KARNATAK LAW SOCIETY'S

# GOGTE INSTITUTE OF TECHNOLOGY

UDYAMBAG, BELAGAVI-590008

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)

**(APPROVED BY AICTE, NEW DELHI)**


## Department of Electronics and Communication Engineering

**M. Tech. Scheme (1st to 4th Semester) and**
**1st and 2nd Semester Syllabus (2022 Scheme)**
**Digital Communication and Networking (DCN)**

## INSTITUTION VISION

Gogte Institute of Technology shall stand out as an institution of excellence in technical education and in training individuals for outstanding caliber, character coupled with creativity and entrepreneurial skills.

## MISSION

To train the students to become Quality Engineers with High Standards of Professionalism and Ethics who have Positive Attitude, a Perfect blend of Techno-Managerial Skills and Problem solving ability with an analytical and innovative mindset.

## QUALITY POLICY

- Imparting value added technical education with state-of-the-art technology in a congenial, disciplined and a research oriented environment.
- Fostering cultural, ethical, moral and social values in the human resources of the institution.
- Reinforcing our bonds with the Parents, Industry, Alumni, and to seek their suggestions for innovating and excelling in every sphere of quality education.

| DEPARTMENT VISION |
| --- |
| The Electronics & Communication Engineering department shall impart quality technical education and entrepreneurship skills to develop creative individuals to face changing global scenario. |

| MISSION |
| --- |
| To augment the national talent pool, with Electronics and Communication Engineers having all-encompassing technical knowledge, principled practices and nationalistic outlook. |

| PROGRAM EDUCATIONAL OBJECTIVES (PEOs) | |
|---|---|
| 1. | The post graduates will acquire core competence in Digital Communication and Networking fundamentals necessary to formulate, analyze, and solve problems in communication and networking domain and to pursue advanced study or research. |
| 2. | The post graduates will engage in the activities that demonstrate desire for ongoing personal and professional growth, and self-confidence to adapt to ongoing technological developments. |
| 3. | The post graduates will maintain high professionalism and ethical standards, effective oral and written communication skills, work as part of teams on multidisciplinary projects under diverse professional environments, and relate engineering issues to the society, global economy and to emerging technologies. |

| PROGRAM OUTCOMES (POs) | |
|---|---|
| 1. | An ability to independently carry out research /investigation and development work to solve practical problems. |
| 2. | An ability to write and present a substantial technical report/document. |
| 3. | Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. |

| PROGRAM SPECIFIC OUTCOMES (PSOs) | |
|---|---|
| **1.** | Understanding and applying the mathematical and scientific concepts, for analysis and design of Communication and Networking systems. |
| **2.** | Developing critical thinking abilities coupled with competence in use of computational tools for professional growth; complimented with communication skills and leadership attributes. |
| **3.** | Identifying societal needs and sensitizing individuals towards finding innovative solutions to contemporary issues with multidisciplinary outlook. |

## 2022-23 Scheme of Teaching and Examination

## 1st to 4th Semester M. Tech. (Digital Communication and Networking)

**Total credits for M. Tech. Program: 80**

| | Semester | Credits per Sem | Total credits |
|---|---|---|---|
| 1st year | 1 | 22 | 40 |
| | 2 | 18 | |
| 2nd year | 3 | 22 | 40 |
| | 4 | 18 | |
| | **Total** | **80** | **80** |

### Curriculum frame work:

| Sl. No. | Course | | Credits |
|---|---|---|---|
| 1 | Basic Science Courses | BSC | 03 |
| 2 | Professional Core Courses | PCC | 29 |
| 3 | Professional Elective Courses | PEC | 09 |
| 5 | Open Elective Courses | OEC | 03 |
| 6 | Internship | INT | 06 |
| 7 | Minor with seminar | MPS | 03 |
| 8 | Societal project | SP | 03 |
| 9 | Major project | PROJ | 21 |
| 10 | Research methodology and IPR | MCC | 03 |
| | **Total** | | 80 |

| Theory Course Credits | | Online Course Credits | |
|---|---|---|---|
| **Duration of course** | **Credits** | **Online course duration** | **Credits** |
| 50 hours of course content | 4 | 04 weeks | 1 |
| 40 hours of course content | 3 | 08 weeks | 2 |
| Lecture (L) One Hour /week | 1 | 12 weeks | 3 |
| Practicals (P) Two hours /week | 1 | | |

| I SEMESTER | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sl. No** | **Course** | **Course Code** | **Course Title** | **Teaching Hours per Week** | | | **Examination** | | | | **Credits** |
| | | | | **Theory** | **Tutorial/ Skill Development Activities** | **Practical /Seminar** | **Duration in hours** | **CIE Marks** | **SEE Marks** | **Total Marks** | |
| | | | | **L** | **T/SDA** | **P** | | | | | |
| 1 | BSC | 22DCN11 | Advanced Engineering Mathematics | 3 | 0 | 0 | 03 | 100 | 100 | 200 | 3 |
| 2 | IPCC | 22DCN12 | Advanced Digital Signal Processing | 3 | 0 | 2 | 03 | 100 | 100 | 200 | 4 |
| 3 | PCC | 22DCN13 | Advanced Communication Networks | 4 | 0 | 0 | 03 | 100 | 100 | 200 | 4 |
| 4 | PCC | 22DCN14 | Wireless Communication | 3 | 0 | 0 | 03 | 100 | 100 | 200 | 3 |
| 5 | PCC | 22DCN15 | Advanced Embedded System | 3 | 0 | 0 | 03 | 100 | 100 | 200 | 3 |
| 6 | MCC | 22DCN16 | Research Methodology and IPR | 3 | 0 | 0 | 03 | 100 | 100 | 200 | 3 |
| 7 | PCCL | 22DCNL17 | Communication Networks Laboratory | 0 | 0 | 4 | 03 | 100 | 100 | 200 | 2 |
| **TOTAL** | | | | **19** | **0** | **06** | **21** | **700** | **700** | **1400** | **22** |

| II SEMESTER | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sl. No | Course | Course Code | Course Title | Teaching Hours per Week | | | Examination | | | | Credits |
| | | | | Theory | Tutorial/ Skill Development Activities | Practical/ Seminar | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | L | T/SDA | P | | | | | |
| 1 | PCC | 22DCN21 | Advanced Digital Communication | 3 | 0 | 0 | 03 | 100 | 100 | 200 | 3 |
| 2 | IPCC | 22DCN22 | Antenna Theory and Design | 3 | 0 | 2 | 03 | 100 | 100 | 200 | 4 |
| 3 | PEC | 22DCN23x | Professional elective 1 | 3 | 0 | 0 | 03 | 100 | 100 | 200 | 3 |
| 4 | PEC | 22DCN24x | Professional elective 2 | 3 | 0 | 0 | 03 | 100 | 100 | 200 | 3 |
| 5 | MPS | 22DCN25 | Mini Project with Seminar | 0 | 2 | 4 | -- | 100 | -- | 100 | 3 |
| 6 | PCCL | 22DCNL26 | Advanced Communication laboratory | 0 | 0 | 4 | 03 | 100 | 100 | 200 | 2 |
| **TOTAL** | | | | **12** | **2** | **10** | **15** | **600** | **500** | **1100** | **18** |

| Professional Elective 1 | | Professional Elective 2 | |
|---|---|---|---|
| **Course Code under 22DCN23X** | **Course title** | **Course Code under 22DCN24X** | **Course title** |
| 22DCN231 | Soft Computing | 22DCN241 | Pattern Recognition and Classification |
| 22DCN232 | Advanced Multimedia Communication | 22DCN242 | Cyber Physical System |
| 22DCN233 | Information Security | 22DCN243 | Optical Networks |
| 22DCN234 | Modelling Simulation and Analysis of Systems | 22DCN244 | Statistical Signal Processing |

**III SEMESTER**

| Sl. No | Course | Course Code | Course Title | Teaching Hours per Week | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | Tutorial/ Skill Development Activities | Practical/Seminar | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | L | T/SDA | P | | | | | |
| 1 | IPCC | 22DCN31 | Adaptive Signal Processing | 3 | 0 | 2 | 03 | 100 | 100 | 200 | 4 |
| 2 | PEC | 22DCN32X | Professional elective 3 | 3 | 0 | 0 | 03 | 100 | 100 | 200 | 3 |
| 3 | OEC | 22DCN33X | Open elective Courses-1 | 3 | 0 | 0 | 03 | 100 | 100 | 200 | 3 |
| 4 | PROJ | 22DCN34 | Project Work phase - 1 | 0 | 0 | 6 | -- | 100 | -- | 100 | 3 |
| 5 | SP | 22DCN35 | Societal Project | 0 | 2 | 4 | -- | 100 | -- | 100 | 3 |
| 6 | INT | 22DCNI36 | Internship | (06 weeks Internship Completed during the intervening vacation of II and III semesters.) | | | 03 | 100 | 100 | 200 | 6 |
| 7 | AUD | 22AUD37 | BOS recommended ONLINE courses | Classes and evaluation procedures are as per the policy of the online course providers. | | | | | | | PP |
| **TOTAL** | | | | **9** | **2** | **12** | **12** | **600** | **400** | **1000** | **22** |

| Professional elective 3 | | Open elective 1 | |
|---|---|---|---|
| **Course Code under 22DCN32X** | **Course title** | **Course Code under 22DCN33X** | **Course title** |
| 22DCN321 | Software Defined Networks | 22DCN331 | Real Time Systems |
| 22DCN322 | RF and Microwave Circuit Design | 22DCN332 | RF MEMS |
| 22DCN323 | Software Defined Radio | 22DCN333 | Modelling Simulation and Analysis of Systems |
| 22DCN324 | Error Control Coding | 22DCN334 | Internet of Things |

| IV SEMESTER | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sl. No** | **Course** | **Course Code** | **Course Title** | **Teaching Hours /Week** | | **Examination** | | | | **Credits** |
| | | | | **Theory** | **Practical/ Field work** | **Duration in hours** | **CIE Marks** | **SEE Marks Viva voce** | **Total Marks** | |
| | | | | **L** | **P** | | | | | |
| 1 | Project | 22DCN41 | Project work phase -2 | -- | 08 | 03 | 100 | 100 | 200 | 18 |
| 2 | AUD | 22AUD42 | BOS recommended ONLINE courses | Classes and evaluation procedures are as per the policy of the online course providers. | | | | | | PP |
| **TOTAL** | | | | **--** | **08** | **03** | **100** | **100** | **200** | **18** |

| **Course code** | **Details** |
|---|---|
| 22AUD37/ 22AUD42 | The students have to complete the online MOOC courses offered by NPTEL/AICTE of specific duration specified by the department and submit the certificate of completion.<br>The list of courses will be given by PG coordinator depending on the availability. |

**Advanced Engineering Mathematics**

| **Course Code** | **22DCN11** | **Course type** | **BSC** | **Credits L-T-P** | 3 – 0 – 0 |
|---|---|---|---|---|---|
| **Hours/week: L - T- P** | 3 – 0 – 0 | | | **Total credits** | 3 |
| **Total Contact Hours** | L = 40 Hrs; T = 0 Hrs; P = 0 Hrs<br>Total = 40 Hrs | | | **CIE Marks** | 100 |
| **Flipped Classes content** | 0 Hours | | | **SEE Marks** | 100 |

| **Course learning objectives** | |
|---|---|
| 1. | To introduce the basic concepts of linear algebra such as RREF, linear independence and linear transformations. |
| 2. | To explore the concepts of vector spaces, dimension of vector space, rank and change of basis. |
| 3. | To understand the orthogonality of vectors and matrix factorization techniques. |
| 4. | To introduce the probability theory concepts. |

**Pre-requisites:** Engineering Mathematics.

| **Unit – I** | **Contact Hours = 8 Hours** |
|---|---|
| Fundamentals of Linear Algebra<br>Systems of Linear Equations, Row Reduction and Echelon Forms (RREF), Vector equations, Matrix equations, solution sets of linear systems, Applications of linear systems, Linear Independence, Linear Transformation. | |
| **Case Study:** DFT as a linear Transformation. | |

| **Unit – II** | **Contact Hours = 8 Hours** |
|---|---|
| Matrix operations, Matrix inversion, Characterization of invertible matrices, Subspaces of $\mathcal{R}^n$,(Null Space, Column Space, Basis of a subspace), Dimension and rank.<br>Vector Spaces and Subspaces, Null Spaces, Column Spaces, and Linear Transformations, Linearly Independent Sets; Bases, Coordinate Systems, The Dimension of a Vector Space, Rank and change of basis. | |
| **Case Study:** Fourier Transforms as change of basis. | |

| **Unit – III** | **Contact Hours = 8 Hours** |
|---|---|
| Eigen values and Eigen vectors, Inner Product, Length and Orthogonality, Orthogonal Sets, Orthogonal Projections, Gram-Schmidt Process, Least Squares Problems, Inner Product Spaces.<br>Diagonalization of Symmetric Matrices, Quadratic forms, Constrained Optimization and SVD. | |
| **Case Study:**<br>Orthogonal Frequency Division Multiplexing (OFDM) system<br>SVD based image reconstruction | |

| **Unit – IV** | **Contact Hours = 8 Hours** |
|---|---|
| **Probability Theory:-** Review of basic probability theory. Definitions of random variables and probability distributions, probability mass and density functions, expectation, moments, central moments, characteristic functions, probability generating and moment generating functions illustrations. Poisson, Gaussian and Erlang distributions-examples. | |
| **Case Study:** Gaussian Mixture Models | |

| Unit – V | Contact Hours = 8 Hours |
|---|---|
| **Engineering Applications on Random Processes: -** Classification. Stationary, WSS and ergodic random process. Autocorrelation function-properties, Gaussian random process. | |
| **Case Study:** Optimum filtering Weiner Filtering. | |

| **Self-Study:** After the end of each unit, the students have to review minimum two research papers on any topic covered in the unit and submit the report. |
|---|

| Books | |
|---|---|
| | **Text Books:** |
| 1. | David C. Lay, "Linear Algebra and its Applications," 6th edition, Pearson Education (Asia) Pvt. Ltd, 2021. |
| 2. | S. L. Miller and D. C. Childers, "Probability and Random Processes with Application to Signal Processing and Communication", 2nd edition, Academic Press/ Elsevier 2012 and onwards |
| | **Reference Books:** |
| 1. | Gilbert Strang, "Linear Algebra and its Applications," 5th edition, Thomson Learning Asia, 2016 onwards. |
| 2. | A. Papoullis and S. U. Pillai, "Probability, Random Variables and Stochastic Processes", McGraw- Hill, 2002 and onwards. |
| 3. | Peyton Z. Peebles, "Probability, Random Variables and Random Signal Principles", 4th ed., TMH, 2007 and onwards. |
| | **E-resourses (NPTEL/SWAYAM.. Any Other)- mention links** |
| 1. | Prof. Aditya K. Jagannatham, Applied Linear Algebra for Signal Processing, Data Analytics and Machine Learning, IIT Kanpur, url:https://nptel.ac.in/courses/108104174 |

| Course delivery methods | | Assessment methods | |
|---|---|---|---|
| 1. | Chalk and Talk | 1. | IA tests |
| 2. | PPT and Videos | 2. | Online Quizzes (Surprise and Scheduled) |
| | | 3. | Open Book Tests (OBT) |
| | | 4. | Course Seminar |
| | | 5. | Semester End Examination |

**Course Outcome (COs)**

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

| | **Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create** | **Learning Level** | **PO(s)** | **PSO(s)** |
|---|---|---|---|---|
| 1. | Understand the advanced concepts in linear algebra and probability theory. | Un | 3 | 1 |
| 2. | Apply probability theory and linear algebra to model and solve dynamic systems. | Ap | 3 | 1 |
| 3. | Analyze the given system using linear algebraic and probabilistic tools. | An | 1,3 | 1,2 |

**Scheme of Continuous Internal Evaluation (CIE): Theory course**

| Components | Addition of two IA tests | Online Quiz | Addition of two OBAs | Course Seminar | Total Marks |
|---|---|---|---|---|---|
| Marks | 25+25 = 50 | 4* 5 marks = 20 | 10+10 =20 | 10 | 100 |

**OBA - Open Book Assignment**
**Minimum score to be eligible for SEE: 50 OUT OF 100**

| **Scheme of Semester End Examination (SEE):** | |
|---|---|
| 1. | It will be conducted for 100 marks of 3 hours duration. |
| 2. | **Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%. |
| 3. | Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C. |

| **CO-PO Mapping (Planned)** | | | | **CO-PSO Mapping (Planned)** | | |
|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PSO 1** | **PSO 2** | **PSO 3** |
| **1** | | | ✓ | ✓ | | |
| **2** | | | ✓ | ✓ | | |
| **3** | ✓ | | ✓ | ✓ | ✓ | |
| **Tick mark the CO, PO and PSO mapping** | | | | | | |

**Advanced Digital Signal Processing (Integrated)**

| | | | | | |
|---|---|---|---|---|---|
| **Course Code** | **22DCN12** | **Course type** | **IPCC** | **Credits L-T-P** | 3 - 0 - 1 |
| **Hours/week: L - T- P** | 3 - 0 - 2 | | | **Total credits** | 4 |
| **Total Contact Hours** | L = 40 Hrs; T = 0 Hrs; P = 20 Hrs<br>Total = 60 Hrs | | | **CIE Marks** | 100 |
| **Flipped Classes content** | 10 Hours | | | **SEE Marks** | 100 |

| **Course learning objectives** | |
|---|---|
| 1. | To review the fundamentals of discrete time systems. |
| 2. | To explore various single rate filter design. |
| 3. | To understand the basics of multirate systems. |
| 4. | To introduce the concepts of filter banks and transmultiplexers. |
| 5. | To explore maximally decimated filter banks and time frequency representations. |

**Required Knowledge of:** Digital Signal Processing

| **Unit – I** | **Contact Hours = 8 Hours** |
|---|---|
| **Review of Spectral Analysis of Discrete time Signals and Systems:**<br>**Review of Transforms:** DTFT, Z transforms, DFT computation using FFT.<br>**Introduction to real transforms:** DCT and DST.<br>**Frequency response analysis of discrete time systems:** Computing frequency response of a discrete time system for sinusoidal, sum of sinusoidal and complex exponential sequences. | |

| **Unit – II** | **Contact Hours = 8 Hours** |
|---|---|
| **Fixed Rate Filter Design and Realization:**<br>**IIR –** Butterworth and Chebyshev (Type – I) LPF, HPF and BPF filter design using bilinear transformation.<br>**FIR –** Filter design using frequency sampling technique.<br>**Realization:** State space realization of IIR and FIR filters. | |

| **Unit – III** | **Contact Hours = 8 Hours** |
|---|---|
| **Multirate Digital Signal Processing Fundamentals:**<br>Introduction, statement of the problem and definitions, analysis of down sampling and up sampling, sampling rate conversion by a rational factor, multi stage implementation of digital filters, efficient implementation of multirate systems, application of multirate DSP: analog to digital conversion, sampling frequency and quantization error. | |

| **Unit – IV** | **Contact Hours = 8 Hours** |
|---|---|
| **DFT Filter Banks and Transmultiplexers:**<br>Introduction, DFT filter banks, maximally decimated DFT filter banks and transmultiplexers, transmultiplexers, application of transmultiplexers to digital communications modulation. | |
| **Unit – V** | **Contact Hours = 8 Hours** |
| **Maximally Decimated Filter Banks:**<br>Introduction, vector spaces, two channel perfect reconstruction conditions, design of perfect reconstruction filter banks with real coefficients, lattice implementation of orthonormal filter banks, application to an audio signal. | |

| **Time frequency expansion:**<br>Short time Fourier Transform (STFT), Gabor Transform (GT), wavelet transforms. |
|---|

| S. No. | List of Experiments |
|---|---|
| 1. | Design and synthesis of Digital IIR filters:<br>a. LPF<br>b. HPF |
| 2. | Design and synthesis of Digital FIR filters.<br>a. LPF<br>b. HPF |
| 3. | Simulation of Up sampler. |
| 4. | Simulation of down sampler. |
| 5. | QMF Filter design. |
| 6. | Study of FFT analyzer for given application. |
| 7. | Demonstration of Adaptive Sub Band Speech Coding (ASBC) |
| 8. | Implementation of STFT applied to speech analysis. |

| Books | |
|---|---|
| | **Text Books:** |
| 1. | Roberto Cristi, “Modern Digital Signal Processing”, Thomson Brooks/Cole Publishers, 2004 onwards. |
| | **Reference Books:** |
| 1. | N. J. Fliege, “Multirate Digital Signal Processing”, John Wiley & Sons, USA,2000. |
| 2. | P. P. Vaidyanathan, “Multirate Systems and Filter Banks”, Pearson Education (Asia) Pte.Ltd, 2004. |
| 3. | Steven M. Kay, “Modern Spectral Estimation”, Pearson Education, First edition (2017) |

| Course delivery methods | | Assessment methods | |
|---|---|---|---|
| 1. | Chalk and Talk | 1. | IA tests |
| 2. | PPT and Videos | 2. | Open Book Assignments (OBA)/ Lab Project |
| 3. | Flipped Classes | 3. | Lab Test |
| 4. | Practice session/Demonstrations in Labs | 4. | Semester End Examination |
| 5. | Virtual Labs ( if present) | | |

**Course Outcome (COs)**

**Learning Levels:**

**Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create**

| At the end of the course, the student will be able to | | Learning Level | PO(s) | PSO(s) |
|---|---|---|---|---|
| 1. | Understand and apply suitable multirate signal processing technique for a given application. | Ap | 1,3 | 1,2 |
| 2. | Implement transmultiplexers and QMF filter banks for a given application. | Ap | 1,3 | 1,2 |
| 3. | Design and implement fixed and multirate filter banks and perform spectral analysis. | An | 1,3 | 1,2 |

**Scheme of Continuous Internal Evaluation (CIE):**

For integrated courses, a lab test also will be conducted at the end of the semester.

The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

| **THEORY (60 marks)** | | | **LAB (40 marks)** | | Total |
|---|---|---|---|---|---|
| IA test 1 | IA test 2 | Assignment (OA/Lab Project/ Industry assignment/Course Project) | Conduction | Lab test | |
| 25 marks | 25 marks | 10 marks | 15 marks | 25 marks | 100 marks |

**IA Test:**
1. No objective part in IA question paper
2. All questions descriptive

**Conduct of Lab:**
1. Conducting the experiment and journal: 5 marks
2. Calculations, results, graph, conclusion and Outcome: 5 marks
3. Viva voce: 5 marks

**Lab test: (Batchwise with 15 students/batch)**
1. Test will be conducted at the end of the semester
2. Timetable, Batch details and examiners will be declared by Exam section
3. Conducting the experiment and writing report: 5 marks
4. Calculations, results, graph and conclusion: 10 marks
5. Viva voce: 10 marks

**Eligibility for SEE:**
1. 50% and above (30 marks and above) in theory component
2. 50% and above (20 marks and above) in lab component
3. **Lab test is COMPULSORY**
4. Not eligible in any one of the two components will make the student **Not Eligible** for SEE

| **Scheme of Semester End Examination (SEE):** | |
|---|---|
| 1. | It will be conducted for 100 marks of 3 hours duration. |
| 2. | **Minimum marks required in SEE to pass:** Score should be ≥ 40% &, however overall score of CIE+SEE should be ≥ 50%. |
| 3. | Question paper contains three parts **A,B and C**. Students have to answer<br>1. From Part A answer any 5 questions each Question Carries 6 Marks.<br>2. From Part B answer any one full question from each unit and each Question Carries 10 Marks.<br>3. From Part C answer any one full question and each Question Carries 20 Marks. |

| **CO-PO Mapping (Planned)** | | | | **CO-PSO Mapping (Planned)** | | |
|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
| **1** | ✓ | | ✓ | ✓ | ✓ | |
| **2** | ✓ | | ✓ | ✓ | ✓ | |
| **3** | ✓ | | ✓ | ✓ | ✓ | |
| **Tick mark (✓) the CO, PO and PSO mapping** | | | | | | |

**Advanced Communication Networks**

| **Course Code** | **22DCN13** | **Course type** | **PCC** | **Credits L-T-P** | 4 – 0 – 0 |
|---|---|---|---|---|---|
| **Hours/week: L - T- P** | 4 – 0 – 0 | | | **Total credits** | 4 |
| **Total Contact Hours** | L = 50 Hrs; T = 0 Hrs; P = 0 Hrs<br>Total = 50 Hrs | | | **CIE Marks** | 100 |
| **Flipped Classes content** | 0 Hours | | | **SEE Marks** | 100 |

| **Course learning objectives** | |
|---|---|
| 1. | To overview depth in computer communication systems and networks topics that may have been covered at undergraduate level. |
| 2. | To introduce students to some of the latest systems and technologies, and how they are used today. |
| 3. | To discuss some of the key emerging systems and technologies, including research issues and challenges, and their impact on current and future systems. |
| 4. | To understand the impact of block chain technology and software defined networking in computer communication. |

**Pre-requisites:** Digital Communication, Information theory coding.

| **Unit – I** | **Contact Hours = 10 Hours** |
|---|---|
| **Foundation**: Overview Of Communication Networks And Internet, Nuts And Bolts Description, Services Description, Protocol Description, Network Edge, Access Networks, Network Core, Performance Parameters, Layered Architecture, Delay Tolerant Networks.<br><br>**Case study:** Implementing Network Software, IEEE 802.3 and 802.11 standards. | |

| **Unit – II** | **Contact Hours = 10 Hours** |
|---|---|
| **Internetworking-I**: Reliable Transmission, Stop-and-Wait, Sliding Window, Switching and Forwarding, Virtual Circuit Switching, Source Routing.<br>**Internetworking-II**: Datagram Forwarding in IP, IP addressing, IPv6, Datagram Fragmentation and Delays, ARP configuration, Numerical relevant to the topic.<br>**Case study:** Subnetting, Error Reporting (ICMP), Virtual Networks and Tunnels. | |

| **Unit – III** | **Contact Hours = 10 Hours** |
|---|---|
| **Resource Allocation in Networks:** Challenges, Taxonomy, Mismatch Multi Link Model And Evaluation Criteria. Quality Of Service, Application Requirements, Integrated Services (RSVP), Differentiated Services (EF, AF), Equation-Based Traffic Control.<br>**Networks Attacks**: Types, Firewall, Zone Based Firewall, Firewall Methodologies, HTTP Non-Persistent & Persistent Connection.<br>**Case study:** LZW (Lempel–Ziv–Welch) Compression technique. RC4 and RC5 Encryption Algorithm. | |

| **Unit – IV** | **Contact Hours = 10 Hours** |
|---|---|
| **Switches and Control Planes**: Evolution of Switches And Control Planes, Cost, SDN Implications For Research And Innovation, Data Center Innovation, Data Center Needs.<br>**Software Defined Networking**: Abstract, Fundamental Characteristics of SDN, SDN operation, SDN Devices, SDN Controller, SDN Applications. | |

| Unit – V | Contact Hours = 10 Hours |
|---|---|
| **Block chain Technology**: Origin of block chain technology, The birth of block chain, Revolutionizing the Traditional Business Network, Exploring a block chain application, Recognizing the key business benefits, Building trust with block chain, What Makes a Block chain Suitable for Business, Identifying Participants and Their Roles, Use of Block chain in Internet of Things.<br>**Case study:** Uses of Block chain for Network Engineers. | |

| Books | |
|---|---|
| | **Text Books:** |
| 1. | Larry Peterson and Bruce S Davis, "Computer Networks: A System Approach" 5th Edition, Elsevier, 2014. |
| 2. | Computer Networking: A Top-Down Approach Hardcover – by Kurose Ross. Student Edition, 26 April 2016. |
| 3. | Jean Wairand and Pravin Varaiya, "High Performance Communications Networks", 2nd edition, 2010. |
| | **Reference Books** |
| 1. | Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach" , Morgan Kaufman Publishers, 2004 |
| 2. | Manav Gupta, Blockchain For Dummies, IBM Limited Edition, John Wiley & Sons, Inc. |
| | **E- Resource** |
| 1. | https://www.blockchain-council.org/blockchain/uses-of-blockchain-for-network-engineers/ |
| 2. | Habib, G.; Sharma, S.; Ibrahim, S.; Ahmad, I.; Qureshi, S.; Ishfaq, M. Blockchain Technology: Benefits, Challenges, Applications, and Integration of Blockchain Technology with Cloud Computing. *Future Internet* 2022, *14*, 341. https://doi.org/10.3390/fi14110341 |

| Course delivery methods | | Assessment methods | |
|---|---|---|---|
| 1. | Chalk and Talk | 1. | IA tests |
| 2. | PPT and Videos | 2. | Online Quizzes (Surprise and Scheduled) |
| 3. | Flipped Classes | 3. | Open Book Tests (OBT) |
| 4. | Online classes | 4. | Course Seminar |
| | | 5. | Semester End Examination |

**Course Outcome (COs)**

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

| | **Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create** | **Learning Level** | **PO(s)** | **PSO(s)** |
|---|---|---|---|---|
| 1. | Identify and explain current technology trends for the implementation and deployment of communication network. | L2 | 1,2 | 1 |
| 2. | Design and develop protocols for reliable communication Networks | L3 | 1,2 | 1 |
| 3. | Design a network with appropriate protocols selected according to performance requirement. | L4 | 2,3 | 2 |
| 4. | Optimize the Network Design with use of block chain technology and software defined network. | L4 | 2,3 | 2 |

**Scheme of Continuous Internal Evaluation (CIE): Theory course**

| Components | Addition of two IA tests | Online Quiz | Addition of two OBAs | Course Seminar | Total Marks |
|---|---|---|---|---|---|
| Marks | 25+25 = 50 | 4* 5 marks = 20 | 10+10 =20 | 10 | 100 |
| **OBA - Open Book Assignment**<br>**Minimum score to be eligible for SEE: 50 OUT OF 100** | | | | | |

| **Scheme of Semester End Examination (SEE):** | |
|---|---|
| 1. | It will be conducted for 100 marks of 3 hours duration. |
| 2. | **Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%. |
| 3. | Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C. |

| **CO-PO Mapping (Planned)** | | | | **CO-PSO Mapping (Planned)** | | |
|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
| **1** | ✓ | ✓ | | ✓ | | |
| **2** | ✓ | ✓ | | ✓ | | |
| **3** | | ✓ | ✓ | | ✓ | |
| **4** | | ✓ | ✓ | | ✓ | |
| **Tick mark (✓) the CO, PO and PSO mapping** | | | | | | |

**Wireless Communication**

| | | | | | |
|---|---|---|---|---|---|
| **Course Code** | **22DCN14** | **Course type** | **PCC** | **Credits L-T-P** | 3 – 0 – 0 |
| **Hours/week: L - T- P** | 3 – 0 – 0 | | | **Total credits** | 3 |
| **Total Contact Hours** | L = 40 Hrs; T = 0 Hrs; P = 0 Hrs<br>Total = 40 Hrs | | | **CIE Marks** | 100 |
| **Flipped Classes content** | 10 Hours | | | **SEE Marks** | 100 |

| **Course learning objectives** | |
|---|---|
| 1. | To enable the student to understand the cellular concept and system design fundamentals |
| 2. | To enable the student to analyze large scale path loss |
| 3. | To enable the student to analyze small scale fading and multipath |
| 4. | To enable the student to choose different modulation techniques for wireless communication |
| 5. | To enable the student to understand advanced wireless communication techniques |

**Pre-requisites :** : 1. Analog Communication
2. Digital Communication

| **Unit – I** | **Contact Hours = 8 Hours** |
|---|---|
| **The Cellular Concept- System Design Fundamentals**<br>Introduction, Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Improving coverage and capacity in cellular systems. | |

| **Unit – II** | **Contact Hours = 8 Hours** |
|---|---|
| **Wireless Signal Propagation: Large Scale Path Loss**<br>Introduction, Free-space propagation model, Relating power to electric field, The three propagation mechanisms- Reflection, Diffraction, Scattering, Outdoor propagation models, Indoor propagation models. | |

| **Unit – III** | **Contact Hours = 8 Hours** |
|---|---|
| **Wireless Signal Propagation: Small-scale Fading and Multipath**<br>Small-scale multipath propagation, Impulse response model of a multipath channel, Small-scale multipath measurements, Parameters of mobile multipath channels, Types of small-scale fading, Rayleigh and Ricean distributions, Statistical models for multipath fading channels. | |

| **Unit – IV** | **Contact Hours = 8 Hours** |
|---|---|
| **Modulation Techniques for Wireless Communication**<br>Linear modulation techniques, Constant envelope modulation, Combined linear and constant envelope modulation, Spread spectrum modulation techniques, Multiple Access Techniques. | |

| **Unit – V** | **Contact Hours = 8 Hours** |
|---|---|
| **Advanced Wireless Communication Techniques**<br>Introduction to MIMO, OFDM, Wi-MAX, 4G-LTE, 5G – Basic concepts, types, advantages, disadvantages, applications. | |

**Flipped Classroom Details**

| Unit No. | I | II | III | IV | V |
|---|---|---|---|---|---|
| No. for Flipped Classroom Sessions | 1 | 1 | 1 | 1 | 1 |

| Books | |
|---|---|
| | **Text Books:** |
| 1. | Theodore S. Rappaport, Wireless Communications- Principles and Practice, Pearson, 2nd Ed, 2010. |
| 2. | Dr. Kamilo Feher, Wireless Digital Communications, PHI, 4th Ed, 2010. |
| | **Reference Books:** |
| 1. | Jochen Schiller, Mobile Communications, Pearson Education, 2nd Ed, 2004. |
| 2. | Vijay K. Garg, Wireless Communications and Networking, Elsevier, 1st Ed, 2008. |

| Course delivery methods | | Assessment methods | |
|---|---|---|---|
| 1. | Chalk and Talk | 1. | IA tests |
| 2. | PPT and Videos | 2. | Online Quizzes (Surprise and Scheduled) |
| 3. | Flipped Classes | 3. | Open Book Tests (OBT) |
| 4. | Online classes | 4. | Course Seminar |
| | | 5. | Semester End Examination |

**Course Outcome (COs)**

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

| **Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create** | | **Learning Level** | **PO(s)** | **PSO(s)** |
|---|---|---|---|---|
| 1. | **Understand** the cellular concept and system design fundamentals | Un | 3 | 1,2 |
| 2. | **Analyze** large scale path loss in wireless communication channel | An | 3 | 1,2 |
| 3. | **Analyze** small scale fading and multipath in wireless communication channel | An | 3 | 1,2 |
| 4. | **Choose** different modulation techniques for given applications in wireless communication | Ap | 1,3 | 1,2 |
| 5. | **Understand** advanced wireless communication techniques | Un | 3 | 1,2 |

**Scheme of Continuous Internal Evaluation (CIE): Theory course**

| Components | Addition of two IA tests | Online Quiz | Addition of two OBAs | Course Seminar | Total Marks |
|---|---|---|---|---|---|
| Marks | 25+25 = 50 | 4* 5 marks = 20 | 10+10 =20 | 10 | 100 |

**OBA - Open Book Assignment**
**Minimum score to be eligible for SEE: 50 OUT OF 100**

| **Scheme of Semester End Examination (SEE):** | |
|---|---|
| 1. | It will be conducted for 100 marks of 3 hours duration. |
| 2. | **Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%. |
| 3. | Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C. |

| CO-PO Mapping (Planned) | | | | CO-PSO Mapping (Planned) | | |
|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
| **1** | | | ✓ | ✓ | ✓ | |
| **2** | | | ✓ | ✓ | ✓ | |
| **3** | | | ✓ | ✓ | ✓ | |
| **4** | ✓ | | ✓ | ✓ | ✓ | |
| **5** | | | ✓ | ✓ | ✓ | |
| **Tick mark (✓) the CO, PO and PSO mapping** | | | | | | |

**Advanced Embedded System**

| | | | | | |
|---|---|---|---|---|---|
| **Course Code** | **22DCN15** | **Course type** | **PCC** | **Credits L-T-P** | 3 – 0 – 0 |
| **Hours/week: L - T- P** | 3 – 0 – 0 | | | **Total credits** | 3 |
| **Total Contact Hours** | L = 40 Hrs; T = 0 Hrs; P = 0 Hrs<br>Total = 40 Hrs | | | **CIE Marks** | 100 |
| **Flipped Classes content** | 10 Hours | | | **SEE Marks** | 100 |

| **Course learning objectives** | |
|---|---|
| 1. | To gain knowledge about ARM Cortex M series, popularly used in embedded systems as processing unit and other Embedded processors. |
| 2. | To study the hardware modules and software tools used in programming an embedded system |
| 3. | To study about device drivers needed for embedded systems and Real time communication |
| 4. | To study application areas of Embedded Systems |

| **Pre-requisites: Microcontrollers** |
|---|

| **Unit – I** | **Contact Hours = 8 Hours** |
|---|---|
| Embedded vs General computing system, classification, application and purpose of ES. Core of an Embedded System, Sensors, Actuators, Communication Interface.<br>**ARM-32 bit Microcontroller:** Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence | |

| **Unit – II** | **Contact Hours = 8 Hours** |
|---|---|
| **Hardware Modules**: Introduction: MC9S12XD family features, Modes of operation, functional block diagram, overview, programming model. Memory Map Overview of Pulse Width Modulator (PWM), On-chip ADC, Serial Communication. Memory Map Overview of Serial Communication Interface (SCI), Serial Peripheral Interface (SPI), Inter-Integrated Circuit (IIC), Controller Area Network (CAN)<br>**Case Study:** Code warrior IDE | |

| **Unit – III** | **Contact Hours = 8 Hours** |
|---|---|
| **Real Time Communication**: Examples of real-time communication in applications, basic concepts, Real-time communication in LAN, Soft Real-time communication in LAN, Hard Real-time communication in LAN, Bounded Access Protocol, Performance comparison, Real-time comparison over internet, Routing, Multicast routing, resource sharing, traffic shaping and policing, scheduling mechanisms, QOS models.<br>**Real Time Databases**: Example applications of real-time databases, Review of basic database concepts, real-time databases, characteristics of temporal data, concurrency control in real-time databases, commercial real-time databases. | |

| **Unit – IV** | **Contact Hours = 8 Hours** |
|---|---|
| **Linux Fundamentals & Device Driver Programming**<br>Linux Fundamentals, Linux Commands, VI Editors, Introduction to Device Driver, The Role of Device Driver, Kernel Module Vs Application, Types of Device Driver, Character Driver, Block Driver & Network Driver | |

| Unit – V | Contact Hours = 8 Hours |
|---|---|
| **Embedded System Applications**: Design multitasking Embedded System to simulate ATM machines, mirrors and sun-roofs, Central locking and Electric windows, Cruise control, Multimedia over IP, Airbags, Safety critical systems, Battery operated smartcard reader, Automated meter reading system<br>**Design Case Studies**: Prototype model of Dashboard, Lighting system, Power window prototype and Sun roof control using DC Motor, Climate control system prototype using temperature sensor. | |

**Flipped Classroom Details**

| Unit No. | I | II | III | IV | V |
|---|---|---|---|---|---|
| No. for Flipped Classroom Sessions | 2 | 2 | 2 | 2 | 2 |

| Books | |
|---|---|
| | **Text Books:** |
| 1. | James K. Peckol, "Embedded systems- A contemporary design tool", John Wiley, 2008**.** |
| 2. | ARM System on Chip Architecture by Steve Furber, Pearson Education. |
| 3. | David E. Simon An Embedded Software Primer, Pearson Education |
| 4. | Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education Private Limited, 2009 and onwards. |
| 5. | Raj Kamal, "Embedded Systems Architecture, programming and design", TMH, 2nd Edition, 2008 |
| 6. | Application module student learning kit featuring freescale MC9S12XDT512. |
| 7. | CodeWarrior Debugger IDE, NXP semiconductors. |
| 8. | Ross Dickson, Jason Andrews, Jacob Engblom, "Design Flow for Embedded System Device Driver Development and Verification". |
| 9. | Michael Opdenacker, "Embedded Linux kernel and driver development". |
| 10. | Rajib Mall, "Real-Time Systems: Theory and Practice," Pearson, 2008. |
| 11. | Krishna and Shin, "Real-Time Systems," Tata McGraw Hill. 1999. |

| Course delivery methods | | Assessment methods | |
|---|---|---|---|
| 1. | Chalk and Talk | 1. | IA tests |
| 2. | PPT and Videos | 2. | Online Quizzes (Surprise and Scheduled) |
| 3. | Flipped Classes | 3. | Open Book Tests (OBT) |
| 4. | Online classes | 4. | Course Seminar |
| | | 5. | Semester End Examination |

**Course Outcome (COs)**

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

| Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create | | Learning Level | PO(s) | PSO(s) |
|---|---|---|---|---|
| 1. | **Understand** the importance of embedded systems in real life. | Un | 1 | 2 |
| 2. | **Anlayze** the importance of cortex M series compared to other series in embedded systems | Ap | 2 | 2 |
| 3. | **Design and implement** the concepts of Hardware-Software co- | An | 1,3 | 1,2 |

| | | | | |
|---|---|---|---|---|
| | design to design an Embedded System. | | | |
| 4. | **Apply** the knowledge of device drivers for development of embedded systems | Ap | 2 | 2 |
| 5. | **Design** and simulate embedded systems for different application domains | Cr | 1,3 | 1,2 |

**Scheme of Continuous Internal Evaluation (CIE): Theory course**

| Components | Addition of two IA tests | Online Quiz | Addition of two OBAs | Course Seminar | Total Marks |
|---|---|---|---|---|---|
| Marks | 25+25 = 50 | 4* 5 marks = 20 | 10+10 =20 | 10 | 100 |
| **OBA - Open Book Assignment**<br>**Minimum score to be eligible for SEE: 50 OUT OF 100** | | | | | |

| **Scheme of Semester End Examination (SEE):** | |
|---|---|
| 1. | It will be conducted for 100 marks of 3 hours duration. |
| 2. | **Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%. |
| 3. | Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C. |

| **CO-PO Mapping (Planned)** | | | | **CO-PSO Mapping (Planned)** | | |
|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
| **1** | ✓ | | | | ✓ | |
| **2** | | ✓ | | | ✓ | |
| **3** | ✓ | | ✓ | ✓ | ✓ | |
| **4** | | ✓ | | | ✓ | |
| **5** | ✓ | | ✓ | ✓ | ✓ | ✓ |
| **Tick mark (✓) the CO, PO and PSO mapping** | | | | | | |

**Research Methodology and IPR**

| | | | | | |
|---|---|---|---|---|---|
| **Course Code** | 22DCN16 | **Course type** | MCC | **Credits L-T-P** | 3 – 0 – 0 |
| **Hours/week: L-T-P** | 3 – 0 – 0 | | | **Total credits** | 3 |
| **Total Contact Hours** | L = 40Hrs; T = 00 Hrs;P = 00Hrs<br>Total = 40Hrs | | | **CIE Marks** | 100 |
| **Flipped Classes content** | 00 Hrs | | | **SEE Marks** | 100 |

| **Course learning Objectives** | |
|---|---|
| 1. | Understand the basic concepts of research and its methodologies |
| 2. | Identify and select the appropriate research/sampling design methods. |
| 3. | Analyze and interpret the data to enable hypothesis testing |
| 4. | CreatetheawarenessaboutIntellectualPropertyRightsfortheprotectionofinventions. |

**Pre-requisites:** Probability &Statistics

| **Unit–I** | **8 Hours** |
|---|---|

**Research Methodology: Introduction**

Meaning, Objectives, types, Research Approaches. Significance of Research, Research Methods versus Methodology, Research and scientific method, research Process, Criteria of good research, Problems encountered by researchers.

**Research Problem:**

Defining a research problem, Selecting a research problem, necessity and techniques involved in defining the research problem.

| **Unit–II** | **8 Hours** |
|---|---|

**Research Design:**

Meaning, need for research design, features of a good design, important concepts relating to research design, different research designs, Basic principles of experimental designs, developing a research plan.

**Sampling design:**

Implications of a sample design, Steps in sample design, criteria of selecting a sampling procedure, characteristics of a good sample design, different types of sample designs, Random Sample and complex random sample designs.

| **Unit–III** | **8 Hours** |
|---|---|

**Data Collection Methods:**

Collection of Primary Data, Observation Method, Interview Method, Questionnaires, Schedules, Other Methods of Data Collection, Collection of Secondary Data, Case study method.

**Processing and Analysis of Data**

Processing operations, Elements/ types of analysis, Statistics in research- measures of central tendency or statistical averages, measures of dispersion, measures of asymmetry (skewness), measures of relationship, Simple regression analysis, Multiple correlation and regression, Partial correlation, Association in case of attributes,

| Unit– IV | 8 Hours |
|---|---|
| **Testing of hypotheses-** Basic concepts, procedure for hypothesis testing, flow diagram, Test of hypothesis, procedure for hypothesis testing, Hypothesis for means, difference between means, comparing two related samples, proportions, difference between proportions, comparing a variance to some hypothesized population variance, power of test,. **Chi-square test: χ2** test and their applications in research studies. **Analysis of variance:** Basic principles of ANOVA, ANOVA technique, setting up of analysis of variance table, one way, ANOVA, two way ANOVA, ANOVA in Latin square Design. | |

| Unit–V | 8 Hours |
|---|---|
| **Intellectual Property Rights – IPR-** Invention and Creativity- Intellectual Property-Importance and Protection of Intellectual Property Rights (IPRs)- A brief summary of: Patents, Copyrights, Trademarks, Industrial Designs-Integrated Circuits-Geographical Indications-Establishment of WIPO-Application and Procedures. Research ethics, Plagiarism, Prior art search. **Interpretation and Report Writing**: Meaning of interpretation, Why interpretation, Technique of interpretation, Precaution in interpretation, Significance of report writing, Different steps in writing report, Layout of the research report, Types of reports, Mechanics of writing research report. | |

| Self-Study Topics | |
|---|---|
| UnitNo. | **Topic description** |
| I | Significance of Research Methodology. |
| II | Implications of a sample design. |
| III | Other measures-Index numbers, Time series analysis. |
| IV | Limitations of test of hypothesis. |
| V | Precautions for writing research reports. |

| Books | |
|---|---|
| | **Text Books:** |
| 1. | C R. Kothari, Research Methodology, New Age International Publishers, 2nd edition, 2007. |
| | **Reference Books:** |
| 1. | Panneer Selvam, Research Methodology, PHI Learning Pvt. Ltd., 2007. |
| 2. | Dr. B.L. Wadhera -Intellectual Property Rights, Universal Law Publishing Co. Ltd.. 2002 |
| | William G Zikmund, Business Research Methods, Indian edition, South western Publishers, 8th Indian Reprint – 2009. |
| | |
| | **E-resourses (NPTEL/SWAYAM. Any Other)- mention links** |
| 1. | https://onlinecourses.swayam2.ac.in/cec20_ge37 (Research Methodology) |

| Course delivery methods | | Assessment methods | |
|---|---|---|---|
| 1. | Lecture and Board | 1. | Assignments and Open Book Assignments |
| 2. | NPTEL/ Edusat | 2. | Quizzes |
| 3. | PowerPoint Presentation | 3. | Internal Assessment Tests |
| 4. | Videos | 4. | Semester End Examination |

| Course Outcome (COs)<br>**Learning Levels:**<br>**Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create** | | | | |
|---|---|---|---|---|
| At the end of the course, the student will be able to | | **Learning Level** | **PO(s)** | **PSO(s)** |
| 1. | Identify and select an appropriate methodology for research. | Re | 1 | 1 |
| 2. | Design and Apply suitable research/sampling procedure for the research problem. | Ap | 1 | 1 |
| 3. | Analyze and interpret data collected & Evaluate various approaches for hypothesis testing. | An | 1,2,3 | 1,2,3 |
| 4. | Discuss the significance of Intellectual Property Rights & report writing | Ev | 1,2,3 | 2,3 |

**Scheme of Continuous Internal Evaluation (CIE): Theory course**

| Components | Addition of two IA tests | Addition of two OBAs | Course Seminar | Total Marks |
|---|---|---|---|---|
| Marks | 30+30= 60 | 10+10 =20 | 20 | 100 |
| **OBA - Open Book Assignment**<br>**Minimum score to be eligible for SEE: 50 OUT OF 100** | | | | |

| **Scheme of Semester End Examination (SEE):** | |
|---|---|
| 1. | It will be conducted for 100 marks of 3 hours duration. |
| 2. | **Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%. |
| 3. | Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C. |

| **CO-PO Mapping (Planned)** | | | | **CO-PSO Mapping(Planned)** | | |
|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
| **1** | ✔ | | | ✔ | | |
| **2** | ✔ | | | ✔ | | |
| **3** | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| **4** | ✔ | ✔ | ✔ | | ✔ | ✔ |
| **Tick mark the CO, PO and PSO mapping** | | | | | | |

## Communication Networks Laboratory

| Course Code | 22DCNL17 | Course type | PCCL | Credits L-T-P | 0 – 0 – 2 |
|---|---|---|---|---|---|
| Hours/week: L-T-P | 0 – 0 – 4 | | | Total credits | 2 |
| Total Contact Hours | L = 0 Hrs; T = 0 Hrs; P = 48 Hrs<br>Total = 48 Hrs | | | CIE Marks | 100 |
| | | | | SEE Marks | 100 |

| Course learning objectives | |
|---|---|
| 1. | To understand the working principle of various communication protocols. |
| 2. | To analyze the various routing algorithms. |
| 3. | To know the concept of data transfer between nodes. |
| 4. | To design small enterprise networks |

**Required Knowledge of:** Communication Engineering, Computer communication

| Topics to be covered | Contact Hours = 10 Hours |
|---|---|
| Types of networks: LAN, WAN, MAN and PAN. IP addressing, Introduction to NS2. Need to go for ns2 simulation, Sample code for ns2 basics. Installation and introduction of simulation tool packet tracer. Object explore, Node Configuration, interface types, channel selection, IP configuration. Introduction to Wire shark, Packet Capturing and Analyzing, Data packets on Wire shark, Wire shark filters. | |
| Orientation session on open ended experiment and course project | **Contact Hours = 02 Hours** |

**List of Experiments**

| No. of Experiments | Topic(s) related to Experiment |
|---|---|
| | **The following experiments shall be conducted using NS2/ NS3 Network Simulator** |
| 1. | Simulate a point-to-point network with N nodes and duplex links between them. |
| 2. | Implement extended service set in multiple node communication scenarios and determine the performance of the network with respect to transmission of packets. |
| 3. | Implement an enterprise network using N nodes and plot the congestion window. |
| 4. | Simulate mobile network with wireless LAN. |
| 5. | Implement network of N nodes with random delay and bandwidth. Using drop tail queue of 10, show the packet flow under i) Simplex link ii) Duplex links |
| | **The following experiments shall be conducted using wireshark/ Packet Tracer (analyzer tool/configure tool)** |
| 6. | Simulation of home/office LAN network using N nodes. |
| 7. | Design and Simulate the DHCP server configuration. |
| 8. | Design and simulate the IOT home automation application. |
| 9. | Simulate the soil sensing and control using IOT application. |
| 10. | Implement and simulate the Routing Information Protocol. |
| 11. | Implement and simulate the Border gateway routing protocol. |
| 12. | Open ended experiment: Implementation of Information exchange between moving vehicles. |

| **Books** | |
|---|---|
| | **Text Books:** |
| 1. | Larry Peterson and Bruce S Davis, "Computer Networks: A System Approach" 5th Edition, Elsevier, 2014. |
| | **E-resourses (NPTEL/SWAYAM. Any Other)- mention links** |
| 1. | https://onl.kmi.open.ac.uk/ |
| 2. | https://www.wireshark.org/ |
| 3. | https://www.isi.edu/nsnam/ns/ |

| **Course delivery methods** | | **Assessment methods** | |
|---|---|---|---|
| 1. | Chalk and Talk | 1. | IA tests |
| 2. | PPT and Videos | 2. | Open Book Assignments (OBA)/ Lab Project |
| 3. | Flipped Classes | 3. | Lab Test |
| 4. | Practice session/Demonstrations in Labs | 4. | Semester End Examination |
| 5. | Virtual Labs (if present) | | |

| Course Outcome (COs) | | | | |
|---|---|---|---|---|
| **Learning Levels:** **Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create** | | | | |
| At the end of the course, the student will be able to | | **Learning Level** | **PO(s)** | **PSO(s)** |
| 1. | Evaluate the performance of computer networks with n nodes. | Ev | 1,3 | 2 |
| 2. | Identify and explain current technology trends for the implementation and deployment of wireless network routing. | Ap | 1,3 | 2 |
| 3. | Design a network with appropriate protocols selected according to requirement. | An | 1,2 | 2 |
| 4. | Analyze performance of various communication protocols. | An | 1,2 | 2 |

**Lab CIE:**

| **IA** | **Journal submission** | **Conduction and Viva** | **Course Project** |
|---|---|---|---|
| 25 | 25 | 20+10 | 20 |
| **IA Test:**<br>1. No objective part in IA question paper<br>2. All questions are experiments. | | | |
| **Conduct of Lab:**<br>1. Lab IA: 25 marks<br>2. Lab Journal: 25 marks<br>3. Daily lab execution and viva (average): 30 marks<br>4. Submission of course project: 20 marks | | | |
| **Lab test: (Batchwise with 15 students/batch)**<br>1. Test will be conducted at the end of the semester<br>2. Conducting the experiment and writing report: 5 marks<br>3. Calculations, results, graph and conclusion: 10 marks<br>4. Viva voce: 10 marks | | | |
| **Eligibility for SEE:**<br>1. 50% and above (50 marks and above) | | | |

| **Scheme of Semester End Examination (SEE):** | |
|---|---|
| 1. | It will be conducted for 100 marks of 3 hours duration. |
| 2. | **Minimum marks required in SEE to pass: 40 out of 100** |
| 3. | Two questions will be asked and student should execute both. Exam includes quiz and viva voce. |

| **CO-PO Mapping (Planned)** | | | | **CO-PSO Mapping (Planned)** | | |
|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
| **1** | ✓ | | ✓ | | ✓ | |
| **2** | ✓ | | ✓ | | ✓ | |
| **3** | ✓ | ✓ | | | ✓ | |
| **4** | ✓ | ✓ | | | ✓ | |
| **Tick mark (✓) the CO, PO and PSO mapping** | | | | | | |

**Advanced Digital Communication**

| | | | | | |
|---|---|---|---|---|---|
| **Course Code** | 22DCN21 | **Course type** | PCC | **Credits L-T-P** | 3 – 0 – 0 |
| **Hours/week: L-T-P** | 3– 0– 0 | | | **Total credits** | 3 |
| **Total Contact Hours** | L = 40 Hrs; T = 0 Hrs; P = 0 Hrs<br>Total = 40 Hrs | | | **CIE Marks** | 100 |
| **Flipped Classes content** | 10Hrs | | | **SEE Marks** | 100 |

| **Course Learning Objectives (CLOs)** | |
|---|---|
| 1. | Understand the mathematical modeling of wired and wireless channels,<br>I-Q modulation and demodulation principles,Bit and carrier Synchronization. |
| 2. | To Study Equalization Techniques and types of adaptive equalizers used in Digital communication systems. |
| 3. | To know the importance of Block and Convolutional coded communication systems. |
| 4. | To Study the principles of Multicarrier Modulation systems. |
| 5. | To know the importance and future of Semantic Communications. |

**Pre-requisites: Digital Communication and Information Theory.**

| **Unit – I** | **8 Hours** |
|---|---|
| **Introduction mathematical models for communication channel:**<br>Communication channels and their characteristics, Mathematical models for communication channels. Introduction to Wireless channels Rayleigh and Rician channels, Mathematical models for wireless channels, Coherent and noncoherent communication systems,<br>Carrier Synchronization-Bit synchronization. $M^{th}$ power loop, I-Q modulation and demodulation, Importance of I-Q Carriers in digital communication. | |

| **Unit – II** | **8 Hours** |
|---|---|
| **Equalization Techniques:**<br>Why Equalizers are used in Communication, Types of Equalizers used in Digital communication, Linear Equalizer-Decision feedback equalization-Adaptive Equalization and Adaptive Equalization Algorithms. Self-recovering (Blind)equalizers. Block diagram of different types of adaptive Equalizers and their working. | |

| **Unit – III** | **8 Hours** |
|---|---|
| **Block and Convolutional Coded Digital Communication:**<br>Architecture and performance–Binary block codes; Modified Linear Block codes, Orthogonal; Biorthogonal; Trans orthogonal–Shannon's channel coding theorem; Channel capacity, Linear block codes; Reed-Muller codes – Space time block codes. Convolutional codes Representation of codes using Polynomial, State diagram, Tree diagram, and Trellis diagram. Decoding techniques using Maximum likelihood, Viterbi algorithm, Turbo Coding. | |

| Unit – IV | 8 Hours |
|---|---|
| **Multichannel, Multicarrier and OFDM Systems:** Multichannel Digital Communications in AWGN Channels**,** Binary Signals, M-ary Orthogonal Signals, Single -Carrier verses Multicarrier Modulation, OFDM, Modulation and Demodulation in an OFDM System, An FFT Algorithm Implementation of an OFDM system, Generation of sub-carriers using the IFFT algorithm. | |

| Unit – V | 8 Hours |
|---|---|
| **Introduction to Semantic Communication:** A 3-Level communication Model**,** Semantic Information source and Destination, Principles and challenges, Semantic Communication system for object recognition, Comparison of conventional and Semantic communication systems, Semantic Channel and Semantic Channel Capacity, Semantic Rate distortion and Information Bottleneck, The main components in a Semantic Communication system, Semantic OSI model, Semantic Noise, Text Semantic Similarity, Image Semantic Similarity, Speech Quality Measurement, Deep Learning Based Image compression, Semantic Communications for image/video transmission. | |

| **Unit No.** | **I** | **II** | **III** | **IV** | **V** |
|---|---|---|---|---|---|
| **No. for Flipped Classroom Sessions** | **2** | **2** | **2** | **2** | **2** |

| **Books** | |
|---|---|
| | **Text Books:** |
| 1. | Bernard Sklar, "Digital Communications", 2nd edition, Pearson Education, 2001. |
| 2. | John G. Proakis, "Digital Communication", 4th edition, Mc Graw Hill Publication, 2001. |
| 3. | IEEE Transactions on Semantic Communications. |
| | **Reference Books:** |
| 1. | Simon Haykin, "Digital communications", John Wiley and sons, 1998. |
| 2. | Shu Lin and Daniel J. Costello, "Error control coding", Pearson – Prentice Hall Publication, 2004. |

| **Course delivery methods** | | **Assessment methods** | |
|---|---|---|---|
| 1. | Chalk and Talk | 1. | IA tests |
| 2. | PPT and Videos | 2. | Online Quizzes (Surprise and Scheduled) |
| 3. | Flipped Classes | 3. | Open Book Tests (OBT) |
| 4. | Online classes | 4. | Course Seminar |
| | | 5. | Semester End Examination |

| Course Outcome (COs) | | | | |
|---|---|---|---|---|
| **Learning Levels:** **Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create** | | | | |
| At the end of the course, the student will be able to | | **Learning Level** | **PO(s)** | **PSO(s)** |
| 1. | Understand and apply mathematical modelling of channels and equalization techniques. | Ap | 1,3 | 1,2 |
| 2. | Apply various channel coding and multicarrier modulation techniques for effective utilization communication resources like bandwidth and power. | Ap | 1, 3 | 1,2 |
| 3. | Understand the limitations of existing digital communication systems and apply semantic communication techniques for error free and effective data transmission. | Ap | 1, 3 | 1,2 |

**Scheme of Continuous Internal Evaluation (CIE): Theory course**

| Components | Addition of two IA tests | Online Quiz | Addition of two OBAs | Course Seminar | Total Marks |
|---|---|---|---|---|---|
| Marks | 25+25 = 50 | 4* 5 marks = 20 | 10+10 =20 | 10 | 100 |
| **OBA - Open Book Assignment** **Minimum score to be eligible for SEE: 50 OUT OF 100** | | | | | |

| **Scheme of Semester End Examination (SEE):** | |
|---|---|
| 1. | It will be conducted for 100 marks of 3 hours duration. |
| 2. | **Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%. |
| 3. | Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C. |

| **CO-PO Mapping (Planned)** | | | | **CO-PSO Mapping (Planned)** | | |
|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
| **1** | ✓ | | ✓ | ✓ | ✓ | |
| **2** | ✓ | | ✓ | ✓ | ✓ | |
| **3** | ✓ | | ✓ | ✓ | ✓ | |
| **Tick mark (✓) the CO, PO and PSO mapping** | | | | | | |

**Antenna Theory and Design**

| Course Code | 22DCN22 | Course type | IPCC | Credits L-T-P | 3 – 0 – 2 |
|---|---|---|---|---|---|
| Hours/week: L - T- P | 3 – 0 – 2 | | | Total credits | 4 |
| Total Contact Hours | L = 40 Hrs; T = 0 Hrs; P = 20 Hrs<br>Total = 60 Hrs | | | CIE Marks | 100 |
| Flipped Classes content | Nil | | | SEE Marks | 100 |

| Course learning objectives | |
|---|---|
| 1. | To introduce important parameters of antenna and develop EM equations of dipole and loop. |
| 2. | To explore the arrays of antenna and array synthesis techniques. |
| 3. | To understand the operation of resonant and antennas and broadband antennas. |
| 4. | To introduce aperture antennas and computational electromagnetic techniques applied to antennas. |

**Pre-requisites:** Antenna basics

| Unit – I | Contact Hours = 8 Hours |
|---|---|
| **Definition and significance of important antenna parameters –** Antenna, Isotropic antenna, practical antenna, beam width, Directive gain and power gain, radiation resistance, antenna aperture, near and far field regions and polarization.<br>Derivation of EM field components of infinitesimal dipole and small loop antenna.<br>Comparison of field patterns, radiation resistance and directivity of dipole and loop antennas. | |

| Unit – II | Contact Hours = 8 Hours |
|---|---|
| **Arrays:** Array factor for linear arrays, uniformly excited equally spaced linear arrays, Pattern multiplication, Directivity of linear arrays, Nonuniformly excited equally spaced linear arrays, Mutual coupling.<br>**Antenna Synthesis:** Formulation of the synthesis problem, Synthesis principles, Line sources shaped beam synthesis, Linear array shaped beam synthesis, Fourier series, Woodward - Lawson sampling method, Comparison of shaped beam synthesis methods, low side lobe narrow main beam synthesis methods, Dolph Chebyshev linear array, Taylor line source method. | |
| **Self-study:** Use of antenna arrays in practical applications – Rhombic array, Multiple Unit Steerable Antenna (MUSA). | |

| Unit – III | Contact Hours = 8 Hours |
|---|---|
| **Resonant Antennas:** Wires and Patches, Dipole antenna, Yagi-Uda antennas, Micro-strip antenna.<br>**Broadband antennas:** Traveling wave antennas Helical antennas, Biconical antennas, Sleeve antennas, and Principles of frequency independent antennas, Spiral antennas, and Log - periodic antennas. | |

| Unit – IV | Contact Hours = 8 Hours |
|---|---|
| **Aperture antennas:** Techniques for evaluating gain, Reflector antennas- Parabolic reflector antenna principles, Axi-symmetric parabolic reflector antenna, Offset parabolic reflectors, Dual reflector antennas, Gain calculations for reflector antennas, Feed antennas for reflectors, Field representations, Matching the feed to the reflector, General feed model, Feed antennas used in practice. | |

| Unit – V | Contact Hours = 8 Hours |
|---|---|
| **CEM for antennas:** The method of moments: Introduction of the methods moments, Pocklington's integral equation, Integral equation and Kirchhoff's networking equations, Source modeling weighted residual formulations and computational consideration, Calculation of antenna and scatter characteristics. | |

| **Lab Experiments:** | |
|---|---|
| 1. | Measurement of directivity and gain of microstrip antennas:<br>a. Dipole<br>b. Patch |
| 2. | Design and Simulation of Dipole antenna and measurement of characteristics of the same. |
| 3. | Design and Simulation of Loop antenna and measurement of characteristics of the same. |
| 4. | Design and Simulation of Helical antenna and measurement of characteristics of the same. |
| 5. | Design and Simulation of Patch antenna and measurement of characteristics of the same. |
| 6. | Design and Simulation of N element linear array of dipole and loop – using array factor and principle of pattern multiplication. |
| 7. | Design and Simulation of NxN planar arrays of isotropic point sources. |
| 8. | Antenna array synthesis using Dolph Chebyshev method. |
| 9. | Design and simulation of an antenna for a given application. (open ended) |

| **Books** | |
|---|---|
| | **Text Books:** |
| 1. | Stutzman and Thiele, 'Antenna Theory and Design', John Wiley, 2nd Edition, 2010 |
| | **Reference Books:** |
| 1. | C. A. Balanis, 'Antenna Theory Analysis and Design', John Wiley, 2nd Edition, 2007 |
| 2. | J. D. Krauss, 'Antennas and Wave Propagation', McGraw Hill TMH, 4th Edition, 2010 |
| 3. | A. R. Harish, M. Sachidanada, 'Antennas and propagation', Pearson Education, 2015 |

| Course delivery methods | | Assessment methods | |
|---|---|---|---|
| 1. | Chalk and Talk | 1. | IA tests |
| 2. | PPT and Videos | 2. | Online Quizzes (Surprise and Scheduled) |
| 3. | Flipped Classes | 3. | Open Book Tests (OBT) |
| 4. | Online classes | 4. | Course Seminar |
| | | 5. | Semester End Examination |

| Course Outcome (COs)<br>At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.) | | | | |
|---|---|---|---|---|
| **Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create** | | **Learning Level** | **PO(s)** | **PSO(s)** |
| 1. | **Understand** the basic parameters of various types of antennas and computational electromagnetic techniques applied to antennas. | Un | 1,3 | 1 |
| 2. | **Design** various antennas for the specified application or for given design constraints. | Ap | 1,3 | 1,2 |
| 3. | **Analyze** the designed antenna for various performance parameters. | An | 1,3 | 1,2 |

**Scheme of Continuous Internal Evaluation (CIE):**

For integrated courses, a lab test also will be conducted at the end of the semester.

The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

| **THEORY (60 marks)** | | | **LAB (40 marks)** | | Total |
|---|---|---|---|---|---|
| IA test 1 | IA test 2 | Assignment (OA/Lab Project/ Industry assignment/Course Project) | Conduction | Lab test | |
| 25 marks | 25 marks | 10 marks | 15 marks | 25 marks | 100 marks |

**IA Test:**
1. No objective part in IA question paper
2. All questions descriptive

**Conduct of Lab:**
1. Conducting the experiment and journal: 5 marks
2. Calculations, results, graph, conclusion and Outcome: 5 marks
3. Viva voce: 5 marks

**Lab test: (Batchwise with 15 students/batch)**
1. Test will be conducted at the end of the semester
2. Timetable, Batch details and examiners will be declared by Exam section
3. Conducting the experiment and writing report: 5 marks
4. Calculations, results, graph and conclusion: 10 marks
5. Viva voce: 10 marks

**Eligibility for SEE:**
1. 50% and above (30 marks and above) in theory component
2. 50% and above (20 marks and above) in lab component
3. **Lab test is COMPULSORY**
4. Not eligible in any one of the two components will make the student **Not Eligible** for SEE

| **Scheme of Semester End Examination (SEE):** | |
|---|---|
| 1. | It will be conducted for 100 marks of 3 hours duration. |
| 2. | **Minimum marks required in SEE to pass:** Score should be ≥ 40% &, however overall score of CIE+SEE should be ≥ 50%. |
| 3. | Question paper contains three parts **A,B and C**. Students have to answer<br>1. From Part A answer any 5 questions each Question Carries 6 Marks.<br>2. From Part B answer any one full question from each unit and each Question Carries 10 Marks.<br>3. From Part C answer any one full question and each Question Carries 20 Marks. |

| CO-PO Mapping (Planned) | | | | CO-PSO Mapping (Planned) | | |
|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PSO 1** | **PSO 2** | **PSO 3** |
| **1** | ✓ | | ✓ | ✓ | | |
| **2** | ✓ | | ✓ | ✓ | ✓ | |
| **3** | ✓ | | ✓ | ✓ | ✓ | |
| **Tick mark the CO, PO and PSO mapping** | | | | | | |

**Soft Computing**

| Course Code | 22DCN231 | Course type | PEC | Credits L-T-P | 3 – 0 – 0 |
|---|---|---|---|---|---|
| Hours/week: L - T- P | 3 – 0 – 0 | | | Total credits | 3 |
| Total Contact Hours | L = 40 Hrs; T = 0 Hrs; P = 0 Hrs<br>Total = 40 Hrs | | | CIE Marks | 100 |
| Flipped Classes content | 0 Hours | | | SEE Marks | 100 |

| Course learning objectives | |
|---|---|
| 1. | Introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience. |
| 2. | Become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems. |
| 3. | Provide the mathematical background for carrying out the optimization associated with neural network learning. |
| 4. | Familiarize with genetic algorithms and other random search procedures useful while seeking global optimum in self-learning situations. |
| 5. | Study Elementary Search Advanced Search Techniques. |

| Pre-requisites: Linear Algebra and Probability theory. |
|---|

| Unit – I | Contact Hours = 8 Hours |
|---|---|
| **Introduction to Soft Computing:** What Fuzzy, Artificial Neural Networks, Evolutionary Search Strategies.<br>**Fuzzy Set Theory:** Crisp, Fuzzy Sets, Fuzzy Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Fuzzy Extension Principle.<br>**Fuzzy Logic:** Crisp, Fuzzy Logic Basics, Fuzzy Truth in Terms of Fuzzy Sets, Fuzzy Rules, Fuzzy Reasoning. | |

| Unit – II | Contact Hours = 8 Hours |
|---|---|
| **Fuzzy Inference Systems:** Introduction, Fuzzification of the Input Variables, Application of Fuzzy, Operators on the Antecedent Parts of the Rules, Evaluation of the Fuzzy Rules, Aggregation of Output Fuzzy Sets Across the Rules, Defuzzification of the Resultant Aggregate Fuzzy Set, Fuzzy Controllers. | |

| Unit – III | Contact Hours = 8 Hours |
|---|---|
| **Artificial Neural Networks:** Basic Concepts- Introduction, Computation in Terms of Patterns, The McCulloch–Pitts Neural Model, The Perceptron, Neural Network Architectures, Activation Functions, Learning by Neural Nets. | |

| Unit – IV | Contact Hours = 8 Hours |
|---|---|
| **Pattern Classifiers:** Ebb, Perceptrons, ADALINE, MADALINE.<br>**Pattern Associators:** Hopfield Networks, Bidirectional Associative Memory.<br>**Competitive Neural Nets:** Kohonen's Self-organizing Map (SOM), Learning Vector Quantization (LVQ), Adaptive Resonance Theory (ART).<br>**Backpropagation:** Multi-layer Feedforward Net, The Generalized Delta Rule, The Backpropagation Algorithm. | |

| Unit – V | Contact Hours = 8 Hours |
|---|---|
| **Elementary Search Techniques:** State Spaces, State Space Search, Exhaustive Search, Heuristic Search, Production Systems.<br>Strategies: Natural, Genetic Algorithms (Gas), Multi-objective Genetic Algorithms, Simulated Annealing. | |

| Books | |
|---|---|
| | **Text Books:** |
| 1. | Samir Roy and Udit Chakraborty, "Introduction to Soft Computing- Neuro-Fuzzy and Genetic Algorithms", Pearson, 2013 and onwards. |
| | **Reference Books:** |
| 1. | J. S. R. Jang, C. T. Sun and E. Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004 and onwards. |
| 2. | Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997 and onwards. |
| 3. | Davis E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989 and onwards. |
| 4. | S. Rajasekaran and G. A. V. Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003 and onwards. |
| 5. | R. Eberhart, P. Simpson, and R. Dobbins, "Computational Intelligence – PC Tools", AP Professional, Boston, 1996 and onwards. |

| Course delivery methods | | Assessment methods | |
|---|---|---|---|
| 1. | Chalk and Talk | 1. | IA tests |
| 2. | PPT and Videos | 2. | Online Quizzes (Surprise and Scheduled) |
| 3. | Flipped Classes | 3. | Open Book Tests (OBT) |
| 4. | Online classes | 4. | Course Seminar |
| | | 5. | Semester End Examination |

| Course Outcome (COs)<br>At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.) | | | | |
|---|---|---|---|---|
| **Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create** | | **Learning Level** | **PO(s)** | **PSO(s)** |
| 1. | Understand the pattern recognition techniques and apply to real time applications. | Ap | 1,3 | 1,2 |
| 2. | Develop fuzzy and neural network algorithms for pattern recognition applications. | Ap | 1,3 | 1,2 |
| 3. | Apply search technique algorithms in optimization of neuro/fuzzy models. | Ap | 1,3 | 1,2 |

**Scheme of Continuous Internal Evaluation (CIE): Theory course**

| Components | Addition of two IA tests | Online Quiz | Addition of two OBAs | Course Seminar | Total Marks |
|---|---|---|---|---|---|
| Marks | 25+25 = 50 | 4* 5 marks = 20 | 10+10 =20 | 10 | 100 |
| **OBA - Open Book Assignment**<br>**Minimum score to be eligible for SEE: 50 OUT OF 100** | | | | | |

| **Scheme of Semester End Examination (SEE):** | |
|---|---|
| 1. | It will be conducted for 100 marks of 3 hours duration. |
| 2. | **Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%. |
| 3. | Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C. |

| **CO-PO Mapping (Planned)** | | | | **CO-PSO Mapping (Planned)** | | |
|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
| **1** | ✓ | | ✓ | ✓ | ✓ | |
| **2** | ✓ | | ✓ | ✓ | ✓ | |
| **3** | ✓ | | ✓ | ✓ | ✓ | |
| **Tick mark (✓) the CO, PO and PSO mapping** | | | | | | |

**Advanced Multimedia Communication**

| **Course Code** | **22DCN232** | **Course type** | **PEC** | **Credits L-T-P** | 3 – 0 – 0 |
|---|---|---|---|---|---|
| **Hours/week: L - T- P** | 3 – 0 – 0 | | | **Total credits** | 3 |
| **Total Contact Hours** | L = 40 Hrs; T = 0 Hrs; P = 0 Hrs<br>Total = 40 Hrs | | | **CIE Marks** | 100 |
| **Flipped Classes content** | 0 Hours | | | **SEE Marks** | 100 |

| **Course learning objectives** | |
|---|---|
| 1. | Introduce basic concepts of multimedia communication. |
| 2. | Explore different image compression standards. |
| 3. | Understand the concepts of digital representation of audio. |
| 4. | Understand the importance of compression of video and audio for efficient transmission over band limited channel. |
| 5. | Explore applications of virtual reality in entertainment, business and education. |

**Pre-requisites :** Basics of Signals and Systems, Digital Signal Processing

| **Unit – I** | **Contact Hours = 8 Hours** |
|---|---|
| **Basics of Multimedia Technology:**<br>Computers, Communication and Entertainment: Multimedia -An introduction: Framework for multimedia systems; multimedia devices CD Audio. CD-ROM. CD-I: presentation devices and the user interface; multimedia presentation and authoring; professional development tools: LANs & multimedia. Internet, World Wide Web & Multimedia; distribution network ATM & ADSL; multimedia servers & databases: vector graphics; 3-D graphics programs; animation techniques; shading; anti -aliasing; morphing: video on demand. | |

| **Unit – II** | **Contact Hours = 8 Hours** |
|---|---|
| **Image Compression & Standards:**<br>Making still images: editing and capturing images; scanning images; computer color models: color palettes; vector drawing; 3 -D drawing and rendering; JPEG-objectives and architecture: JPEG-DCT encoding and quantization, JPEG statistical coding; JPEG predictive loss less coding; JPEG performance; Overview of other image file formats as GIF, TIFF. BMP. PNG etc. | |

| **Unit – III** | **Contact Hours = 8 Hours** |
|---|---|
| **Digital representation of sound:** time domain sampled representation; method of encoding the analog signals; sub-band coding; Fourier method: transmission of digital sound; digital audio signal processing; stereophonic & quadraphonic signal processing; editing sampled sound. | |

| Unit – IV | Contact Hours = 8 Hours |
|---|---|
| **MPEG Audio and Video compression standard**: brief survey of speech recognition and generation; audio synthesis; Musical Instrument Digital Interface (MIDI); digital video and image Compression; MPEG Motion video compression standard; DVI technology: time-based media representation and delivery. | |

| Unit – V | Contact Hours = 8 Hours |
|---|---|
| **Virtual Reality**<br>Applications of multimedia, Intelligent multimedia system, Desktop Virtual Reality (VR). VR operating System, Virtual environment displays and orientation tracking; visually coupled system requirements; intelligent VR software systems. Applications of environments in various fields viz. Entertainment. manufacturing. Business, education, etc. | |

| Books | |
|---|---|
| | **Text Books:** |
| 1. | John Villamil and Lois Molina, "Multimedia: An Introduction", Prentice Hall of India, 1997 onwards. |
| 2. | Jose Lozano, "Multimedia Sound & Video", Pearson, 1997 onwards. |
| | **Reference Books:** |
| 1. | John Villamil and Lois Molina, "Multimedia: Production. Planning and Delivery", Prentice Hall of India, 1997 onwards. |
| 2. | Sinclair, "Multimedia on the PC", BPB Publications, 2008 onwards |

| Course delivery methods | | Assessment methods | |
|---|---|---|---|
| 1. | Chalk and Talk | 1. | IA tests |
| 2. | PPT and Videos | 2. | Online Quizzes (Surprise and Scheduled) |
| 3. | Flipped Classes | 3. | Open Book Tests (OBT) |
| 4. | Online classes | 4. | Course Seminar |
| | | 5. | Semester End Examination |

**Course Outcome (COs)**

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

| **Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create** | | **Learning Level** | **PO(s)** | **PSO(s)** |
|---|---|---|---|---|
| 1. | Represent multimedia information by applying various compression techniques. | Ap | 1,3 | 1,2 |
| 2. | Apply audio and video compression standards to conserve bandwidth. | Ap | 1,3 | 1,2 |
| 3. | Apply virtual reality techniques to multimedia information. | Ap | 1,3 | 1,2 |

**Scheme of Continuous Internal Evaluation (CIE): Theory course**

| Components | Addition of two IA tests | Online Quiz | Addition of two OBAs | Course Seminar | Total Marks |
|---|---|---|---|---|---|
| Marks | 25+25 = 50 | 4* 5 marks = 20 | 10+10 =20 | 10 | 100 |
| **OBA - Open Book Assignment**<br>**Minimum score to be eligible for SEE: 50 OUT OF 100** | | | | | |

| **Scheme of Semester End Examination (SEE):** | |
|---|---|
| 1. | It will be conducted for 100 marks of 3 hours duration. |
| 2. | **Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%. |
| 3. | Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C. |

| **CO-PO Mapping (Planned)** | | | | **CO-PSO Mapping (Planned)** | | |
|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
| **1** | ✓ | | ✓ | ✓ | ✓ | |
| **2** | ✓ | | ✓ | ✓ | ✓ | |
| **3** | ✓ | | ✓ | ✓ | ✓ | |
| **Tick mark (✓) the CO, PO and PSO mapping** | | | | | | |

**Information Security**

| Course Code | 22DCN233 | Course type | PEC | Credits L-T-P | 3 – 0 – 0 |
|---|---|---|---|---|---|
| Hours/week: L - T- P | 3 – 0 – 0 | | | Total credits | 3 |
| Total Contact Hours | L = 40 Hrs; T = 0 Hrs; P = 0 Hrs<br>Total = 40 Hrs | | | CIE Marks | 100 |
| Flipped Classes content | 0 Hours | | | SEE Marks | 100 |

| Course learning objectives | |
|---|---|
| 1. | Explain the network security model. |
| 2. | Demonstrate use of various private and public key encryption techniques used in modern cryptosystems. |
| 3. | Explain the concept of digital signatures and authentication protocols. |
| 4. | Explain the concept of secured electronic transaction with web security considerations. |
| 5. | Analyze the security issues with Kerberos and E-mails. |

| Unit – I | Contact Hours = 8 Hours |
|---|---|
| **Introduction on Security**<br>Security Goals, Types of Attacks: Passive attack, active attack, attacks on confidentiality, attacks on Integrity and availability, Security services and mechanisms, Techniques: Cryptography, Steganography, Revision on Mathematics for Cryptography.<br>Case study: Any two watermarking techniques. | |

| Unit – II | Contact Hours = 8 Hours |
|---|---|
| **Symmetric & Asymmetric Key Algorithms**<br>Substitutional Ciphers, Transposition Ciphers, Stream and Block Ciphers, Data Encryption Standards (DES), Advanced Encryption Standard (AES), RC4, principle of asymmetric key algorithms, RSA Cryptosystem.<br>Case study: Elliptic curve cryptography. | |

| Unit – III | Contact Hours = 8 Hours |
|---|---|
| **Integrity, Authentication and Key Management**<br>Message Integrity, Hash functions: SHA, Digital signatures: Digital signature standards.<br>Authentication: Entity Authentication: Biometrics, Key management Techniques.<br>Case study: Any two Biometric authentication techniques. | |

| Unit – IV | Contact Hours = 8 Hours |
|---|---|
| **Network Security, Firewalls and Web Security**<br>Introduction on Firewalls, Types of Firewalls, Firewall Configuration and Limitation of Firewall. IP Security Overview, IP security Architecture, authentication Header, Security payload, security associations, Key Management. Web security requirement, secure sockets layer, transport layer security, secure electronic transaction, dual signature.<br>Case study: VoIP security. | |

| Unit – V | Contact Hours = 8 Hours |
|---|---|
| **Wireless Network Security**<br>Security Attack issues specific to Wireless systems: Worm hole, Tunneling, DoS. WEP for Wi-Fi network, Security for 4G networks: Secure Ad hoc Network, Secure Sensor Network.<br>Case study: Any two techniques for Ad hoc Network security. | |

| Books | |
|---|---|
| | **Text Books:** |
| 1. | Behrouz A. Fourouzan, "Cryptography and Network security" Tata McGraw- Hill, 2008 and onwards. |
| 2. | William Stallings, "Cryptography and Network security: principles and practice", 2nd Edition, Prentice Hall of India, New Delhi,2002 and onwards. |
| 3. | Atul Kahate, "Cryptography and Network security", 2nd Edition, Tata McGraw- Hill, 2008 and onwards. |
| 4. | R. K. Nichols and P.C. Lekkas, "Wireless Security". |
| 5. | H. Yang et al., Security in Mobile Ad Hoc Networks: Challenges and Solution, IEEE Wireless Communications, Feb. 2004. |

| Course delivery methods | | Assessment methods | |
|---|---|---|---|
| 1. | Chalk and Talk | 1. | IA tests |
| 2. | PPT and Videos | 2. | Online Quizzes (Surprise and Scheduled) |
| 3. | Flipped Classes | 3. | Open Book Tests (OBT) |
| 4. | Online classes | 4. | Course Seminar |
| | | 5. | Semester End Examination |

**Course Outcome (COs)**

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

| **Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create** | | **Learning Level** | **PO(s)** | **PSO(s)** |
|---|---|---|---|---|
| 1. | Apply the information security concepts for symmetric and asymmetric cryptographic applications. | Ap | 1,3 | 1,2 |
| 2. | Apply security algorithms for ensuring data integrity confidentiality and authentication. | Ap | 1,3 | 1,2 |
| 3. | Analyse security enhancement in various networks using firewalls and secure coding. | An | 1,3 | 1,2 |

**Scheme of Continuous Internal Evaluation (CIE): Theory course**

| Components | Addition of two IA tests | Online Quiz | Addition of two OBAs | Course Seminar | Total Marks |
|---|---|---|---|---|---|
| Marks | 25+25 = 50 | 4* 5 marks = 20 | 10+10 =20 | 10 | 100 |

**OBA - Open Book Assignment**
**Minimum score to be eligible for SEE: 50 OUT OF 100**

| **Scheme of Semester End Examination (SEE):** | |
|---|---|
| 1. | It will be conducted for 100 marks of 3 hours duration. |
| 2. | **Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%. |
| 3. | Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C. |

| **CO-PO Mapping (Planned)** | | | | **CO-PSO Mapping (Planned)** | | |
|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
| **1** | ✓ | | ✓ | ✓ | | |
| **2** | ✓ | | ✓ | ✓ | ✓ | |
| **3** | ✓ | | ✓ | ✓ | ✓ | |
| **Tick mark (✓) the CO, PO and PSO mapping** | | | | | | |

**Modelling Simulation and Analysis of Systems**

| **Course Code** | **22DCN234** | **Course type** | **PEC** | **Credits L-T-P** | 3 – 0 – 0 |
|---|---|---|---|---|---|
| **Hours/week: L - T- P** | 3 – 0 – 0 | | | **Total credits** | 3 |
| **Total Contact Hours** | L = 40 Hrs; T = 0 Hrs; P = 0 Hrs<br>Total = 40 Hrs | | | **CIE Marks** | 100 |
| **Flipped Classes content** | 0 Hours | | | **SEE Marks** | 100 |

| **Course learning objectives** | |
|---|---|
| 1. | Introduce fundamental concepts in mathematical modelling of a system. |
| 2. | Understand concept of lumped element modelling. |
| 3. | Explore the modeling of first and second order systems. |
| 4. | Analysis of systems in the frequency domain. |
| 5. | Study systems with feedback. |

**Pre-requisites:** Basic knowledge of Engineering Mathematics, Signals and Systems and Control Systems

| **Unit – I** | **Contact Hours = 8 Hours** |
|---|---|
| **Fundamental concepts in mathematical modeling:** Abstraction, linearity and superposition, balance and conservation laws and the system, boundary approach. | |

| **Unit – II** | **Contact Hours = 8 Hours** |
|---|---|
| **Lumped element modeling:** Mechanical Systems-Translational, rotational. Hydraulic systems. Thermal systems. RLC Electrical Systems. | |

| **Unit – III** | **Contact Hours = 8 Hours** |
|---|---|
| **Modeling of first order and second order systems:** Governing equations for free and forced responses, transient response specifications, experimental determination, Laplace transform. | |

| **Unit – IV** | **Contact Hours = 8 Hours** |
|---|---|
| **Time domain, frequency domain and state space:** Frequency response of Linear, Time invariant systems, frequency response of first order and second order systems, state space formulations of systems problems relating frequency response to pole location – transient response-poles and frequency response. | |

| **Unit – V** | **Contact Hours = 8 Hours** |
|---|---|
| **Feedback systems:** Systems with feedback – block diagrams – properties of feedback systems – relative stability-phase and gain margins. | |

| Books | |
|---|---|
| | **Text Books:** |
| 1. | Philip D Cha, James J Rosenberg and Clive L Dym, “Fundamentals of Modeling and Analyzing Engineering Systems”, Cambridge University, 2000. |
| 2. | Amalendu Mukherjee, Ranjit Karmakar, “Modeling and Simulation of engineering Systems through Bondgraphs”, Narosa, 2000. |
| | **Reference Books:** |
| 1. | Close Frederick, “Modeling and Analysis of Dynamic Systems”, Wiley. |
| 2. | Woods, Robert L., and Lawrence Kent L, “Modeling and Simulation of Dynamic Systems”, Prentice Hall, 1997. |

| Course delivery methods | | Assessment methods | |
|---|---|---|---|
| 1. | Chalk and Talk | 1. | IA tests |
| 2. | PPT and Videos | 2. | Online Quizzes (Surprise and Scheduled) |
| 3. | Flipped Classes | 3. | Open Book Tests (OBT) |
| 4. | Online classes | 4. | Course Seminar |
| | | 5. | Semester End Examination |

**Course Outcome (COs)**

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

| **Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create** | | **Learning Level** | **PO(s)** | **PSO(s)** |
|---|---|---|---|---|
| 1. | Demonstrating the fundamental concepts of mathematical modelling of physical systems. | Un | 1,3 | 1,2 |
| 2. | Application of lumped parameter modelling concepts for first and second order systems. | Ap | 1,3 | 1,2 |
| 3. | Application and time frequency analysis of feedback systems with differential equation and state variable modellling. | An | 1,3 | 1,2 |

**Scheme of Continuous Internal Evaluation (CIE): Theory course**

| Components | Addition of two IA tests | Online Quiz | Addition of two OBAs | Course Seminar | Total Marks |
|---|---|---|---|---|---|
| Marks | 25+25 = 50 | 4* 5 marks = 20 | 10+10 =20 | 10 | 100 |

**OBA - Open Book Assignment**
**Minimum score to be eligible for SEE: 50 OUT OF 100**

| Scheme of Semester End Examination (SEE): | |
|---|---|
| 1. | It will be conducted for 100 marks of 3 hours duration. |
| 2. | **Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%. |
| 3. | Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C. |

| CO-PO Mapping (Planned) | | | | CO-PSO Mapping (Planned) | | |
|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
| **1** | ✓ | | ✓ | ✓ | | |
| **2** | ✓ | | ✓ | ✓ | ✓ | |
| **3** | ✓ | | ✓ | ✓ | ✓ | |
| **Tick mark (✓) the CO, PO and PSO mapping** | | | | | | |

**Pattern Recognition and Classification**

| | | | | | |
|---|---|---|---|---|---|
| **Course Code** | **22DCN241** | **Course type** | **PEC** | **Credits L-T-P** | 3 – 0 – 0 |
| **Hours/week: L - T- P** | 3 – 0 – 0 | | | **Total credits** | 3 |
| **Total Contact Hours** | L = 40 Hrs; T = 0 Hrs; P = 0 Hrs<br>Total = 40 Hrs | | | **CIE Marks** | 100 |
| **Flipped Classes content** | 0 Hours | | | **SEE Marks** | 100 |

| **Course learning objectives** | |
|---|---|
| 1. | Provide knowledge of models, methods and tools used to solve regression, classification, feature selection and density estimation problems. |
| 2. | Provide knowledge of current research topics and issues in Pattern Recognition and Machine Learning. |
| 3. | Provide knowledge of learning and adaptation in supervised modes of learning. |
| 4. | Provide experience in conducting and presenting a literature review on a research topic. |

**Pre-requisites:** It is assumed the students have a working knowledge of calculus, linear algebra, and probability theory. It is also assumed the students have some experience in programming in a scientific computing environment.

| **Unit – I** | **Contact Hours = 8 Hours** |
|---|---|
| **Introduction to Pattern Recognition:**<br>Introduction to Pattern Recognition - Definitions, Datasets for Pattern Recognition, Different Paradigms of Pattern Recognition., Tree Classifiers - Decision Trees: CART, C4.5, ID3, Random Forests, Bayesian Decision Theory. | |

| **Unit – II** | **Contact Hours = 8 Hours** |
|---|---|
| **Parameter Estimation Methods:**<br>Maximum Likelihood Estimation (MLE), Maximum A Posteriori Estimation (MAP), Bayes Estimator for multivariate Gaussian density with unknown covariance matrices.<br>Sequential Pattern Recognition: Hidden Markov Models (HMM), Discrete HMM. | |

| **Unit – III** | **Contact Hours = 8 Hours** |
|---|---|
| **Dimensionality Reduction:**<br>Introduction to Data Reduction, Principal Component Analysis (PCA) – Its relation to Eigen Analysis. Fisher Discriminant Analysis (FDA) – Generalized Eigen Analysis. Dictionary Learning Methods – Sparse Coding. | |

| Unit – IV | Contact Hours = 8 Hours |
|---|---|
| **Classification Techniques:**<br>Introduction to Data Classification, Unsupervised classification methods: k Means and k Nearest Neighborhood, Supervised classification methods: Neural Networks, Support Vector Machine. | |

| Unit – V | Contact Hours = 8 Hours |
|---|---|
| **Applications of Pattern Recognition:**<br>Overview of applications of Pattern Recognition - Text Classification, Image Classification and Speech recognition and classification. | |

| Books | |
|---|---|
| | **Text Books:** |
| 1. | R. O. Duda, P. E. Hart and D. Stork, "Pattern Classification", (2nd. Edition), Wiley 2002, |
| 2. | C. Bishop, "Pattern Recognition and Machine Learning", Springer 2006. |
| | **Reference Books:** |
| 1. | S. Theodoris and K. Koutroumbas, "Pattern Recognition", 4th Edition, Academic Press 2009 onwards. |
| 2. | Simon Haykin, "Neural Networks and Learning Machines", 3rd Edition, Prentice Hall, 2008 onwards. |

| Course delivery methods | | Assessment methods | |
|---|---|---|---|
| 1. | Chalk and Talk | 1. | IA tests |
| 2. | PPT and Videos | 2. | Online Quizzes (Surprise and Scheduled) |
| 3. | Flipped Classes | 3. | Open Book Tests (OBT) |
| 4. | Online classes | 4. | Course Seminar |
| | | 5. | Semester End Examination |

**Course Outcome (COs)**

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

| | **Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create** | **Learning Level** | **PO(s)** | **PSO(s)** |
|---|---|---|---|---|
| 1. | Understand the role of information as a pattern and apply classification techniques to make decisions. | Ap | 1,3 | 1,2 |
| 2. | Apply dimension reduction techniques to reduce feature of any pattern to classify accurately. | Ap | 1,3 | 1,2 |
| 3. | Develop mathematical models for pattern analysis and classification. | Ap | 1,3 | 1,2 |

**Scheme of Continuous Internal Evaluation (CIE): Theory course**

| Components | Addition of two IA tests | Online Quiz | Addition of two OBAs | Course Seminar | Total Marks |
|---|---|---|---|---|---|
| Marks | 25+25 = 50 | 4* 5 marks = 20 | 10+10 =20 | 10 | 100 |
| **OBA - Open Book Assignment**<br>**Minimum score to be eligible for SEE: 50 OUT OF 100** | | | | | |

| **Scheme of Semester End Examination (SEE):** | |
|---|---|
| 1. | It will be conducted for 100 marks of 3 hours duration. |
| 2. | **Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%. |
| 3. | Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C. |

| **CO-PO Mapping (Planned)** | | | | **CO-PSO Mapping (Planned)** | | |
|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
| **1** | ✓ | | ✓ | ✓ | ✓ | |
| **2** | ✓ | | ✓ | ✓ | ✓ | |
| **3** | ✓ | | ✓ | ✓ | ✓ | |
| **Tick mark (✓) the CO, PO and PSO mapping** | | | | | | |

**Cyber Physical System**

| Course Code | 22DCN242 | Course type | PEC | Credits L-T-P | 3 – 0 – 0 |
|---|---|---|---|---|---|
| Hours/week: L - T- P | 3 – 0 – 0 | | | Total credits | 3 |
| Total Contact Hours | L = 40 Hrs; T = 0 Hrs; P = 0 Hrs<br>Total = 40 Hrs | | | CIE Marks | 100 |
| Flipped Classes content | 0 Hours | | | SEE Marks | 100 |

| Course learning objectives | |
|---|---|
| 1. | Understand the concept of cyber physical systems (CPS) and know the fundamentals |
| 2. | research challenges in this area. |
| 3. | Understand the networked interoperability in heterogeneous CPS systems. |
| 4. | Improving critical reading, presentation, and research skills. |

**Pre-requisites:** Background in embedded systems and computer networking is necessary.

| Unit – I | Contact Hours = 8 Hours |
|---|---|
| Introduction, Modeling Dynamic Behaviors, Basics of Discrete systems, Hybrid systems, Hierarchical State machines.<br>**Self-learning Topics:** Data flow and timed models of computation. | |

| Unit – II | Contact Hours = 8 Hours |
|---|---|
| Embedded processors, Types and parallelism, Memory Architecture, Technology Heirarchy and Models. | |

| Unit – III | Contact Hours = 8 Hours |
|---|---|
| I/O, I/O hardware, Sequential Software, Analog/Digital Interface, Multitasking, Imperative programs and threads, Processes and Message passing, Scheduling basics, Rate monotonic, Earliest Deadline first.<br>**Self-learning Topics**: Scheduling and Mutual Exclusion, Multiprocessor scheduling. | |

| Unit – IV | Contact Hours = 8 Hours |
|---|---|
| Invariants and temporal logic, linear temporal logic, equivalence and refinement, Models as specifications, Type equivalence and refinement. | |

| Unit – V | Contact Hours = 8 Hours |
|---|---|
| Open and closed systems, Reachability analysis, Abstraction in model checking, Quantitative analysis, Factors determining execution time, Execution time analysis. | |

| Books | |
|---|---|
| | **Text Books:** |
| 1. | E. A. Lee and S. A. Seshia, "Introduction to Embedded Systems - A Cyber-Physical Systems Approach", 1st Edition, 2014 and onwards. |
| 2. | Other readings for this course will be in the form of research papers which will be made available to students during course delivery. |

| Course delivery methods | | Assessment methods | |
|---|---|---|---|
| 1. | Chalk and Talk | 1. | IA tests |
| 2. | PPT and Videos | 2. | Online Quizzes (Surprise and Scheduled) |
| 3. | Flipped Classes | 3. | Open Book Tests (OBT) |
| 4. | Online classes | 4. | Course Seminar |
| | | 5. | Semester End Examination |

| **Course Outcome (COs)**<br>At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.) | | | | |
|---|---|---|---|---|
| **Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create** | | **Learning Level** | **PO(s)** | **PSO(s)** |
| 1. | Understand the networked interoperability in heterogeneous CPS. | Un | 1,3 | 1 |
| 2. | Appy system-modeling techniques and timed automata to CPS system design. | Ap | 1,3 | 1,2 |
| 3. | Analyze hardware and OS capabilities in CPS. | Ap | 1,3 | 1,2 |

**Scheme of Continuous Internal Evaluation (CIE): Theory course**

| Components | Addition of two IA tests | Online Quiz | Addition of two OBAs | Course Seminar | Total Marks |
|---|---|---|---|---|---|
| Marks | 25+25 = 50 | 4* 5 marks = 20 | 10+10 =20 | 10 | 100 |
| **OBA - Open Book Assignment**<br>**Minimum score to be eligible for SEE: 50 OUT OF 100** | | | | | |

| **Scheme of Semester End Examination (SEE):** | |
|---|---|
| 1. | It will be conducted for 100 marks of 3 hours duration. |
| 2. | **Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%. |
| 3. | Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C. |

| CO-PO Mapping (Planned) | | | | CO-PSO Mapping (Planned) | | |
|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
| **1** | ✓ | | ✓ | ✓ | | |
| **2** | ✓ | | ✓ | ✓ | ✓ | |
| **3** | ✓ | | ✓ | ✓ | ✓ | |
| **Tick mark (✓) the CO, PO and PSO mapping** | | | | | | |

**Optical Networks**

| **Course Code** | **22DCN243** | **Course type** | **PEC** | **Credits L-T-P** | 3 – 0 – 0 |
|---|---|---|---|---|---|
| **Hours/week: L - T- P** | 3 – 0 – 0 | | | **Total credits** | 3 |
| **Total Contact Hours** | L = 40 Hrs; T = 0 Hrs; P = 0 Hrs<br>Total = 40 Hrs | | | **CIE Marks** | 100 |
| **Flipped Classes content** | 0 Hours | | | **SEE Marks** | 100 |

| **Course learning objectives** | |
|---|---|
| 1. | Learn the basic elements of optical fiber transmission link, fiber modes configurations and structures. |
| 2. | Understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors. |
| 3. | Learn the various optical source materials, LED structures, quantum efficiency, Laser diodes. |
| 4. | Learn the fiber optical network components, variety of networking aspects, FDDI, SONET/SDH and operational principles of WDM. |
| 5. | Acquire knowledge about fault and congestion management. |

**Pre-requisites:** Optic Fiber Communication and Computer Communication Networks

| **Unit – I** | **Contact Hours = 8 Hours** |
|---|---|
| **Client Layers of the Optical Layer:** SONET/SDH: Multiplexing, CAT and LCAS, Sonnet/SDH Layers, SONET Frame Structure, SONET/SDH Physical Layer, Elements of a SONET/SDH Infrastructure.<br>**Optical Transport Network:** Hierarchy, Frame Structure, Multiplexing, Generic Framing **Procedure**<br>**Ethernet:** Frame Structure, Switches, Ethernet Physical Layer, Carrier Transport IP: Routing and Forwarding, Quality of Service.<br>**Multiprotocol Label Switching:** Labels and Forwarding, Quality of Service, Signaling and Routing, Carrier Transport, Resilient Packet Ring: Quality of Service, Node Structure, Fairness**.**<br>**Storage-Area Networks:** Fiber Channel. | |

| **Unit – II** | **Contact Hours = 8 Hours** |
|---|---|
| **WDM Network Elements:** Optical Line Terminals, Optical Line Amplifiers, Optical Add/Drop Multiplexers: OADM Architectures, Reconfigurable OADMs Optical Cross connects: All-Optical OXC Configurations. | |

| **Unit – III** | **Contact Hours = 8 Hours** |
|---|---|
| **Control and Management Network Management Functions:** Management Framework, Information Model, Management Protocols. Optical Layer Services and Interfacing, Layers within the Optical Layer, Multivendor Interoperability.<br>**Performance and Fault Management:** The Impact of Transparency, BER measurement, Optical | |

Trace, Alarm Management, Data Communication Network (DCN) and Signaling, Policing, Optical Layer Overhead, Client Layers.
**Configuration Management:** Equipment Management, Connection Management, Adaptation Management. Optical Safety: Open Fiber Control Protocol.

| **Unit – IV** | **Contact Hours = 8 Hours** |
|---|---|
| **Protection in SONET/SDH:** Point-to-Point Links, Self-Healing Rings, Unidirectional Line-Switched Rings, Bidirectional Line-Switched Rings, Ring Interconnection and Dual Homing, Protection in the Client Layer: Protection in Resilient Packet Rings, Protection in Ethernet, Protection in IP, Protection in MPLS, Why Optical Layer Protection: Service Classes Based on Protection. Optical Layer Protection Schemes: 1+1 OMS Protection, 1:1 OMS Protection, OMS-DPRing, OMS-SPRing, 1:N Transponder Protection, 1+1 OCh Dedicated Protection, OCh-SPRing, OCH-Mesh Protection, GMPLS Protection, Interworking between Layers. | |

| **Unit – V** | **Contact Hours = 8 Hours** |
|---|---|
| **WDM Network Design:** Cost Trade-OFFS: A Detailed Ring Network Example LTD and RWA Problems, Light path Topology Design, Routing and Wavelength Assignment, Wavelength Conversion. Dimensioning Wavelength- Routing Networks, Statistical Dimensioning Models: First-Passage Model, Blocking Model, Maximum Load Dimensioning Models: Offline Light Path Requests, Online RWA in Rings. | |

| **Books** | |
|---|---|
| | **Text Books:** |
| 1. | Rajeev Ramaswamy, Kumar N Sivarajan and Galen H Sasaki, “Optical Networks”, Elsevier Publication 3rd Edn. (onwards), 2009. |
| | **Reference Books:** |
| 1. | Uyless Black, “Optical Networks-Third generation transport system”, Pearson, 2013 and onwards. |

| **Course delivery methods** | | **Assessment methods** | |
|---|---|---|---|
| 1. | Chalk and Talk | 1. | IA tests |
| 2. | PPT and Videos | 2. | Online Quizzes (Surprise and Scheduled) |
| 3. | Flipped Classes | 3. | Open Book Tests (OBT) |
| 4. | Online classes | 4. | Course Seminar |
| | | 5. | Semester End Examination |

**Course Outcome (COs)**

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

| | **Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create** | **Learning Level** | **PO(s)** | **PSO(s)** |
|---|---|---|---|---|
| 1. | Understand the architecture of SONET/SDH in optical networks. | Un | 1,3 | 1 |
| 2. | Apply WDMs in optical network for appropriate utilization of network resources. | Ap | 1,3 | 1,2 |
| 3. | Apply secured algorithms to protect data over SONET/SDH optical networks. | Ap | 1,3 | 1,2 |

**Scheme of Continuous Internal Evaluation (CIE): Theory course**

| Components | Addition of two IA tests | Online Quiz | Addition of two OBAs | Course Seminar | Total Marks |
|---|---|---|---|---|---|
| Marks | 25+25 = 50 | 4* 5 marks = 20 | 10+10 =20 | 10 | 100 |
| **OBA - Open Book Assignment**<br>**Minimum score to be eligible for SEE: 50 OUT OF 100** | | | | | |

| **Scheme of Semester End Examination (SEE):** | |
|---|---|
| 1. | It will be conducted for 100 marks of 3 hours duration. |
| 2. | **Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%. |
| 3. | Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C. |

| **CO-PO Mapping (Planned)** | | | | **CO-PSO Mapping (Planned)** | | |
|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
| **1** | ✓ | | ✓ | ✓ | | |
| **2** | ✓ | | ✓ | ✓ | ✓ | |
| **3** | ✓ | | ✓ | ✓ | ✓ | |
| **Tick mark (✓) the CO, PO and PSO mapping** | | | | | | |

**Statistical Signal Processing**

| | | | | | |
|---|---|---|---|---|---|
| **Course Code** | **22DCN244** | **Course type** | **PEC** | **Credits L-T-P** | 3 – 0 – 0 |
| **Hours/week: L - T- P** | 3 – 0 – 0 | | | **Total credits** | 3 |
| **Total Contact Hours** | L = 40 Hrs; T = 0 Hrs; P = 0 Hrs<br>Total = 40 Hrs | | | **CIE Marks** | 100 |
| **Flipped Classes content** | 0 Hours | | | **SEE Marks** | 100 |

| **Course learning objectives** | |
|---|---|
| 1. | Study the statistical modelling techniques for modelling real-world signals and systems. |
| 2. | Understand the spectrum estimation and optimal filtering techniques. |
| 3. | Study the concepts of adaptive filtering and array processing with applied to real-world signals and systems. |

**Pre-requisites:** Basic knowledge of Advanced Engineering Mathematics, Signals and Systems and Digital Signal Processing is required.

| **Unit – I** | **Contact Hours = 8 Hours** |
|---|---|
| **Random Processes:** Random variables, random processes, white noise, filtering random processes, spectral factorization, ARMA, AR and MA processes (Text 1). | |

| **Unit – II** | **Contact Hours = 8 Hours** |
|---|---|
| **Signal Modeling:** Least squares method, Padé approximation, Prony's method, finite data records, stochastic models, Levinson-Durbin recursion; Schur recursion; Levinson recursion (Text 1). | |

| **Unit – III** | **Contact Hours = 8 Hours** |
|---|---|
| **Spectrum Estimation:** Nonparametric methods, minimum-variance spectrum estimation, maximum entropy method, parametric methods, frequency estimation, principal components spectrum estimation (Text 1). | |

| **Unit – IV** | **Contact Hours = 8 Hours** |
|---|---|
| **Optimal and Adaptive Filtering:** FIR and IIR Wiener filters, Discrete Kalman filter, FIR Adaptive filters: Steepest descent, LMS, LMS-based algorithms (Text 1). | |

| **Unit – V** | **Contact Hours = 8 Hours** |
|---|---|
| **Array Processing:** Array fundamentals, beam-forming, optimum array processing, performance considerations, adaptive beamforming, linearly constrained minimum-variance beam-formers, side-lobe cancellers (Text 2). | |

| Books | |
|---|---|
| | **Text Books:** |
| 1. | Monson H Hayes, 'Statistical Digital Signal Processing and Modeling', John Wiley & Sons (Asia) Pvt. Ltd., 2002. |
| 2. | Dimitris G. Manolakis, Vinay K. Ingle, and Stephen M. Kogon, 'Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering and Array Processing', McGraw Hill International Edition, 2000. |

| Course delivery methods | | Assessment methods | |
|---|---|---|---|
| 1. | Chalk and Talk | 1. | IA tests |
| 2. | PPT and Videos | 2. | Online Quizzes (Surprise and Scheduled) |
| 3. | Flipped Classes | 3. | Open Book Tests (OBT) |
| 4. | Online classes | 4. | Course Seminar |
| | | 5. | Semester End Examination |

**Course Outcome (COs)**

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

| **Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create** | | **Learning Level** | **PO(s)** | **PSO(s)** |
|---|---|---|---|---|
| 1. | Apply the concepts of random processes for the modelling of signals and systems. | Ap | 1,3 | 1,2 |
| 2. | Apply various spectrum estimation techniques for the spectral analysis of real-world signals. | Ap | 1,3 | 1,2 |
| 3. | Apply optimal filtering and array processing techniques for analysis of real-world signals. | Ap | 1,3 | 1,2 |

**Scheme of Continuous Internal Evaluation (CIE): Theory course**

| Components | Addition of two IA tests | Online Quiz | Addition of two OBAs | Course Seminar | Total Marks |
|---|---|---|---|---|---|
| Marks | 25+25 = 50 | 4* 5 marks = 20 | 10+10 =20 | 10 | 100 |
| **OBA - Open Book Assignment**<br>**Minimum score to be eligible for SEE: 50 OUT OF 100** | | | | | |

| **Scheme of Semester End Examination (SEE):** | |
|---|---|
| 1. | It will be conducted for 100 marks of 3 hours duration. |
| 2. | **Minimum marks required in SEE to pass:** Score should be $\geq$ 40%, however overall score of CIE + SEE should be $\geq$ 50%. |
| 3. | Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C. |

| CO-PO Mapping (Planned) | | | | CO-PSO Mapping (Planned) | | |
|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
| **1** | ✓ | | ✓ | ✓ | ✓ | |
| **2** | ✓ | | ✓ | ✓ | ✓ | |
| **3** | ✓ | | ✓ | ✓ | ✓ | |
| **Tick mark (✓) the CO, PO and PSO mapping** | | | | | | |

## Advanced Communication laboratory

| Course Code | 22DCNL26 | Course type | PCCL | Credits L-T-P | 0 – 0 – 2 |
|---|---|---|---|---|---|
| Hours/week: L - T- P | 0 – 0 – 4 | | | Total credits | 2 |
| Total Contact Hours | L = 0Hrs; T = 0 Hrs; P = 48 Hrs<br>Total = 48 Hrs | | | CIE Marks | 100 |
| Flipped Classes content | Nil | | | SEE Marks | 100 |

| Course learning objectives | |
|---|---|
| 1. | To study the effect of SNR variation on BER. |
| 2. | To study the use of channel equalizers in digital communication. |
| 3. | To know the importance of adaptive signal processing applied to digital communication systems. |

| **Required Knowledge of:** Digital Communication, Information Theory and Coding and Digital Signal Processing. |
|---|

| Topics to be covered | Contact Hours = 10 Hours |
|---|---|
| **Review of RF digital modulation techniques –** ASK, FSK, PSK and QPSK, effect ISI, Probability of error, Bit error rate.<br>Significance of Signal constellation, Effect of SNR on BER. Introduction to communication tool box and useful commands.<br>Introduction to Rayleigh distribution, Rayleigh channel modelling, Rayleigh fading.<br>Gaussian distribution and AWGN channel Modelling.<br>Introduction to equalizers, adaptive equalizers, types – ZFE and MMSE.<br>Introduction to adaptive signal processing, adaptive systems, basic applications, introduction to LMS algorithm, significance of learning curve. | |
| Orientation session on open ended experiment and course project | **Contact Hours = 02 Hours** |

### List of Experiments

| Expt. No. | Topic(s) related to Experiment |
|---|---|
| 1. | To study the effect of ISI in Amplitude Shift Keying using Signal Constellation and to analyze the effect of SNR variation on error probability. |
| 2. | To study the effect of ISI in Frequency Shift Keying using Signal Constellation and to analyze the effect of SNR variation on error probability. |
| 3. | To study the effect of ISI in Phase Shift Keying using Signal Constellation and to analyze the effect of SNR variation on error probability. |
| 4. | To study the effect of ISI in Quadrature Phase Shift Keying (QPSK) using Signal Constellation and to analyze the effect of SNR variation on error Probability. |
| 5. | To study the effect of BER against SNR for QPSK modulation in Rayleigh fading channel & AWGN channel. |
| 6. | To study the effect of BER against SNR for M-ary QAM with Rayleigh fading channel & AWGN channel. |

| | |
|---|---|
| 7. | To study the effect of BER against SNR for BPSK Modulation with ZFE Equalizer In 3 Tap ISI Channel. |
| 8. | To study the effect of BER against SNR for BPSK modulation with Minimum Mean Square Error (MMSE) equalization in 3 tap ISI channels. |
| 9. | Comparative analysis of BER for BPSK modulation in 3 tap ISI channels with ZFE and MMSE Equalization. |
| 10. | To study the performance of Least Mean Square (LMS) Algorithm for adaptive filtering applications. |

| **Books** | |
|---|---|
| | **Text Books:** |
| 1. | Bernard Sklar, "Digital Communications", 2nd edition, Pearson Education, 2001. |
| 2. | John G. Proakis, "Digital Communication", 4th edition, Mc Graw Hill Publication, 2001. |
| | **Reference Books:** |
| 1. | Simon Haykin, "Digital communications", John Wiley and sons, 1998. |
| 2. | Shu Lin and Daniel J. Costello, "Error control coding", Pearson – Prentice Hall Publication, 2004. |

| **Course delivery methods** | | **Assessment methods** | |
|---|---|---|---|
| 1. | Chalk and Talk | 1. | IA tests |
| 2. | PPT and Videos | 2. | Open Book Assignments (OBA)/ Lab Project |
| 3. | Flipped Classes | 3. | Lab Test |
| 4. | Practice session/Demonstrations in Labs | 4. | Semester End Examination |
| 5. | Virtual Labs ( if present) | | |

**Course Outcome (COs)**

**Learning Levels:**

**Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create**

| At the end of the course, the student will be able to | | **Learning Level** | **PO(s)** | **PSO(s)** |
|---|---|---|---|---|
| 1. | **Apply** the various RF digital modulation and equalization techniques. | Ap | 1,3 | 1,2 |
| 2. | **Apply** LMS algorithms for adaptive filtering applications. | Ap | 1,3 | 1,2 |
| 3. | **Analyze** channel performance in terms of SNR and BER variation. | An | 1,3 | 1,2 |

**Scheme of Continuous Internal Evaluation (CIE):**

**Lab CIE:**

| **IA** | **Journal submission** | **Conduction and Viva** | **Course Project** |
|---|---|---|---|
| 25 | 25 | 20+10 | 20 |
| **IA Test:**<br>1. No objective part in IA question paper<br>2. All questions are experiments. | | | |
| **Conduct of Lab:** | | | |

| |
|---|
| 1. Lab IA: 25 marks<br>2. Lab Journal: 25 marks<br>3. Daily lab execution and viva (average): 30 marks<br>4. Submission of course project: 20 marks |
| **Lab test: (Batchwise with 15 students/batch)**<br>1. Test will be conducted at the end of the semester<br>2. Conducting the experiment and writing report: 5 marks<br>3. Calculations, results, graph and conclusion: 10 marks<br>4. Viva voce: 10 marks |
| **Eligibility for SEE:**<br>1. 50% and above (50 marks and above) |

| **Scheme of Semester End Examination (SEE):** | |
|---|---|
| 1. | It will be conducted for 100 marks of 3 hours duration. |
| 2. | **Minimum marks required in SEE to pass: 40 out of 100** |
| 3. | Two questions will be asked and student should execute both. Exam includes quiz and viva voce. |

| **CO-PO Mapping (Planned)** | | | | **CO-PSO Mapping (Planned)** | | |
|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
| **1** | ✓ | | ✓ | ✓ | ✓ | |
| **2** | ✓ | | ✓ | ✓ | ✓ | |
| **3** | ✓ | | ✓ | ✓ | ✓ | |
| **Tick mark (✓) the CO, PO and PSO mapping** | | | | | | |