driven Development(BDD)-BDD framework using Cucumber-Preparing selenium and cucumber environment -creating a feature files using Gherkins and Gherkin syntax-writing features and scenario, Given – When -Then structure -Writing glue code -Cucumber and Java step definitions-writing step definition/ implementing scenarios steps-Cucumber data driven testing | | |
| | | **Total:45 Periods** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | Yogesh Singh, "Software Testing", Cambridge University Press, 2012 |
| 2. | Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" - Second Edition 2018 |

**REFERENCES:**

| | |
|---|---|
| 1. | Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, 2012, John Wiley & Sons, Inc. |
| 2. | Ron Patton, Software testing, 2nd Edition, 2006, Sams Publishing |
| 3 | Paul C. Jorgensen, Software Testing: A Craftsman's Approach, Fourth Edition, 2014, Taylor & Francis Group. |
| 4 | Carl Cocchiaro, Selenium Framework Design in Data-Driven Testing, 2018, Packt Publishing |

| **COURSE OUTCOMES:**<br>**Upon successful completion of the course the student will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Understand the basic concepts of software testing and test planning. Understand | K2 |
| CO2 | Design effective test cases that can uncover critical defects in the application. | K3 |
| CO3 | Automate the software testing using Selenium Apply | K3 |
| CO4 | Automate the software testing using TestNG Apply | K3 |
| CO5 | Automate the software testing using Cucumber | K3 |

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

| **ACB703 - SOCIAL NETWORK ANALYSIS** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Programme & Branch** | **B.TECH & CSBS** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |

| Prerequisites | | - | OE | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|---|---|

| Preamble | ➢ To understand the concept of semantic web and related applications.<br>➢ To learn knowledge representation using ontology.<br>➢ To understand human behaviour in social web and related communities.<br>➢ To learn visualization of social networks. |
|---|---|

| UNIT I | INTRODUCTION | 9 |
|---|---|---|

Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis.

| UNIT II | MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION | 9 |
|---|---|---|

Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modelling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations

| UNIT III | EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS | 9 |
|---|---|---|

Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures and communities - Decentralized online social networks - Multi-Relational characterization of dynamic social network communities.

| UNIT IV | PREDICTING HUMAN BEHAVIOUR AND PRIVACY ISSUES | 9 |
|---|---|---|

Understanding and predicting human behaviour for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures.

| UNIT V | VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS | 9 |
|---|---|---|

Graph theory - Centrality - Clustering - Node-Edge Diagrams - Matrix representation - Visualizing online social networks, Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations - Applications - Cover networks - Community welfare - Collaboration networks - Co-Citation networks.

**Total:45 Periods**

**TEXTBOOK:**


| | |
|---|---|
| 1. | Peter Mika, “Social Networks and the Semantic Web”, First Edition, Springer 2007. |
| 2. | Borko Furht, “Handbook of Social Network Technologies and Applications”, 1st Edition, Springer, 2010. |


**REFERENCES:**


| | |
|---|---|
| 1. | Guandong Xu ,Yanchun Zhang and Lin Li, “Web Mining and Social Networking – Techniques and applications”, First Edition, Springer, 2011. |
| 2. | Dion Goh and Schubert Foo, “Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively”, IGI Global Snippet, 2008. |

| | |
|---|---|
| 3 | Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, "Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling", IGI Global Snippet, 2009. |
| 4. | John G. Breslin, Alexander Passant and Stefan Decker, "The Social Semantic Web", Springer, 2009 |


| **COURSE OUTCOMES:**<br>**Upon successful completion of the course the student will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Develop semantic web related applications. | K4 |
| CO2 | Represent knowledge using ontology. | K3 |
| CO3 | Predict human behaviour in social web and related communities. | K4 |
| CO4 | Visualize social networks. | K3 |

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

## AAI701 - DRINKING WATER SUPPLY AND TREATMENT

| **Programme &Branch** | **B.TECH & AIDS** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|---|
| **Prerequisites** | | | **OE** | **3** | **0** | **0** | **3** |

| | | |
|---|---|---|
| **Preamble** | To equip the students with the principles and design of water treatment units and distribution system. | |
| **UNIT I** | **SOURCES OF WATER** | **9** |

Public water supply system – Planning, Objectives, Design period, Population forecasting; Water demand – Sources of water and their characteristics, Surface and Groundwater – Impounding Reservoir – Development and selection of source – Source Water quality – Characterization – Significance – Drinking Water quality standards.

| | | |
|---|---|---|
| **UNIT II** | **CONVEYANCE FROM THE SOURCE** | **9** |

Water supply – intake structures – Functions; Pipes and conduits for water – Pipe materials – Hydraulics of flow in pipes – Transmission main design – Laying, jointing and testing of pipes – appurtenances – Types and capacity of pumps – Selection of pumps and pipe materials.

| | | |
|---|---|---|
| **UNIT III** | **WATER TREATMENT** | **9** |

Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation –- sand filters - Disinfection –- Construction, Operation and Maintenance aspects

| UNIT IV | ADVANCED WATER TREATMENT | 9 |
|---|---|---|
| Water softening – Desalination- R.O. Plant – demineralization – Adsorption - Ion exchange– Membrane Systems - Iron and Manganese removal - Defluoridation - Construction and Operation and Maintenance aspects. | | |
| **UNIT V** | **WATER DISTRIBUTION AND SUPPLY** | **9** |
| Requirements of water distribution – Components – Selection of pipe material – Service reservoirs - Functions – Network design – Economics - Computer applications – Appurtenances – Leak detection - Principles of design of water supply in buildings – House service connection – Fixtures and fittings, systems of plumbing and types of plumbing. | | |
| | | **Total:45Periods** |

**TEXTBOOK:**


| | |
|---|---|
| 1. | Garg. S.K., "Water Supply Engineering", Khanna Publishers, Delhi, September 2008. |
| 2. | Punmia B.C, Arun K.Jain, Ashok K.Jain, " Water supply Engineering" Lakshmi publication private limited, New Delhi, 2016 |
| 3. | Rangwala "Water Supply and Sanitary Engineering", February 2022 4. Birdie.G.S., "Water Supply and Sanitary Engineering", Dhanpat Rai and sons, 2018 |


**REFERENCES:**


| | |
|---|---|
| 1. | Fair. G.M., Geyer.J.C., "Water Supply and Wastewater Disposal", John Wiley and Sons, 1954. |
| 2. | Babbit.H.E, and Donald.J.J, "Water Supply Engineering" , McGraw Hill book Co, 1984. |
| 3 | Steel. E.W.et al., "Water Supply Engineering" , Mc Graw Hill International book Co, 1984. |
| 4 | Duggal. K.N., "Elememts of public Health Engineering", S.Chand and Company Ltd, New Delhi, 1998. |


| **COURSEOUTCOMES:**<br>**Upon successful completion of the course the student will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | An understanding of water quality criteria and standards, and their relation to public health | K2 |
| CO2 | The ability to design the water conveyance system 247 | K3 |
| CO3 | The knowledge in various unit operations and processes in water treatment | K3 |
| CO4 | An ability to understand the various systems for advanced water treatment | K3 |
| CO5 | An insight into the structure of drinking water distribution system | K4 |

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

## AAI702 - GEOGRAPHICAL INFORMATION SYSTEM

| Programme &Branch | B.TECH& AIDS | Sem. | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|
| Prerequisites | | | OE | 3 | 0 | 0 | 3 |

| | |
|---|---|
| **Preamble** | ➢ To impart the knowledge on basic components, data preparation and implementation of Geographical Information System. To build test cases and execute them |

| | | |
|---|---|---|
| **UNIT I** | **FUNDAMENTALS OF GIS** | **9** |

Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.

| | | |
|---|---|---|
| **UNIT II** | **SPATIAL DATA MODELS** | **9** |

Database Structures – Relational, Object Oriented – Entities – ER diagram - data models - conceptual, logical and physical models - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models.

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| **UNIT III** | **DATA INPUT AND TOPOLOGY** | **9** |

Scanner - Raster Data Input – Raster Data File Formats – Georeferencing – Vector Data Input – Digitizer – Datum Projection and reprojection -Coordinate Transformation – Topology - Adjacency, connectivity and containment – Topological Consistency – Non topological file formats - Attribute Data linking – Linking External Databases – GPS Data Integration

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| **UNIT IV** | **DATA QUALITY AND STANDARDS** | **9** |

Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability - OGC - Spatial Data Infrastructur

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| **UNIT V** | **DATA MANAGEMENT AND OUTPUT** | **9** |

Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GISdistributed GIS.

**Total:45Periods**

**TEXTBOOK:**


1. Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction Geographical Information Systems, Pearson Education, 2nd Edition,2007.


**REFERENCES:**

| | |
|---|---|
| 1. | Lo. C. P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006 |

| **COURSEOUTCOMES:** On completion of the course, the student is expected to | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | Have basic idea about the fundamentals of GIS. | K2 |
| CO2 | Understand the types of data models.. | K3 |
| CO3 | Get knowledge about data input and topology | K3 |
| CO4 | Gain knowledge on data quality and standards | K3 |
| CO5 | Understand data management functions and data output | K3 |

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

| **AAI703 - IT IN AGRICULTURAL SYSTEM** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Programme &Branch** | **B.TECH& AIDS** | **Sem.** | **Category** | **L** | **T** | **P** | **C** |
| **Prerequisites** | | | **OE** | **3** | **0** | **0** | **3** |

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| **Preamble** | ➢ To introduce the students to areas of agricultural systems in which IT and computers play a major role.<br>➢ To also expose the students to IT applications in precision farming, environmental control systems, agricultural systems management and weather prediction models |

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| **UNIT I** | **PRECISION FARMING** | **9** |
| Precision agriculture and agricultural management – Ground based sensors, Remote sensing, GPS, GIS and mapping software, Yield mapping systems, Crop production modeling. | | |
| **UNIT II** | **ENVIRONMENT CONTROL SYSTEMS** | **9** |
| Artificial light systems, management of crop growth in greenhouses, simulation of CO2 consumption in greenhouses, on-line measurement of plant growth in the greenhouse, models of plant production and expert systems in horticulture. | | |
| **UNIT III** | **AGRICULTURAL SYSTEMS MANAGEMENT** | **9** |
| Agricultural systems - managerial overview, Reliability of agricultural systems, Simulation of crop growth and field operations, Optimizing the use of resources, Linear programming, Project scheduling, Artificial intelligence and decision support systems. | | |
| **UNIT IV** | **WEATHER PREDICTION MODELS** | **9** |

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| Importance of climate variability and seasonal forecasting, Understanding and predicting world's climate system, Global climatic models and their potential for seasonal climate forecasting, General systems approach to applying seasonal climate forecasts. | | |
| **UNIT V** | **E-GOVERNANCE IN AGRICULTURAL SYSTEMS** | **9** |
| Expert systems, decision support systems, Agricultural and biological databases, e-commerce, business systems & applications, Technology enhanced learning systems and solutions, eLearning, Rural development and information society | | |
| | | **Total:45 Periods** |

**TEXTBOOK:**

| | |
|---|---|
| 1. | National Research Council, "Precision Agriculture in the 21st Century", National Academies Press, Canada, 1997. |
| 2. | H. Krug, Liebig, H.P. "International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation", 1989. |

**REFERENCES:**

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|---|---|
| 1. | Peart, R.M., and Shoup, W. D., "Agricultural Systems Management", Marcel Dekker, New York, 2004. |
| 2. | Hammer, G.L., Nicholls, N., and Mitchell, C., "Applications of Seasonal Climate", Springer, Germany, 2000. |

| **COURSEOUTCOMES: Upon successful completion of the course the student will be able to** | | **Bloom's Taxonomy Level** |
|---|---|---|
| CO1 | The students shall be able to understand the applications of IT in remote sensing applications such as Drones etc | K1 |
| CO2 | The students will be able to get a clear understanding of how a greenhouse can be automated and its advantages. | K2 |
| CO3 | The students will be able to apply IT principles and concepts for management of field operations | K4 |
| CO4 | The students will get an understanding about weather models, their inputs and applications. | K1 |
| CO5 | The students will get an understanding of how IT can be used for e-governance in agriculture | K4 |

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