# SIDDAGANGA INSTITUTE OF TECHNOLOGY

## *DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING*

**SCHEME & SYLLABUS**

**OF**

**V & VI SEMESTER**

**B.E.**

**Electronics & Telecommunication Engg.**

**2024 - 25**

**Vision of the Dept.:**

To become center of excellence in Electronics & Telecommunication Engineering and empower graduates to take up global challenges in emerging areas to harness technological competence while harmoniously blending with spiritual pursuits.

**Mission of the Dept.**

1. To provide best learning experience for students through excellent curriculum, industry collaboration and innovative teaching learning processes.
2. To create academic ambience for faculty and students by establishing high-quality R & D labs leading to quality research in Telecommunication Engineering and allied disciplines.
3. To produce graduates with technological competence, necessary professional skills and ethics.

**Program Educational Objectives (PEOs)**

**The graduates of Telecommunication Engineering are able to:**

- Build successful careers in industry, R&D Labs by applying mathematical, scientific and state-of-the-art Engineering knowledge with multidisciplinary approaches to solve real world problems in the fields of Telecommunication Engineering and allied disciplines.
- Pursue higher education by lifelong learning in the areas of Telecommunication Engineering and allied disciplines.
- Display professional and ethical attitude, spiritual values with effective communication skills and leadership qualities.

**PROGRAM SPECIFIC OUTCOMES (PSOs):**

- Apply and analyze the concepts of circuits and systems for real time challenges in the areas of electronic circuits, signal processing and VLSI/Embedded Systems.
- Identify, design and develop solutions for complex engineering problems related to, communication systems using analytical techniques, state of the art simulation tools and hardware.

# SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMKUR

**(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A++' grade & ISO 9001:2015 Certified)**

## B.E. in ELECTRONICS & TELECOMMUNICATION ENGINEERING

## SCHEME OF TEACHING AND EXAMINATION NEP-2

## V Semester

| Sl. No. | Course and Course Code | | Course Title | Teaching / Paper setting Dept. | Teaching hrs./week | | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Lecture | Tutorial | Practical/ Drawing | SSC/ SDA | Duration in hrs. | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | S | | | | | |
| 1. | HSMS | SHS03 | Management and Entrepreneurship | ME | 42 | 0 | 0 | 48 | 3 | 50 | 50 | 100 | 3 |
| 2. | IPCC | S5ETI01 | Digital Signal processing | ETE | 42 | 0 | 28 | 50 | 3 | 50 | 50 | 100 | 4 |
| 3. | IPCC | S5ETI02 | Digital Communication and Coding Theory | ETE | 42 | 0 | 28 | 50 | 3 | 50 | 50 | 100 | 4 |
| 4. | PCCL | S5ETL01 | Advanced Communication Lab | ETE | 0 | 0 | 28 | 2 | 3 | 50 | 50 | 100 | 1 |
| 5. | PEC | SETExx | Professional Elective Course-I | ETE | 42 | 0 | 0 | 48 | 3 | 50 | 50 | 100 | 3 |
| 6. | PROJ | S5ETMP | Mini Project / Extension Survey Project | ETE | 0 | 0 | 42 | 18 | 3 | 50 | 50 | 100 | 2 |
| 7. | AEC | SHS04 | Research Methodology and IPR **(Board: IEM)** | ETE | 42 | 0 | 0 | 48 | 3 | 50 | 50 | 100 | 3 |
| 8. | HSMS | SHS05 | Environmental Studies **(Board: CV)** | CV | 28 | 0 | 0 | 32 | 3 | 50 | 50 | 100 | 2 |
| 9. | AEC | ARAS | Aptitude Related Analytical Skill | T&P | 0 | 0 | 28 | 2 | 1.5 | 50 | 50 | 100 | 1 |
| 10. | NCMC | SMC01 | National Service Scheme (NSS) | NSS CO | - | - | - | - | | 100 | - | 100 | 0 |
| | | SMC02 | Physical Education (PE) (Sports and Athletics) | PED | | | | | | | | | |
| | | SMC03 | Yoga and Pranayama | PED | | | | | | | | | |
| | | SMC04 | National Cadets Corps | NCC | | | | | | | | | |
| | | | **Total** | | | | | | **24** | **600** | **400** | **1000** | **23** |
| | | AAP | AICTE Activity Points (Applicable for both Regular and Lateral Entry students) | 40 hours community service to be documented and produced for the examination | | | | | | | | | |

**Note: HSMS:** Humanity and Social Science and management Course **IPCC**: Integrated Professional Core Course, **PCCL**: Professional Core Course laboratory, **PEC**: Professional Elective Course**; PROJ**: Project/Mini Project; **AEC**: Ability Enhancement Course; **NCMC**: Non-Credit Mandatory Course, **L**: Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.
**SSC:** Self Study Component

**Professional Elective Course (PEC) (Offered by the Department)**

| | | | |
|---|---|---|---|
| SETE01 | Digital Image Processing | SETE03 | Digital VLSI design |
| SETE02 | RF and Microwave Circuit Design | SETE04 | Industrial Electronics |

**Professional Core Course (IPCC)**: Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE(no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering (B.E.) 2022-23 may please be referred.

**National Service Scheme /Physical Education/Yoga:** All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first Week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the Degree.

The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progressionas well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of Degree.

**Mini-project work:** Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

**CIE procedure for Mini-project:**

**(i)** **Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates.

**(ii)** **Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project. The CIE marks awarded for theMini-project, shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for theproject report shall be the same for all the batch mates.

**No SEE component for Mini-Project.**

**Professional Elective Courses (PEC):** A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of Engineering. Each group will providean option to select one course. The minimum number of students' strengths for offering a professional elective is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

# SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMKUR

**(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A++' grade & ISO 9001:2015 Certified)**

## B.E. in ELECTRONICS & TELECOMMUNICATION ENGINEERING

## SCHEME OF TEACHING AND EXAMINATION (NEP-2, 2022 Scheme) (w.e.f. 2024-25)

## VI Semester

| Sl. No. | Course and Course Code | | Course Title | Teaching / Paper setting Dept. | Teaching hrs./week | | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Lecture | Tutorial | Practical/ Drawing | SSC / SDA | Duration in hrs. | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | S | | | | | |
| 1. | IPCC | S6ETI01 | Data Communication Networks | ETE | 42 | 0 | 28 | 50 | 3 | 50 | 50 | 100 | 4 |
| 2. | PCC | S6ET01 | Microwave Engg. and Antenna Design | ETE | 42 | 28 | 0 | 50 | 3 | 50 | 50 | 100 | 4 |
| 3. | PEC | SETExx | Professional Elective Course-II | ETE | 42 | 0 | 0 | 48 | 3 | 50 | 50 | 100 | 3 |
| 4. | OEC | SOExx | Open Elective Course-I | - | 3 | 0 | 0 | 48 | 3 | 50 | 50 | 100 | 3 |
| 5. | PROJ | S6ETMP | Major Project Phase I | ETE | 0 | 0 | 42 | 18 | 3 | 100 | - | 100 | 2 |
| 6. | PCCL | S6ETL01 | Microwave Engg. and Antenna Design Lab | ETE | 0 | 0 | 28 | 2 | 3 | 50 | 50 | 100 | 1 |
| 7. | NCMC | SHS06 | Soft Skills (Additional Course offered by SIT) | T&P | - | - | - | - | - | 100 | - | 100 | 0 |
| 8. | NCMC | SMC01 | National Service Scheme (NSS) | NSS CO | - | - | - | - | | 100 | - | 100 | 0 |
| | | SMC02 | Physical Education (PE) (Sports and Athletics) | PED | | | | | | | | | |
| | | SMC03 | Yoga | PED | | | | | | | | | |
| | | SMC04 | National Cadet Corps | NCC | | | | | | | | | |
| | | | **Total** | | | | | | **19.5** | **500** | **300** | **800** | **17** |
| | | AAP | AICTE Activity Points (Applicable for both Regular and Lateral Entry students) | 40 hours community service to be documented and produced for the examination | | | | | | | | | |

**Note:** **IPCC**: Integrated Professional Core Course, **PCC**: Professional Core Course; **PEC**: Professional Elective Course**;**
**OEC:** Open Elective Course; **PROJ:** Project Phase –I; **PCCL**: Professional Core Course laboratory;
**AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course; **NCMC**: Non Credit Mandatory Course; **SSC**: Self Study Component
**L**: Lecture, **T**: Tutorial, **P**: Practical **S= CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **SDA**: Skill Development Activity.

**Professional Elective Course (PEC) (Offered by the Department)**

| | | | |
|---|---|---|---|
| SETE05 | Analog VLSI Design | SETE07 | Multimedia Communication |
| SETE06 | Radar Systems | SETE08 | Artificial Neural Network |
| SETE09 | Bio-Medical Signal Processing | | |

**Professional Core Course (IPCC)**: Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering (B.E.) 2022-23 may please be referred.

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| |
|---|
| scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progressionas well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of Degree. |
| **Professional Elective Courses (PEC):** A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of Engineering. Each group will providean option to select one course. The minimum number of students' strengths for offering a professional elective is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10. |
| **Open Elective Courses:**<br>Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the ProgramCoordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10. |
| **Project Phase-I :** Students have to discuss with the mentor /guide and with their help he/she has to complete the literature survey and prepare the report and finally define theproblem statement for the project work. |

# MANAGEMENT AND ENTREPRENEURSHIP

| | | | |
|---|---|---|---|
| Contact Hours/ Week: | : 3(L) | Credits: | 3 |
| Total Lecture Hours: | : 40 | CIE Marks: | 50 |
| Sub. Code: | : SHS03 | SEE Marks: | 50 |

**Course objectives:**

This course will enable students to:

| | |
|---|---|
| 1. | Understand the principles and functions of management through planning. |
| 2. | Analyze the importance of organizing and staffing in an organization. |
| 3. | Analyze the importance of leading and controlling in an organization. |
| 4. | Inculcate entrepreneurial qualities and understand the need of rural entrepreneurship. |
| 5. | Acquire knowledge about funding agencies, understand procedure in applying for funds and analyze the cases of successful entrepreneurs. |

## UNIT I

**Introduction to Management:** Definition of management, management skills, productivity and effectiveness, efficiency, functions and principles of management.

**Planning:** Nature of planning, types of plans- purpose of vision, mission, goals, objectives strategies, policies; steps in planning, MBO, Strategic planning.

**07 Hours**

## UNIT II

**Organizing:** Formal and informal organization, span of management, the structure and Process of organizing, Organizational structure: line and staff organization, Functional organization, matrix organization.

**Staffing:** Definition, systems approach to HRM, factors affecting staffing, recruitment and selection, job design, skill and characteristics of a manager, selection process and techniques

**09 Hours**

## UNIT III

**Leading:** Human factors in managing, motivation, Theory X and Y, the hierarchy of needs theory, leadership behavior and styles.

**Controlling:** Basic control process, critical control points and standards, Benchmarking requirements for effective control**.**

**06 Hours**

| UNIT IV |
|---|
| **Entrepreneur & Entrepreneurship:** Introduction, concept of Entrepreneur, characteristics of an entrepreneur, and qualities of an entrepreneur, functions of an entrepreneur, characteristics of entrepreneurship, factors affecting entrepreneurial growth. Entrepreneurship and economic development-rural, woman and social entrepreneurship.<br>**Financing and Institutional Support for Entrepreneurship:** Startups, business plans, venture capitalists, angel investors, funding agencies-commercial banks, development banks, NBFCS and incubation centres. Innovations and project trends. |
| **12 Hours** |
| **UNIT V** |
| **Taxation benefits:** Depreciation allowances, rehabilitation allowance, investment allowance and other tax concession benefits to an entrepreneur.<br>**Case studies**<br>1. How Zomato is Leading in Foodtech? A Zomato Case Study<br>2. Ola case study: The story of a Millionaire without a car |
| **06 Hours** |

| TEXT BOOKS | | |
|---|---|---|
| 1 | Harold Koontz, HeinzWeihric | Essentials of Management, McGraw Hill , Education, 10th Edition, 2015. |
| 2 | Lucy C. Morse | Managing Engineering and Technology, Pearson Education, 6th Edition, 2015. |
| 3. | S.S. Khanka | Entrepreneurial Development, S. Chand Publishing, 4th Edition, Reprint 2020.ISBN 978-81-219-1801-5, 2021. |

| REFERENCE BOOKS | | |
|---|---|---|
| 1 | James A.F. Stoner, R. Edward Freeman,Daniel R.Gilbert | Management, Pearson Education, 6th Edition, 2018. |

| **Course Outcomes:** Upon completion of this course the student will be able to: | |
|---|---|
| CO1 | Describe various functions of management |
| CO2 | Apply the knowledge of management principles and strategies in various functional areas such as organizing and staffing. |
| CO3 | Apply the knowledge of management principles and strategies in various functional areas such as Leading and Controlling. |
| CO4 | Describe entrepreneurship, its characteristics, and benefits and identify various funding sources for starting a business venture. |
| CO5 | Interpret various taxation benefits enjoyed by an entrepreneur and analyze the characteristics and strategies adopted by successful entrepreneurs. |

## Course Articulation Matrix

**Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)**

| | | **PO's** | | | | | | | | | | | **PSO's** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **1** | **2** |
| **CO's** | **1** | 3 | | | | | 1 | | | | | | 3 | |
| | **2** | 3 | | | | | | | | | | 3 | 3 | |
| | **3** | 3 | | | | | | | | | | 3 | 3 | |
| | **4** | 3 | | | | | 2 | | | | 2 | 3 | 3 | |
| | **5** | 3 | 3 | | | | | | | | | 3 | 3 | |
| | **Avg.** | **3** | **3** | | | | **1** | | | | **2** | **3** | **3** | |

**Note:** 1- Weak correlation 2-Medium correlation 3-Strong correlation

# DIGITAL SIGNAL PROCESSING

| | | | |
|---|---|---|---|
| Contact Hours/ Week: | 3(L)+2(P) | Credits: | 4 |
| Total Lecture Hours: | 42(L)+28(P) | CIE Marks: | 50 |
| Sub. Code: | S5ETI01 | SEE Marks: | 50 |

**Course objectives:**
This course will enable students to:

| | |
|---|---|
| 1. | Use Fourier transformation to find the spectral components present in the discrete time signal |
| 2. | Use algorithms to reduce the computation time of discrete Fourier transformation. |
| 3. | Design and realize digital frequency selective filters and to use applications of digital signal processing in Musical sound processing. |

**UNIT I**

Introduction to Digital Signal Processing: Basic elements of a Digital Signal Processing system, advantages of Digital Signal Processing over analog signal processing.
Discrete Fourier Transform: DFT and IDFT, Multiplication of two DFTs and Circular Convolution
Applications of DFT: Linear filtering using DFT, Filtering of long sequences:- Overlap-save method and overlap-add method, Spectral analysis using DFT, Dual tone Multi frequency (DTMF) signal generation and detection.

**10 Hours**

**UNIT II**

Efficient Computation of DFT – Fast Fourier Transform Algorithms: Decimation-in-time and decimation-in-frequency radix-2 FFT and IFFT algorithms, Efficient computation of 2N point DFT from two N point DFTs, Linear filtering approach to compute DFT:- Goertzel algorithm and Chirp-z transform algorithm

**8 Hours**

**UNIT III**

Design and Realization of FIR Filters: Ideal Filter Characteristics: Lowpass, Highpass, Bandpass and Bandstop filters, importance of linear phase, Frequency response of linear phase FIR filters, Locations of zeros of FIR filters, Design techniques of FIR filters:- Windowing method and Frequency Sampling method.
Applications of FIR filters: Design of Hilbert transformer and Ideal differentiators.

**8 Hours**

| UNIT IV |
|---|
| Design of IIR filters: Elementary properties of IIR filters, Frequency transformations in analog domain. Analog filter design:- Butterworth and Chebyshev Type-I low pass filters, Digital filter design from analog filters using Bilinear transformation method. Comparison of FIR and IIR filters |
| **8 Hours** |

| UNIT V |
|---|
| Basic structures for FIR systems: Direct, Cascade, Linear Phase and Frequency sampling structures.<br>Basic structures for IIR systems: Direct, Cascade, and Parallel structures.<br>Applications: Linear-time invariant systems as frequency selective filters: Digital Resonators, Comb Filters, Notch Filters, All-pass filters, Minimum phase systems, Maximum phase and Mixed phase systems, Musical sound processing: Single echo and multiple echo filters. |
| **8 Hours** |

| **TEXT BOOKS** | | |
|---|---|---|
| 1 | J. G. Proakis and D. G.Manolakis | Digital Signal Processing: Principles, Algorithms and Applications, Pearson, 4th Edition, 2007. |

| **REFERENCE BOOKS** | | |
|---|---|---|
| 1 | S. Sanjit K. Mitra | Digital Signal Processing: A computer-Based Approach. TMH, 4th Edition, 2013. |
| 2 | Allan V. Oppenheim and Ronald W. Shafer | Discrete-Time Signal Processing, Pearson Education India, 3rd Edition, 2014. |
| 3 | Lonnie C. Ludeman | Fundamentals of digital signal processing, Wiley India Pvt. Ltd, 2009 |

| **Course Outcomes:**<br>Upon completion of this course the student will be able to: | |
|---|---|
| CO1 | Apply DFT for linear filtering and spectral analysis of signals. |
| CO2 | Compute the DFT efficiently using FFT algorithms and linear filtering approaches. |
| CO3 | Design a digital FIR filter for a given specification and realize the same using different structures. |
| CO4 | Design a digital IIR filter for a given specification and realize the same using different structures. |
| CO5 | Develop basic signal processing algorithms for applications in Communication and Signal Processing. |

**LIST OF EXPERIMENTS USING MATLAB/OCTAVE/SCILAB:**

1. Computation of N-Point DFT using conventional DFT equation and FFT algorithm
2. Computational performance of N-point DFT using direct method and algorithm.
3. Applications of DFT for Linear filtering and Spectral Analysis.
4. Autocorrelation and its application for the estimation of period of noisy sinusoidal signals.
5. Generation of DTMF signals.
6. Application of Goertzel's algorithm for DTMF signal detection.
7. Generation of single and multiple echoes.
8. Design, implementation and verification of FIR LPF to meet given specifications using FDA Tool/Simulink/SCILAB.
9. Design, implementation and verification of IIR Butterworth/ Chebyshev LPF to meet the given specifications using FDA Tool/Simulink/SCILAB.
10. Applications of FIR filters: Ideal differentiator and Hilbert transformer

# Course Articulation Matrix

**Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)**

| | | PO's | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **1** | **2** |
| **CO's** | **1** | 3 | 2 | | | 2 | | | 1 | | 1 | | 1 | |
| | **2** | 3 | 2 | | | 2 | | | 1 | | 1 | | 1 | |
| | **3** | 3 | 2 | 2 | | 2 | | | 1 | | 1 | | 2 | |
| | **4** | 3 | 2 | 2 | | 2 | | | 1 | | 1 | | 2 | |
| | **5** | 3 | 2 | 1 | | 2 | | | 1 | | 1 | | 2 | |
| | **Avg.** | **3** | **2** | **2** | | **2** | | | **1** | | **1** | | **2** | |

**Note:** 1- Weak correlation 2-Medium correlation 3-Strong correlation

# DIGITAL COMMUNICATION & CODING THEORY

| | | | |
|---|---|---|---|
| Contact Hours/ Week: | 3(L)+2(P) | Credits: | 4 |
| Total Lecture Hours: | 42(L)+28(P) | CIE Marks: | 50 |
| Sub. Code: | S5ETI02 | SEE Marks: | 50 |

**Course objectives:**
This course will enable students to:

| | |
|---|---|
| 1. | Realize the concepts of generation and detection of different digital modulation Techniques and their performance analysis |
| 2. | Realize and analyze various source coding techniques |
| 3. | Realize and analyze various channel coding techniques. |

**UNIT I**

Band pass Modulation/Demodulation-I: Why modulate? Digital Band pass modulation Techniques, PSK, FSK, ASK, APK, Detection of Signals in Gaussian Noise, Decision regions, Correlation receiver, Binary Decision threshold, Coherent Detection of PSK, Sample Matched filter, MPSK, FSK, Non coherent Detection- DPSK, FSK, Minimum tone spacing for O-FSK. Quadrature implementation of a Modulator, Error performance for Binary systems: Coherent BPSK, Non-coherent DPSK.

**10 Hours**

**UNIT II**

Spread Spectrum Techniques: Beneficial attribute of spread spectrum system, PN sequence, DSSS, PG and Performance, FHSS-slow and fast, CDMA.
Information Theory: Measure of Information, Entropy of Zero Memory Source, Properties of Entropy, Information Rate, Extension of Zero Memory Source.
Source Encoding: Properties of codes, Code Efficiency and Redundancy, Shannon's Noiseless Coding Theorem, Huffman Minimum Redundancy code.

**8 Hours**

**UNIT III**

Channels for Communication: Introduction to Communication Channels, Discrete Communication Channels, Entropy Function and Equivocation, Mutual Information, Properties of Mutual Information.
Channels for Communication: Rate of Information Transmission over a Discrete Channel, Capacity of a Discrete Memory less Channel, Shannon's Theorem on Channel Capacity, Symmetric channel, Binary erasure channel and Cascaded channels

**8 Hours**

| UNIT IV |
|---|
| Linear Block Codes: Introduction to Error Control Coding, Example of Error Control Coding, Methods of Controlling Errors, Types of Errors, Types of Codes, Linear Block Codes, Matrix Description of Linear Block Codes, Error Detection and Error Correction Capabilities of Linear Block Codes, Single Error Correcting Hamming Codes. |
| **8 Hours** |
| **UNIT V** |
| Binary Cyclic Codes: Algebraic Structures of Cyclic Codes, Encoding using an (n-k) Bit Shift Register, Syndrome Calculation, Error Detection and Error Correction, Special Classes of Cyclic Codes: BCH Codes, RS Codes. Convolution Codes: Encoding using Time Domain and Transfer Domain Approach, State Diagrams, Tree and Trellis diagrams |
| **8 Hours** |

| **TEXT BOOKS** | | |
|---|---|---|
| 1 | Bernard Sklar | Digital Communications - Fundamentals and Applications", 3rd Edition Pearson Education (Asia) Pvt. Ltd, 2021 |
| 2 | K. Sam Shanmugam | Digital and Analog Communication Systems, John Wiley, 1st Edition, 2019 |
| 3 | Shu Lin and Daniel J Costello | Error Control Coding, Pearson Education Limited, 2nd Edition, 2011 |

| **REFERENCE BOOKS** | | |
|---|---|---|
| 1 | Simon Haykin | Digital Communications, John Wiley and Sons**,** 1st Edition, 2010. |
| 2 | Simon Haykin | Communication Systems, John Wiley, 3rd edition, 2007 |
| 3 | Dr. P. S.Sathyanarayana | Concepts of Information Theory and Coding, 2nd revised edition, Medtech, 2016 |

| **Course Outcomes:** Upon completion of this course the student will be able to: | |
|---|---|
| CO1 | Apply and analyze different band pass modulation and Analyze and compare the performance parameters like BER, bandwidth, PSD for different digital modulation schemes. |
| CO2 | Quantify amount of information of a discrete source and devise an optimal code for a discrete source satisfying various properties by selecting appropriate coding theorem. |
| CO3 | Analyze the performance of various communication channels |
| CO4 | Design and develop encoder and decoder circuit for error free communication using linear block codes. |
| CO5 | Develop a binary cyclic encoder and decoder circuit for error free communication and perform encoding and decoding of convolution codes. |

## Lab Experiments:

Part A

**Simulation experiments using LabVIEW**

1. Baseband modulations –ASK, BPSK, FSK – Scatter plots, with
2. Baseband modulations – PSK, QAM – Scatter plots.
3. Band-pass modulations –ASK, PSK (M=2, 4, 8, 16) – Scatter plots. With bandwidth utilization for rectangular pulse and raised cosine pulse for band-pass modulations. ISI effect – Eye diagram study.
4. Band-pass modulations – QAM (M=2, 4, 8, 16, 32, 64,128,256) – Scatter plots. With bandwidth utilization for rectangular pulse and raised cosine pulse for band-pass modulations. ISI effect – Eye diagram study.
5. Band-pass modulations ASK, PSK, QAM – Scatter plots using USRP kit.
6. Bandwidth utilization for rectangular pulse and raised cosine pulse for band-pass modulations using USRP kit.

Part B

**Simulation experiments using SCI-LAB**

1. Determination of entropy of a given source
2. Determination of various entropies and mutual information of a given channel (Noise free channel)
3. Determination of various entropies and mutual information of a given channel (Binary symmetric channel)
4. Generation and evaluation of variable length source coding (Huffman Coding and decoding)
5. Coding & decoding of Linear block codes
6. Coding and decoding of convolutional codes

# Course Articulation Matrix

**Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)**

| | | PO's | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **1** | **2** |
| **CO's** | **1** | 3 | 2 | 1 | | 2 | | | | | | | | 2 |
| | **2** | 2 | 3 | 1 | | 2 | | | | | | | | 2 |
| | **3** | 3 | 3 | 1 | | 2 | | | | | | | | 2 |
| | **4** | 3 | 2 | 1 | | 2 | | | | | | | | 2 |
| | **5** | 3 | 2 | 1 | | 2 | | | | | | | | 2 |
| | **Avg.** | **3** | **2** | **1** | | **2** | | | | | | | | **2** |

**Note:** 1- Weak correlation 2-Medium correlation 3-Strong correlation

# ADVANCED COMMUNICATION LAB

| | | | |
|---|---|---|---|
| Contact Hours/ Week: | 2 (P) | Credits: | 1 |
| Total Labs: | 14 | CIE Marks: | 50 |
| Sub. Code: | S5ETL01 | SEE Marks: | 50 |

| **Course objectives:** This course will enable students to: | |
|---|---|
| 1. | Demonstrate the interface various communication modules to different controllers using different platforms. |
| 2. | Infer the capabilities and limitations of various modules |
| 3. | Identify the best choice of communication module for the given application |
| 4. | Relate the theoretical concepts of Data communications with real time hardware. |

| **Experiment List** | |
|---|---|
| 1. | Demonstrate the application, controlling of LED and motor using Bluetooth module |
| 2. | Demonstrate the application, controlling of two or more home appliances using RFID reader and tags. (Home appliances: LED, motor, buzzer) |
| 3. | Demonstrate the application, controlling of two LEDs using NodeMCU. |
| 4. | Demonstrate the application, detection of intruder by calling the user using GSM module. |
| 5. | Demonstrate the application, alerting temperature variation by sending message from one computer to another using RF433 MHz module. |
| 6. | Demonstrate the application, detecting valid and invalid users using RFID reader and tags. |
| 7. | Demonstrate the application, light intensity detection and sending message from one computer to another using ZigBee module. |
| 8. | Demonstrate the application, alerting the movement detection by sending message from one computer to another using RF433 MHz module. |
| 9. | Demonstrate the application, object detection by sending message from one computer to another using ZigBee module. |
| 10. | Demonstrate the application, movement detection by sending message from one computer to another through free space optical communication. |

| **Course Outcomes:** Upon completion of this course the student will be able to: | |
|---|---|
| CO1 | Experiment with the various communication modules |
| CO2 | Choose an appropriate module depending on the application |
| CO3 | Develop a communication system for the given application |
| CO4 | Demonstrate the real time implementation and applications. |

# Course Articulation Matrix

**Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)**

| | | **PO's** | | | | | | | | | | | **PSO's** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **1** | **2** |
| **CO's** | **1** | | 2 | 2 | | 2 | | | | 2 | | | | 2 |
| | **2** | | 2 | 2 | | 2 | | | | 2 | | | | 2 |
| | **3** | | 2 | 2 | | 2 | | | | 2 | | | | 2 |
| | **4** | | 2 | 2 | | 2 | | | | 2 | | | | 2 |
| | **Avg.** | | **2** | **2** | | **2** | | | | **2** | | | | **2** |

**Note:** 1- Weak correlation 2-Medium correlation 3-Strong correlation

# DIGITAL IMAGE PROCESSING

| | | | |
|---|---|---|---|
| Contact Hours/ Week: | 3 (L) | Credits: | 3 |
| Total Lecture Hours: | 42 | CIE Marks: | 50 |
| Sub. Code: | SETE01 | SEE Marks: | 50 |

| **Course objectives:** This course will enable students to: | |
|---|---|
| 1. | Introduce Fundamental Concepts and tools for Image Processing. |
| 2. | Develop transform basis used in digital image processing and transform domain processing. |
| 3. | Apply the transforms/tools for image enhancement, filtering and implement algorithms for restoration. |
| 4. | Study and compare the various approaches for image compression standards. |

**UNIT I**

Digital Image Fundamentals: What is Digital Image Processing?, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, An Introduction to Mathematical Tools Used in DIP

**10 Hours**

**UNIT II**

Image Transforms: Two-dimensional orthogonal &UNITary transforms, Properties of UNITary transforms, Two dimensional discrete Fourier transform, Discrete cosine transform, Hadamard transform, Haar transform, Slant transform, KL transform, Wavelet transforms.

**8 Hours**

**UNIT III**

Intensity Transformations and Spatial Filtering: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.

Filtering in Frequency Domain: Basics of Filtering in Frequency Domain, Image Smoothing Using Frequency Domain Filters, Image Sharpening Using Frequency Domain Filters, Selective Filtering. Image Segmentation: Point, Line, Edge detection, Thresholding, Region based Segmentation.

**8 Hours**

**UNIT IV**

Image Restoration and Reconstruction: A Model of the Image Degradation/Restoration Process, Noise Models, Restoration in the Presence of Noise Only-Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Geometric Mean Filter

**8 Hours**

| UNIT V |
|---|
| Image Compression: Fundamentals-Coding Redundancy, Spatial and Temporal redundancy, Irrelevant Information, Measuring Image Information, Fidelity Criteria, Image Compression Models, Image Formats, Containers, and Compression Standards. Some Basic Compression Methods- Huffman Coding, Golomb Coding, Arithmetic Coding, LZW Coding, Run-Length Coding, Symbol Based Coding, Bit-Plane Coding, Block Transform Coding, Predictive Coding, Wavelet Coding. |
| **8 Hours** |

| **TEXT BOOKS** | | |
|---|---|---|
| 1 | Rafael C. Gonzalez and Richard E. Woods | Digital Image Processing, Pearson Education, 3rd edition, 2012. |
| 2 | Anil K. Jain | Fundamentals of Digital Image Processing, PHI, 2011. |

| **REFERENCE BOOKS** | | |
|---|---|---|
| 1 | B. Chanda and D. DuttaMajumdar | Digital Image Processing and Analysis, PHI, 2nd Edn. 2011. |
| 2 | S Jayaraman, S Esakkiranjan,TVeerakumar | Digital Image Processing, Tata Mcgraw Hill, 1st Edition 2017. |

| **Course Outcomes:** Upon completion of this course the student will be able to: | |
|---|---|
| CO1 | Explain various steps and components used in digital image processing. |
| CO2 | Develop Transform basis functions and Analyze Images in transform domain. |
| CO3 | Apply image enhancement and restoration techniques in the spatial and frequency domains. |
| CO4 | Analyze redundancy in images and select a suitable compression technique for storage and transmission of images. |
| CO5 | Develop image processing algorithms (individually or in team) using appropriate software tools. |

# Course Articulation Matrix

**Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)**

| | | PO's | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **1** | **2** |
| **CO's** | **1** | 2 | 2 | | | | | | | | | | 3 | 1 |
| | **2** | 3 | 3 | | 2 | | | | | | | | 2 | 2 |
| | **3** | 2 | 3 | 2 | | 2 | | | | | | | | 3 |
| | **4** | 3 | 3 | 2 | | 2 | | | | | | | | 2 |
| | **5** | 3 | 3 | 3 | 2 | 2 | | | | | | | | 3 |
| | **Avg.** | 2.6 | 2.8 | 2.3 | 2 | 2 | | | | | | | 2.5 | 2.2 |

**Note:** 1- Weak correlation 2-Medium correlation 3-Strong correlation

# RF AND MICROWAVE CIRCUIT DESIGN

| | | | |
|---|---|---|---|
| Contact Hours/ Week: | 3 (L) | Credits: | 3 |
| Total Lecture Hours: | 42 | CIE Marks: | 50 |
| Sub. Code: | SETE02 | SEE Marks: | 50 |

**Course objectives:**

This course will enable students to:

| | |
|---|---|
| 1. | Explain reasons for using RF/mw frequencies, limitations of lumped elements, silent futures of resonators, and their applications. |
| 2. | Explain the distributed (rather than lumped) analysis approach for various transmission line problems and analyze. |
| 3. | Solve various transmission line problems and design impedance matching circuits using graphical (Smith chart) and analytical methods. The properties of RF/mw circuit using S parameters. |
| 4. | Design procedures and methods to evaluate the performance of amplifiers, mixer and detector circuits. |
| 5. | Design procedure of amplifiers, phase shifter, mixer and detector circuits operating at RF/mw frequencies and Use simulation tools. |

**UNIT I**

Basics of RF and microwaves: Introduction- Properties of RF and Microwaves, reasons for using rf/microwaves, RF/microwave applications, low RF and high RF circuit design considerations. RF electronics: Introduction to component basics at RF/Microwave: wire, resistors, capacitors, Inductor, definitions- Decibel, Decibel watts, space factor, ripple, bandwidth, Resonance, circuit Q and loaded Q, insertion loss, impedance transformation.

**10 Hours**

**UNIT II**

The wave fundamentals: mathematical form of propagating waves, properties of waves, wave propagation on transmission line (TEM mode), reflection coefficient, lossless transmission lines, a generalized lossless transmission line circuit, Micro-strip line, Empirical Formulas, Two-port network representations: low-frequency parameters, high-frequency parameters, formulation of the s-parameters, properties of s-parameters, signal flow graphs (sfgs), applications of signal flow graphs (sfgs). Text1: Chapter 7, 8

**8 Hours**

| UNIT III |
|---|
| **The Smith Chart:** Description of the smith chart, Smith Chart Applications: distributed and lumped element circuit applications, input impedance determination, Design of matching networks: definition - matching, selection of a matching network, maximum average power transfer, design of matching circuits using lumped elements, matching network design using distributed elements, stub realization using microstrip lines. Text1: Chapter 10, 11 |
| **8 Hours** |
| **UNIT IV** |
| **Microwave Frequency Conversion and control:** Stability Circles. Graphical Solution of Stability Criteria. Analytical Solution of Stability Criteria. Potentially Unstable Case. Noise considerations: Importance of Noise. Noise Definition, Sources of Noise. Thermal Noise Analysis. Noise Model of a Noisy Resistor. Equivalent Noise Temperature. Definitions of Noise Figure. Noise Figure of Cascaded Networks. Constant Noise Figure Circles. Text1: Chapter 19, 20, 12, 14 |
| **8 Hours** |

| UNIT V |
|---|
| **Gain considerations: Power Gain Concepts. A Special Case:** Unilateral Transistor. The Mismatch Factor. Input and Output VSWR. Maximum Gain Design. Unilateral Case (Maximum Gain). Constant Gain Circles (Unilateral Case). Unilateral Figure of Merit. Bilateral Case. RF/microwave amplifiers design: Types of amplifiers. small-signal amplifiers. design of different types of amplifiers. small-signal amplifier design. design of different types of amplifiers, high-gain amplifier (hga) design, maximum-gain amplifier (mga) design, Text1: Chapter 13, 15. |
| **8 Hours** |

| **TEXT BOOKS** | | |
|---|---|---|
| 1. | Matthew. M. Radmanesh | "RF and microwave electronics illustrated", Pearson Education, 2015 |
| 2. | Christopher Bowick | Christopher Bowick "R F Circuit Design" Newnes, 2 nd edition, 2007 |

| **REFERENCE BOOKS** | | |
|---|---|---|
| 1 | Reinhold Ludwig and pavel Bretchko | RF circuit design, theory and applications", Pearson Education (Asia) Pte. Ltd., 2nd edition, 2007 |
| 2 | D K Mishra | "RF Circuit Design", Wiley-Interscience, 2 nd Edition, 2004 |

| **Course Outcomes:** Upon completion of this course the student will be able to: | |
|---|---|
| CO1 | Interpret the limitations of lumped elements, applications, usage of microwaves and study the future industry needs. |
| CO2 | Use proper distributed component required in transmission lines at RF and microwave frequencies. |
| CO3 | Comprehend the S parameters and to design various impedance matching networks related to microwave components. |
| CO4 | Analyze, design, and optimize the performance measures of RF amplifiers, Mixers and detector circuits. |
| CO5 | Analyze and design the RF amplifiers, Mixers and detector circuits at RF and microwave frequencies and optimize the performance and sensitive parameters. |

# Course Articulation Matrix

**Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)**

| | | **PO's** | | | | | | | | | | | **PSO's** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **1** | **2** |
| **CO's** | **1** | 1 | | | | | | | | | | | | 1 |
| | **2** | 1 | 2 | | | | | | | | | | | 2 |
| | **3** | 1 | | 2 | | | | | | | | | | 2 |
| | **4** | | | 2 | | | | | | | | | | 2 |
| | **5** | 2 | 2 | | | | | | | | | | | 2 |
| | **Avg.** | **1.25** | **2** | **2** | | | | | | | | | | **1.8** |

**Note:** 1- Weak correlation 2-Medium correlation 3-Strong correlation

# DIGITAL VLSI DESIGN

| | | | |
|---|---|---|---|
| Contact Hours/ Week: | 3(L) | Credits: | 3 |
| Total Lecture Hours: | 42 | CIE Marks: | 50 |
| Sub. Code: | SETE03 | SEE Marks: | 50 |

**Course objectives:**

This course will enable students to:

| | |
|---|---|
| 1. | Understand the principles and applications of MOS capacitors, and describe the fabrication process of MOSFETs with emphasis on key steps and techniques involved. |
| 2. | Analyze the MOS fabrication process, Layouts |
| 3. | Design and analyze the Digital CMOS circuits |
| 4. | Explain the Memory technologies and basics of Arithmetic building blocks |
| 5. | Understand the testing of VLSI digital designs |

**UNIT I**

Issues and Challenges in Digital IC Design: general overview of design hierarchy, layers of abstraction, integration density and Moore's law, VLSI design styles; MOSFET fabrication: basic steps of fabrication, CMOS p-well and n-well processes, layout design rules,

**10 Hours**

**UNIT II**

CMOS Inverter: MOS Device Model with Sub-micron Effects, VTC Parameters (DC Characteristics), CMOS Propagation Delay, Parasitic Capacitance Estimation, Layout of an Inverter, Switching, Short-Circuit and Leakage Components of Energy and Power; Interconnects: Resistance, Capacitance Estimation, delays, Buffer Chains, Low Swing Drivers, Power Distribution, and Performance Optimization of Digital Circuits by Logical Effort Sizing;.

**8 Hours**

**UNIT III**

Combinational Logic Design: Static CMOS Construction, Ratioed Logic, Pass Transistor, Transmission Gate Logic, DCVSL, Dynamic Logic Design Considerations, noise considerations in dynamic design Power Dissipation in CMOS Logic, Sequential Circuits Design: Classification, Parameters, Static Latches and Register, Race Condition, Dynamic Latches and Registers,

**8 Hours**

| UNIT IV |
|---|
| Design of arithmetic building blocks like adders Carry, look-ahead, linear carry-select, carry bypass and multipliers (Booth's multipliers;) |
| **8 Hours** |

| UNIT V |
|---|
| Semiconductor memories: non-volatile and volatile memory devices, flash memories, SRAM Cell Design, Differential Sense Amplifiers, DRAM Design, Single Ended Sense Amplifier; Testing in VLSI: Defects, Fault Models, Path Sensitization, Scan, Built-in-self Test, IDDQ. |
| **8 Hours** |

| **TEXT BOOKS** | | |
|---|---|---|
| 1 | J.M. Rabaey, A. Chandrakasan and B. Nikolic | Digital Integrated Circuits- A Design Perspective, 2/e, Prentice Hall of India |

| **REFERENCE BOOKS** | | |
|---|---|---|
| 1 | N. Weste and D. Harris, | CMOS VLSI Design: A Circuits and Systems Perspective, 3/e, Pearson Education India, 2007. |
| 2 | D. A. Hodges, H. G. Jackson, R. Saleh | Analysis and Design of Digital Integrated Circuits in Deep submicron Technology, 3/e, McGraw Hill, |
| 3 | J. P. Uyemura, | Introduction to VLSI Circuits and Systems, John Wiley & Sons (Asia), 2002. |

| **Course Outcomes:** Upon completion of this course the student will be able to: | |
|---|---|
| CO1 | Analyze the various processes in fabrication of MOSFETs and Digital circuits. |
| CO2 | Design the mask layout and analyze the transient response of digital circuits. |
| CO3 | Realize the digital circuits using Ratioed Logic, Pass Transistor, Transmission Gate Logic, DCVSL, Dynamic Logic configurations. |
| CO4 | Analyze the arithmetic logic, combinational and sequential circuits. |
| CO5 | Analyze the various memory cells and VLSI testing verification techniques. |

# Course Articulation Matrix

**Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)**

| | | **PO's** | | | | | | | | | | | **PSO's** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **1** | **2** |
| **CO's** | **1** | 2 | 2 | | 1 | | | | | | | | 1 | |
| | **2** | | 2 | 2 | 2 | 2 | | | | 1 | | | 1 | |
| | **3** | | 3 | 2 | 1 | 2 | | | | 1 | | | 1 | |
| | **4** | | 3 | 2 | 1 | 1 | | | | | | | 1 | |
| | **5** | | 2 | | | | | | | | | | 1 | |
| | **Avg.** | **2** | **2.4** | **2** | **1.25** | **1.66** | | | | **1** | | | **1** | |

**Note:** 1- Weak correlation 2-Medium correlation 3-Strong correlation

# INDUSTRIAL ELECTRONICS

| | | | |
|---|---|---|---|
| Contact Hours/ Week: | 3(L) | Credits: | 3 |
| Total Lecture Hours: | 42 | CIE Marks: | 50 |
| Sub. Code: | SETE04 | SEE Marks: | 50 |

**Course objectives:**
This course will enable students to:

| | |
|---|---|
| 1. | Explain broad types of industrial power devices, there structure, and its characteristics. |
| 2. | Design and analyse the broad categories of power electronic circuits. |
| 3. | Explain various types of MEMs devices, principle of operation and construction |
| 4. | Familiarize with soft core processors and computer architecture |
| 5. | Apply protective methods for devices and circuits |

**UNIT I**

Industrial Power Devices: General purpose power diodes, fast recovery power diodes, schottky power diodes, silicon carbide power diodes, Power MOSFETs, Steady state characteristics, switching caracteristics, silicon carbide MOSFETs, COOLMOS, Thyristor, Thyristor characteristics, two transistor model.

**10 Hours**

**UNIT II**

Power Electronics Circuits: Controlled Rectifiers - Single phase full converter with R and RL load, Single phase dual converters, and Three phase full converter with RL load. Switching mode regulators - Buck Regulator, Boost regulator, Buck - Boost regulator, comparison of regulators. Inverters - Principle of operation, Single phase bridge inverter, Three phase inverter with 180 and 120 degree conduction, Current source inverter.

**8 Hours**

**UNIT III**

MEMS Devices: Sensing and Measuring Principles, Capacitive Sensing, Resistive Sensing, Piezoelectric Sensing, Thermal Transducers, Optical Sensors, Magnetic Sensors, MEMS Actuation Principles, Electrostatic Actuation, Thermal Actuation, Piezoelectric Actuation, Magnetic Actuation, MEMS Devices_Inertial Sensors, Pressure Sensors, Radio Frequency MEMS: Capacitive Switches and Phase Shifters, Microfluidic Components, Optical Devices.

**8 Hours**

**UNIT IV**

Soft Core Processors - Processor Core Options, Processor Definition Process, Software Development Aspects, Utilization of Soft-Core Processors, Custom Instructions, Soft-Core Processor on an ASIC vs. FPGA, Design Issues, Applications for Soft-Core Processors.

**8 Hours**

| UNIT V | |
|---|---|
| Protections of Devices and Circuits: Cooling and Heat sinks, Thermal Modeling of Power Switching Devices, Electrical Equivalent Thermal model, Mathematical Thermal Equivalent Circuit, Coupling of Electrical and Thermal Components, Snubber circuits, Reverse Recovery Transients, Supply and Load side transients. | |
| | **8 Hours** |

| **TEXT BOOKS** | | |
|---|---|---|
| 1 | Muhammad H. Rashid | Power Electronics: Devices, Circuits, and Applications, Pearson education, 4th edition, 2017 |
| 2 | Bogdan M. Wilamowski, J. David Irwin | Fundamentals of Industrial Electronics, , CRC Press, 1st edition, 2011. |

| **REFERENCE BOOKS** | | |
|---|---|---|
| 1 | Thomas E. Kissell, | Industrial Electronics: Applications for Programmable Controllers, Instrumentation and Process Control, and Electrical Machines and Motor Controls, Prentice Hall, 3rd edition, 2003, |
| 2 | Ned Mohan, T.M. Undeland and W.P. Robbins | "Power Electronics: Converters, Applications and Design", Wiley India Ltd, 3rd Edn. 2008. |

| **Course Outcomes:** Upon completion of this course the student will be able to: | |
|---|---|
| CO1 | Explain different types of industrial power devices such as MOSFET, BJT, IGBT, their structure, and operating characteristics |
| CO2 | Design and analyse the power electronic circuits such as switch mode regulators, inverters, controlled rectifiers and ac voltage controllers. |
| CO3 | Explain various types of MEMs devices used for sensing pressure, temperature, current, voltage, humidity, vibration etc. |
| CO4 | Describe computer hardware, software, architecture, instruction set, memory organization, multiprocessor architecture. |
| CO5 | Apply protective methods for devices various industrial power devices based on thermal requirements and develop protective methods for the circuits against various electrical parameters |

# Course Articulation Matrix

**Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)**

| | | PO's | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **1** | **2** |
| **CO's** | **1** | 2 | 1 | | | | | | | | | | 2 | |
| | **2** | 2 | 2 | 1 | | | | | | | | | 2 | |
| | **3** | 2 | 1 | | | | | | | | | | 2 | |
| | **4** | 2 | 1 | 1 | | | | | | | | | 2 | |
| | **5** | 2 | 2 | 1 | | | | | | | | | 2 | |
| | **Avg.** | **2** | **1.6** | **1** | | | | | | | | | **2** | |

**Note:** 1- Weak correlation 2-Medium correlation 3-Strong correlation

# RESEARCH METHODOLOGY AND IPR

| | | | |
|---|---|---|---|
| Contact Hours/ Week: | : 3(L) | Credits: | 3 |
| Total Lecture Hours: | : 42 | CIE Marks: | 50 |
| Sub. Code: | : SHS04 | SEE Marks: | 50 |

## UNIT I

**RESEARCH METHODOLOGY:** Objectives and motivation of research - Types of research - Research approaches - Significance of research - Research methods verses methodology - Research and scientific method - Importance of research methodology - Research process - Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations- Criteria of good research. Defining the research problem: Definition of research problem - Problem formulation - Necessity of defining the problem - Technique involved in defining a problem.

**8 Hours**

## UNIT II

**LITERATURE SURVEY AND DATA COLLECTION:** Importance of literature survey - Sources of information - Assessment of quality of journals and articles - Information through internet. Effective literature studies approaches, analysis, plagiarism, and research ethics. Data - Preparing, Exploring, examining and displaying. Referencing methods

**8 Hours**

## UNIT III

**RESEARCH DESIGN AND ANALYSIS:** Meaning of research design - Need of research design - Different research designs - Basic principles of experimental design - Developing a research plan - Design of experimental set-up - Use of standards and codes. Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

**9 Hours**

## UNIT IV

**INTELLECTUAL PROPERTY RIGHTS (IPR):** Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. Role of WIPO and WTO ni IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

**8 Hours**

| UNIT V |
|---|
| PATENT RIGHTS (PR): Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs. Licenses, Licensing of related patents, patent agents, Registration of patent agents. |
| **9 Hours** |

| **Text Books:** | | |
|---|---|---|
| 1 | Prof. Kothari C. R. | "Research methodology: Methods and techniques", New Age International, 5th Edition, 2023. ISBN13: 978-9389802559 |
| 2 | R. Ganesan | "Research Methodology for Engineers", MJP Publishers, Chennai, 2011. |

| **Reference Books :** | | |
|---|---|---|
| 1. | Cooper Donald R, Schindler Pamela S and Sharma JK | "Business Research Methods", Tata McGraw Hill Education, 11th Edition, 2012. |
| 2. | Catherine J. Holland | "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007. |
| 3. | David Hunt, LongNguyen, Matthew Rodgers | "Patent searching: tools &techniques", Wiley, 2007. |
| 4. | The Institute of Company Secretaries of India, Statutory bodyunder an Act of parliament | "Professional Programme Intellectual Property Rights, Lawand practice", September 2013. |
| 5. | Peter S. Menel Mark A. Lemley, Robert P.Merges | "Intellectual Property in the New Technological-Vol. Iperspectives, 2021. |
| 6. | Laura R. Ford | "The Intellectual Property of Nations: Sociological and Historical Perspectives on a Modern Legal InstitutionPaperback -2021. |

| **Course Outcomes:** Upon completion of this course the student will be able to: | |
|---|---|
| CO1 | Describe the research process & formulate research problem |
| CO2 | Perform literature review, manage data & practice research ethics |
| CO3 | Practice basic principles of experimental design, use standard codesand carry out research analysis |
| CO4 | Distinguish between types of innovation, describe patenting procedure, maintenance and role of IPR establishments |
| CO5 | Identify the significance of patent rights, licensing, technology transfer& manage patenting system |

# Course Articulation Matrix

**Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)**

| | | PO's | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **1** | **2** |
| **CO's** | **1** | | 3 | 2 | | | | | | | | 2 | | |
| | **2** | | 3 | 2 | | | | | 3 | | | 2 | | |
| | **3** | | 3 | 3 | | | | | | | | 2 | | |
| | **4** | | 3 | 2 | | | | | | | | 2 | | |
| | **5** | | 3 | 2 | | | | | | | | 2 | | |
| | **Avg.** | | **3** | **2** | | | | | **3** | | | **2** | | |

**Note:** 1- Weak correlation 2-Medium correlation 3-Strong correlation

## ENVIRONMENTAL STUDIES

| | | | |
|---|---|---|---|
| Contact Hours/ Week: | : 2 | Credits: | 2 |
| Total Lecture Hours: | : 28 | CIE Marks: | 50 |
| Sub. Code: | : SHS05 | SEE Marks: | 50 |

**COURSE OBJECTIVES:**

This course will enable students to:

| | |
|---|---|
| 1 | Problems of depletion of natural resources due to deforestation, agricultural practices, and adverse environmental effects, pesticides, soil erosion, mining. |
| 2 | Different types of energy- renewable, non-renewable and energy conservation, impact of environmental pollution on water quality, air quality, soil pollution and noise pollution. |
| 3 | Solid waste management- disposal, treatment of different types of solid waste including MSW, e- waste, biomedical waste, societal impact of environmental issues-ozone layer depletion, GHG effects, water conservation and harvesting and environmental protection & acts |

**UNIT I**

Introduction:

- Components of Environment and their interactions
- Ecology, Ecosystem and
  types Natural Resources:
- Forest Resources-Deforestation, Causes of deforestation, Environmental effects of deforestation and solutions
- Water resources, World's water reserves, Hydrological cycle
- Land resources, Land degradation. Soil erosion, Causes and prevention, Soil conservation and its types
- Numerical problems on rainfall & runoff

**6 Hours**

**UNIT II**

Energy and resources:

- Types of Energy-Renewable, Non renewable & sustainable energy & their advantages and disadvantages
- Renewable energy sources- Solar energy, Wind energy, Tidal energy, Ocean thermal energy. Geothermal energy, Hydroelectric power, Biomass energy, Hydrogen energy, Thermal power- environmental impacts
- Conservation of energy
- Numerical problems on Solar energy, Wind power

**5 Hours**

**UNIT III**

Environmental pollution: • Sources of pollution- Natural and anthropogenic sources • Pollutants - Classification & their effects on environment • Air Pollution -Composition of clean air, Sources of air pollution, Effect of air pollution on human health and climate • Water quality – Potable water, Wholesome water, Sources of water pollution Polluted water & Contaminated water• Common impurities in water(physical, chemical and bacteriological), Effects of impurities on human health • Soil Pollution – Sources, effects, and its control.

Noise pollution- Sources of noise, Effects on human health & its control Numerical problems on pH, hardness of water, noise pollution.

**3 Hours**

**UNIT IV**

Solid Waste Management

- Refuse, Garbage, Rubbish, Ash, types of solid waste
- Necessity of safe disposal, Impacts on human health and environment
- Classification of solid wastes- Quantity and composition of MSW, Collection of solid waste- methods
- Disposal of solid waste-Sanitary land-fill
- E-waste- Problems and solutions
- Biomedical waste-Impacts on human health, storage, treatment methods and disposal
- Numerical problems on moisture content, density & proportioning of land fill

**5 Hours**

**UNIT V**

Sustainable development:

- Issues on energy utilization, water conservation, concept of 3 R's, Rain water harvesting-methods.
- Global environmental issues: Population growth, Urbanization, Global warming, Acid rains, Ozone layer depletion & controlling measures.
- Environmental acts, Regulations, Role of state & central governments.
- Numerical problem on carbon foot print & rainwater harvesting.

**5 Hours**

| TEXT BOOKS: | | |
|---|---|---|
| 1 | Joseph, B | Environmental Studies (2009), India: Tata McGraw-Hill. ISBN: 9781283922524. |
| 2 | Tripathi, A. K | Environmental Studies(2016), India: Energy and Resources Institute. ISBN:9788179935828. |

| REFERENCES: | | |
|---|---|---|
| 1 | Erach Bharucha | Environmental studies for Undergraduate Courses, 1st Edition, University Press, (2013). |
| 2 | Santhosh Kumar Garg | Environmental Science and Engineering Ecology and Environmental Studies, Khanna Publishers, (2015), ISBN-10 : 8174092188 ISBN-13 : 978-8174092182. |

| COURSE OUTCOMES: Upon completion of this course the student will be able to: | |
|---|---|
| CO1 | Describe the importance of forestation, effects of deforestation, land degradation, adverse effects of mining on environment, using the principles of natural sciences compute the runoff from rainfall & estimates the conservation of water for beneficial use of humans. |
| CO2 | Describe the Renewable sources of energy and formulate, review literature, calculate power potential of solar & wind energy by using the principles of natural sciences. |
| CO3 | Describe the effects of pollution of air, water, soil & noise on humans and environment, identify & analyze the pollution problems related to air, water, soil & noise and quantify pollution levels & draw valid inferences using the principles of engineering sciences |
| CO4 | Describe Impact of solid waste on human health and environment, its safe disposal. Use population data & compute percapita solid waste generation, land area requirement for sanitary landfill |
| CO5 | Describe the sustainable development, its importance, current global environmental issues, Present state & central governments protection acts, compute carbon foot print using data(vehicles/industries) & asses its impact on environment. |

# Course Articulation Matrix

**Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)**

| | | PO's | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 1 | 2 |
| CO's | 1 | | | | | | | 2 | | | | | | |
| | 2 | | | | | | | 2 | | | | | | |
| | 3 | | | | | | | 2 | | | | | | |
| | 4 | | | | | | | 2 | | | | | | |
| | 5 | | | | | | | 2 | | | | | | |
| | Avg. | | | | | | | **2** | | | | | | |

**Note:** 1- Weak correlation 2-Medium correlation 3-Strong correlation

# NATIONAL CADET CORPS

| | | | |
|---|---|---|---|
| Contact Hours/Week | : 3+0+0 (L+T+P) | Credits | : 0 |
| Total Lecture Hours | : 39 | CIE Marks | : 50 |
| Course Code | : NMC04 | SEE Marks | : 50 |

The objectives of this course are:

1. Learn the important concept of Rescue methods
2. Acquire the knowledge on Self defence.
3. Learn the basic concepts and types of Yogasanas
4. Learn the advanced concepts of Waste Management.
5. Acquire the basic knowledge on Personality development.

## UNIT I

**Rescue methods:** Carriage of Sick and Wounded Person: Factors influence the carrying methods, Methods of Carrying the sick and wounded person. Fire extinguishing and its types. Fire fighting equipment. Rescue and its methods.

**08 Hours**

## UNIT II

**Self Defence:** For unarmed combat, essentials of unarmed combat, attacking and types of attacking, Basic Throws.

**08 Hours**

## UNIT III

**Yogasanas:** Asanas and its advantages, Hints for successful yogasanas, Types of Yogasanas and its uses.

**08 Hours**

## UNIT IV

**Waste Management:** Types of Waste and their management. Adventure activities (Rock Climbing, Cycling and Trekking), Factors to remember during adventure activities

**08 Hours**

## UNIT V

**Personality Development:** The concept of life skills, Core Skills, Factors influencing the personality, Attitude and Time management

**07 Hours**

**Text Books:**

| | | |
|---|---|---|
| 1. | DG NCC | NCC Cadets Handbook – Common, Directorate General of NCC, New Delhi. |
| 2. | DG NCC | NCC Cadets Handbook – Special, Directorate General of NCC, New Delhi. |

**Reference Books:**

| | | |
|---|---|---|
| 1. | Chandra B. Khanduri | "Field Marshal KM Cariappa: a biographical sketch", Dev Publications, 2000 |
| 2. | Gautam Sharma | "Valour and Sacrifice: Famous Regiments of the Indian Army", Allied Publishers, 1990 |
| 3. | Warren G. Bennis | "On Becoming a Leader", Perseus Books, 1989 |

**Course Outcomes:**

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

CO1 Analyze the concepts of Rescue Methods to apply the same during difficult times

CO2 Apply the learned self defence tactics only during the difficult times.

CO3 Analyze and Practice the Yogasanas to keep healthier mind and body.

CO4 Apply the learned waste management concepts during day to day life.

CO5 Analyze the concepts related to personality development apply the concepts in all walks of life.

# VI SEMESTER

## DATA COMMUNICATION NETWORKS

| | | | |
|---|---|---|---|
| Contact Hours/ Week: | 3(L)+2(P) | Credits: | 4 |
| Total Lecture Hours: | 42(L)+28(P) | CIE Marks: | 50 |
| Sub. Code: | S6ETI01 | SEE Marks: | 50 |

**Course objectives:**
This course will enable students to:

| | |
|---|---|
| 1. | Understand the functions of various layers in the network model (OSI, TCP/IP) for data communication and protocols. |
| 2. | Understand and analyze, framing techniques, flow control, error control mechanisms and data link protocols |
| 3. | Compare the performance of inter-networking devices and IEEE standard frame formats used for Wired and Wireless LANs |
| 4. | Analyze and design the internet protocols I*pv4, Ipv6,* and routing protocols for network connectivity. |
| 5. | Understand the working of TCP/UDP and basic network protocols |

**UNIT I**

**Network Models:** Layered Architecture, TCP/IP protocol Suite, Addressing: Physical, Logical, port and specific addressing, Multiplexing: FDM, TDM and WDM. **Data Link Control:** Framing, Flow and error control, Protocols: Simple protocol, Stop-and-wait protocol, piggybacking, Noiseless channels and noisy channels, HDLC, Point-to-Point Protocol.

**10 Hours**

**UNIT II**

**Multiple Access:** Random access: ALOHA, CSMA, Controlled access: Reservation, Polling, and Token passing, Channelization: FDMA, TDMA, and CDMA. **Wired LAN:** Ethernet, IEEE standards, Standard Ethernet, Changes in the standards, Fast Ethernet, Gigabit Ethernet.

**8 Hours**

**UNIT III**

**Wireless LAN:** IEEE 802.11: Architecture, MAC sublayer, Addressing Mechanism, Bluetooth: Architecture, Layers. **Connecting LANs Backbone Networks and Virtual LANs:** Connecting devices, Backbone Networks, Virtual LANs.

**8 Hours**

| UNIT IV |
|---|
| **Network Layer- Logical addressing**: Ipv4 addresses, Ipv6 addresses, Internet Protocol: Ipv4, Ipv6, and Transition from Ipv4 to Ipv6. **Routing Algorithms:** The Optimality Principle, Shortest Path Routing, Flooding, Distance Vector Routing, Link State Routing. |
| **8 Hours** |

| UNIT V |
|---|
| **Transport Layer:** Process to process delivery, UDP: User Datagram, services, Applications, TCP: Services, Features, Segments, and a TCP Connection<br>**Application Layer:** DNS: Name space, DNS in the Internet, Resolution, Electronic Mail, and World Wide Web.<br>Introduction to Network Management Systems, Basics of SDM, |
| **8 Hours** |

| **TEXT BOOKS** | | |
|---|---|---|
| 1 | Behrouz A. Forouzan | Data Communications and Networking with TCPIP Protocol Suite 6th Edition, Tata McGraw-Hill, 2022 |
| 2 | Alexander Clemm | Network Management Fundamentals 1st Edn. CISCO Press 2006. |

| **REFERENCE BOOKS** | | |
|---|---|---|
| 1 | Andrew S Tanenbaum | Computer Networks – 5th Edition, Pearson Education/PHI, 2010 |
| 2 | William Stallings | Data and Computer Communication, 8th Edition, Pearson Education India 2017 |

| **Lab Experiments** |
|---|
| **C Programming:** |
| 1. Realize a program to find transmitted data with CRC code, and error detection in received code using CRC for the given generator polynomial |
| 2. Design and Develop a Hamming algorithm to encode the given bits for transmission, and check for error bit in the received code |
| 3. Realize a spanning tree algorithm to find loop less path with 6 to 10 nodes. |
| 4. For the given network graph, write a program to implement Link state routing algorithm to build a routing table for the given node |
| **NS2 Simulator:** |
| 1. Simulate the following topology using UDP agent. Find the bandwidth of link-n for no packet loss. Illustrate for packet loss and no packet loss. On other links let the packet size be A bytes with inter-packet gap of B millisecond. Have the simulation run for C second and CBR run from D to E second. Verify in nam the flow of packet. Find the number of packets dropped due congestion |

| |
|---|
| 2. Determine the number of packets sent by TCP and UDP for the following topology. Apply TCP agent between link-1 and UDP between link-2. Apply relevant applications over TCP and UDP agents changing the parameter. |
| 3. Simulate the following topology (star/mesh/ring). Find the number of packets dropped due congestion. Find the default packet size of CBR and FTP |
| 4. Simulate a Standard Ethernet LAN using n nodes (6-10), with and without error rate in a node n and compare the throughput. Simulate a Fast Ethernet LAN using n nodes and set multiple traffic nodes and determine the collision across different nodes |

| **Course Outcomes:** Upon completion of this course the student will be able to: | |
|---|---|
| CO1 | Apply the basics of computer networks technology and analyze the concepts of layered architecture, flow control and error control protocols. |
| CO2 | Distinguish and compare different data link control protocols such as random access, controlled access and channelization protocol. Analyze the performance of inter- networking devices in Wired LANs using Ethernet standard. |
| CO3 | Analyze and apply the IEEE standard frame formats used for Wireless LANs, Backbone networks and virtual LAN |
| CO4 | Analyze and design Internet protocols Ipv4, Ipv6 and routing protocols for network connectivity. |
| CO5 | Analyze connection oriented, connection less protocols, and network protocols. Design different point-to-point and LAN Network systems for the given scenario, by making use of TCP and UDP protocols, |

# Course Articulation Matrix

**Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)**

| | | **PO's** | | | | | | | | | | | **PSO's** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **1** | **2** |
| **CO's** | **1** | 3 | 1 | | | 1 | | | | | | | | 2 |
| | **2** | 3 | 1 | 3 | | 1 | | | | | | | | 2 |
| | **3** | 3 | 2 | 2 | | 1 | | | | 1 | | | | 2 |
| | **4** | 3 | 2 | 3 | | 1 | | | | 1 | 1 | | | 2 |
| | **5** | 3 | 2 | 2 | | 1 | | | | 1 | 1 | | | 2 |
| | **Avg.** | **3** | **1.6** | **2.5** | | **1** | | | | **1** | **1** | | | **2** |

**Note:** 1- Weak correlation 2-Medium correlation 3-Strong correlation

# MICROWAVE ENGINEERING AND ANTENNA DESIGN

| | | | |
|---|---|---|---|
| Contact Hours/ Week: | 3(L)+2(T) | Credits: | 4 |
| Total Lecture Hours: | 42(L)+28(T) | CIE Marks: | 50 |
| Sub. Code: | S6ET01 | SEE Marks: | 50 |

**Course objectives:**

This course will enable students to:

| | |
|---|---|
| 1. | Understand the operating principles, theory, analysis, design, and construction of microwave active and passive devices. |
| 2. | Design and analyze construction of antennas for modern wireless communication systems. |

**UNIT I**

**Microwave sources and detectors:**

Microwave frequencies, advantages of microwaves, general and Industrial applications of microwaves. Klystrons, Reflex Klystron, velocity modulation, transit time, density modulation, beam spreading/ debunching, power output and efficiency, Traveling Wave Tube, Magnetron. Gunn diode and its applications.

**10 Hours**

**UNIT II**

**Passive microwave devices and circuits**

S-Parameters and their Properties, Analysis of Wilkinson Power Divider, The Quadrature (90') Hybrid power divider, Coupled Line Directional Couplers.

**Antenna Parameters:**

Basic antenna parameters: Power density, Radiation intensity, Directivity and Gain, Radiation Patterns, Beam width, resolution, Efficiency, Radiation resistance, input impedance, Effective aperture, Effective Height. Radiation mechanism, Antenna field zones. Relation between gain and directivity

**8 Hours**

**UNIT III**

**Link Budget Analysis and Dipole Antenna**

The Radio communication link, Field components (No derivation) and radiation resistance of short dipole and $\lambda/2$ antennas, Thin linear Antennas and radiation patterns. Construction, Design, Operational and applications of Yagi-Uda Antenna

**8 Hours**

| UNIT IV |
|---|
| **Arrays:** Introduction, applications, factors which control the radiation properties of the array. Linear array of n isotropic point sources of equal amplitude and spacing: Array factor, Null directions, minor lobe maxima directions, Null and Half power beam widths. Array of two point sources. The principle of pattern multiplication. Planar array and array factor. |
| **8 Hours** |

| UNIT V |
|---|
| **Broadband and resonant antennas:** |
| Log periodic antenna, helical antenna: Normal mode and axial mode operation, design procedure. The rectangular horn antenna, corrugated horns, Flat sheet reflectors, Corner Reflector, The symmetric parabolic reflector antenna. Rectangular microstrip antenna (Design Equation and Operating Principle only) |
| **8 Hours** |

| **TEXT BOOKS** | | |
|---|---|---|
| 1 | C. A. Balanis | Antenna Theory Analysis and Design", John Wiley, 2nd Edition, 1997 |
| 2 | D.M. Pozar | "Microwave Engineering", Wiley publications, 3rd edition, 2004. |
| 3 | Samuel Liao | Microwave devices and circuits, Prentice Hall, 3rd edition, 2003. |

| **REFERENCE BOOKS** | | |
|---|---|---|
| 1 | John D Kraus R J Marhefka and Ahmed S Khan | "Antennas for all applications", Tata McGraw Hiill India, 3rd Edition, 2006. |
| 2 | Annapurna Das, Sisir K Das | "Microwave Engineering" TMH publications, 2009. |

| **Course Outcomes:** Upon completion of this course the student will be able to: | |
|---|---|
| CO1 | Explain operating principle, theory, and construction of active devices used at RF and microwave frequencies. |
| CO2 | Analyze the properties of microwave devices and circuits using S-parameters and able to design planar microwave devices. |
| CO3 | Use parameters of antennas & carryout investigation of link budget for radio wave propagation related to different applications and develop solutions to solve practical problems. |
| CO4 | Demonstrate the operating theory, construction, and effective design of antennas for various wireless applications. |
| CO5 | Apply antenna array theory to design antennas for modern wireless communication systems like Smart antenna systems and MIMO systems. |

# Course Articulation Matrix

**Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)**

| | | PO's | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **1** | **2** |
| **CO's** | **1** | 1 | 2 | 2 | 2 | 2 | | | | | | | 1 | 2 |
| | **2** | 1 | 2 | 2 | 2 | 2 | | | | | | | 1 | 2 |
| | **3** | 1 | 2 | 2 | 2 | 2 | | | | | | | 1 | 1 |
| | **4** | 1 | 2 | 2 | 2 | 2 | | | | | | | 2 | 2 |
| | **5** | 1 | 2 | 2 | 2 | 2 | | | | | | | 2 | 2 |
| | **Avg.** | **1** | **2** | **2** | **2** | **2** | | | | | | | **1.4** | **1.8** |

**Note:** 1- Weak correlation 2-Medium correlation 3-Strong correlation

# MICROWAVE ENGG. & ANTENNA DESIGN LAB

| | | | |
|---|---|---|---|
| Contact Hours/ Week: | 2 (P) | Credits: | 1 |
| Total Labs: | 14 | CIE Marks: | 50 |
| Sub. Code: | S6ETL01 | SEE Marks: | 50 |

| **Course objectives:** | |
|---|---|
| This course will enable students to: | |
| 1. | Develop skills in usage of simulation tools like AWR, IE3D, etc., for engineering problems |
| 2. | Demonstrate the design and analysis of passive devices and optimization of their performance using AWR EM simulation tool |
| 3. | Provide practical experience on the usage of RF and Microwave sources and detectors, and conduct experiments to study the properties of RF and Microwave devices. |

| | |
|---|---|
| Using Microstrip | |
| 1. | Ring resonator |
| 2. | S- parameters for Branch line and Parallel line coupler |
| 3. | Radiation pattern for Yagi and dipole antenna |
| 4. | Mode characteristics of Reflex Klystron |
| 5. | Rectangular Wave Guide λ g , λ c , f o , Unknown Load value, VSWR of different loads |
| Using Microwave Office | |
| 1. | Microstrip Line resonator and ring resonator |
| 2. | Equivalent circuits of Line and Ring resonators |
| 3. | Microstrip Branch line coupler |
| 4. | Microstrip parallel line coupler |
| 5. | Microstrip Rectangular patch antenna |
| 6. | Microstrip Dipole and Yagi-Uda antenna |

| **Course Outcomes:** | |
|---|---|
| Upon completion of this course the student will be able to: | |
| CO1 | Effectively use EM and circuit simulation tools (AWR and MATLAB) to analyze the properties of microwave devices and circuits like resonators, power dividers and microstrip antennas. |
| CO2 | Conduct experiments using latest microwave sources and testing equipment's to characterize the properties of microwave passive and active devices |
| CO3 | Carryout measurements on transmission lines and analyze practical problems related to transmission lines |

# Course Articulation Matrix

**Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)**

| | | **PO's** | | | | | | | | | | | **PSO's** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **1** | **2** |
| **CO's** | **1** | 2 | 3 | 3 | | 3 | | | | | | | 1 | 2 |
| | **2** | 1 | 3 | 2 | | 3 | | | | | | | 1 | 2 |
| | **3** | 2 | 3 | 2 | | 2 | | | | | | | 2 | 1 |
| | **Avg.** | **2** | **3** | **2** | | **3** | | | | | | | **1** | **1.6** |

**Note:** 1- Weak correlation 2-Medium correlation 3-Strong correlation

# ANALOG VLSI DESIGN

| | | | |
|---|---|---|---|
| Contact Hours/ Week: | 3 | Credits: | 3 |
| Total Lecture Hours: | 42 | CIE Marks: | 50 |
| Sub. Code: | SETE05 | SEE Marks: | 50 |

**Course objectives:**
This course will enable students to:

| | |
|---|---|
| 1. | Design CMOS Op-amp Amplifiers. |
| 2. | Design Two stage OP amp circuits |
| 3. | Introduce Switched capacitor circuits |
| 4. | Design and analysis of ADC, DAC. |

**UNIT I**

CMOS amplifiers: Current sources, current mirrors, amplifiers with active loads, CG and CD amplifiers, Cascode amplifiers and double Cascode and Folded Cascode amplifiers. Cascode and Wilson current mirrors,

**10 Hours**

**UNIT II**

Differential amplifiers: The MOS differential pair and their small signal operation. Non-ideal characteristics of Differential amplifiers, differential amplifiers with active load and frequency response differential amplifiers

**8 Hours**

**UNIT III**

CMOS amplifiers: Design of CMOS Op-amp, Compensation of op-amps, and two stage Op-amps and Cascode Op-amps.

**8 Hours**

**UNIT IV**

Comparators and Switched Capacitors: Open loop comparators, Performance improvement of Open loop comparators, High speed comparators, Switched Capacitors: Switched Capacitor circuits, Switched Capacitor amplifiers, Switched Capacitor amplifiers, Switched Capacitor filters.

**8 Hours**

**UNIT V**

Data converters: Digital to Analog converters: Introduction to Digital to analog converters, serial and parallel converters, resolution extension techniques. Analog to Digital converters- Introduction to Analog to digital converters, Serial ADC, Medium and High speed ADCs.

**8 Hours**

| TEXT BOOKS | | |
|---|---|---|
| 1 | Phillip E.Allen, Douglas R. Holberg | CMOS Analog Circuit Design, Oxfard University Press, 3rd Edition 2013 |
| 2 | Adel S. Sedra, Kenneth Carless Smith | "Microelectronic Circuits", Oxford University. 7th Edition. 2017 |

| REFERENCE BOOKS | | |
|---|---|---|
| 1 | Hurst, and S. Lewis, | Analog Integrated Circuit Design, John Wiley & Sons, 1997<br>Analysis and Design of Analog Integrated Circuits, John Wiley and Sons, 6th Edition, 2013 |

| **Course Outcomes:**<br>Upon completion of this course the student will be able to: | |
|---|---|
| CO1 | Design basic MOSFET amplifiers and write their transfer functions. |
| CO2 | Design and Analyze the Differential amplifiers with active loads |
| CO3 | Analyze and develop 2 stage Differential amplifiers for the given specifications. |
| CO4 | Analyze and differentiate the performance of RC filters to Switched capacitor filters. |
| CO5 | Design of ADC and DAC using two stage Opamp circuits |

# Course Articulation Matrix

**Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)**

| | | PO's | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **1** | **2** |
| **CO's** | **1** | 2 | 2 | 2 | | | | | | | | | 2 | |
| | **2** | 2 | 2 | 2 | | | | | | | | | 2 | |
| | **3** | 2 | 2 | 2 | | | | | | | | | 2 | |
| | **4** | 2 | 2 | 2 | | | | | | | | | 2 | |
| | **5** | 2 | 2 | 2 | | | | | | | | | 2 | |
| | **Avg.** | **2** | **2** | **2** | | | | | | | | | **2** | |

**Note:** 1- Weak correlation 2-Medium correlation 3-Strong correlation

# RADAR SYSTEMS

| | | | |
|---|---|---|---|
| Contact Hours/ Week: | 3 (L) | Credits: | 3 |
| Total Lecture Hours: | 42 | CIE Marks: | 50 |
| Sub. Code: | SETE06 | SEE Marks: | 50 |

**Course objectives:**

This course will enable students to:

| | |
|---|---|
| 1. | Understand about radar fundamentals, the radar ranges and parameters of general radar equation. |
| 2. | Explain the operation of MTI radar and delay line cancellers. |
| 3. | Understand of the importance of Matched Filter Receivers in Radars. |
| 4. | Describe the functions and parameters of various Radar Antennas. |
| 5. | Expalin the Principles and Applications of Millimeter wave radar. |

**UNIT I**

An Introduction to Radar: Basic Radar, The Simple Form of the Radar Equation, Radar Block Diagram, Radar Frequencies, Applications of Radar, The Radar Equation: Introduction, Detection of Signals in Noise, Receiver Noise and the Signal to Noise Ratio, Probabilities of Detection and False Alarm, Radar Cross section of Simple Targets, Transmitter Power, Pulse Repetition Frequency. System losses.

**10 Hours**

**UNIT II**

MTI and Pulse Doppler Radar: Introduction to Doppler and MTI Radar, Delay Line Cancellers, Digital MTI Processing, Pulse Doppler Radar, Tracking Radar: Tracking with Radar, Mono-pulse Tracking, Conical Scan and Sequential Lobing, Tracking in Range

**8 Hours**

**UNIT III**

Detection of Signals in Noise: Introduction, Matched Filter Receiver, Detection Criteria, Detectors, Automatic Detection Radar Clutter: Introduction to Radar Clutter, Surface Clutter to Radar Equation

**8 Hours**

**UNIT IV**

The Radar Antenna: Functions of Radar Antenna, Antenna Parameters, Reflector Antennas, Electronically Steered Phased Array Antennas, Radar Receiver: The Radar Receiver, Receiver Noise Figure, Super heterodyne Receiver , Duplexers

**8 Hours**

| UNIT V |
|---|
| Principles and Applications of Millimeter wave radar: Introduction, Propagation and scattering of millimeter length waves, Radar design principles, Remote sensing applications, and Security and Safety applications. |
| **8 Hours** |

| **TEXT BOOKS** | | |
|---|---|---|
| 1 | Merrill I. Skolnik | Introduction to Radar Systems, 3rd Edn., TMH, 2001. |
| 2 | F.J. Yanovsky | Millimeter Wave Radar: Principles and Applications,1st Edn., 2008 |

| **REFERENCE BOOKS** | | |
|---|---|---|
| 1 | Byron Edde | RADAR: Principles, Technology & Applications, Pearson Education, 2004. |

| **Course Outcomes:** Upon completion of this course the student will be able to: | |
|---|---|
| CO1 | Analyze the working of Radar system and derive equations for target detection. |
| CO2 | Analyze blind speeds, range gated Doppler filters and compare MTI radar with Pulse Doppler radar. |
| CO3 | Analyze the importance of Matched Filter Receivers in detection of Radar signals. |
| CO4 | Analyze the antenna parameters and the system components of radar receiver. |
| CO5 | Apply the concepts of millimeter wave radar for security and safety applications. |

# Course Articulation Matrix

**Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)**

| | | **PO's** | | | | | | | | | | | **PSO's** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **1** | **2** |
| **CO's** | **1** | 2 | 2 | | | | | | | | | | | 2 |
| | **2** | 2 | 2 | | | | | | | | | | | 2 |
| | **3** | 2 | 2 | | | | | | | | | | | 2 |
| | **4** | 2 | 2 | | | | | | | | | | | 2 |
| | **5** | 2 | 2 | 1 | | | | | | | | | | 2 |
| | **Avg.** | **2** | **2** | **1** | | | | | | | | | | **2** |

**Note:** 1- Weak correlation 2-Medium correlation 3-Strong correlation

# MULTIMEDIA COMMUNICATION

| | | | |
|---|---|---|---|
| Contact Hours/ Week: | 3 (L) | Credits: | 3 |
| Total Lecture Hours: | 42 | CIE Marks: | 50 |
| Sub. Code: | SETE07 | SEE Marks: | 50 |

**Course objectives:**
This course will enable students to:

| | |
|---|---|
| 1. | Understand graphics and image data representations available in multimedia. |
| 2. | Apply lossless and lossy compression algorithms to 1-D and 2-D data. |
| 3. | Use different image and video compression standards for image and video compression. |

**UNIT I**

Introduction to Multimedia, Graphics & Image Representation, Fundamental concepts in Video and audio: Definition of Multimedia, Multi-media and Hypermedia. Graphics/Image Data Types, Popular File Formats. Types of Video Signals, Analog Video, Digital Video, Digitization of sound, Quantization and Transmission of Audio. **SDI:** Audio and Video Standards

**10 Hours**

**UNIT II**

Lossless compression algorithms: Introduction to lossless compression, Basic information theory, Run-length coding, Variable-length coding, Dictionary-Based Coding, Arithmetic coding, Lossless Image compression.

**8 Hours**

**UNIT III**

Lossy compression algorithms: Introduction to lossy compression, Distortion measures, Quantization, Transform coding, Wavelet-Based coding, Wavelet Packets, Embedded Zero tree of Wavelet Coefficients, SPIHT.

**8 Hours**

**UNIT IV**

Image Compression Standards and MPEG Video Coding I: The JPEG standard, The JPEG2000 standard, The JPEG-LS standard, Bi-level Image compression standard, H.261, Overview of MPEG-1.

**8 Hours**

| UNIT V | |
|---|---|
| MPEG Video Coding II: MPEG-2, Overview MPEG-4, Object Based Visual Coding in MPEG-4, Synthetic Object coding in MPEG-4, MPEG-7. | |
| | **8 Hours** |

| **TEXT BOOKS** | | |
|---|---|---|
| 1 | Ze-Nian Li and Mark S. Drew | Fundamentals of Multimedia, Prentice Hall India Learning Private Limited, 2005 |

| **REFERENCE BOOKS** | | |
|---|---|---|
| 1 | Khalid Sayood | Introduction to Data Compression: Elsevier, Third Edition, 2010. |

| **Course Outcomes:** Upon completion of this course the student will be able to: | |
|---|---|
| CO1 | Analyze fundamental concepts of audio and video signals. |
| CO2 | Apply lossless compression algorithms to text and image data. |
| CO3 | Apply lossy compression algorithms to 1D and 2D signals. |
| CO4 | Analyze still image compression standards like JPEG and JPEG2000 |
| CO5 | Analyze video compression standards like MPEG 1, 2, 4 and 7. |

# Course Articulation Matrix

**Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)**

| | | PO's | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 1 | 2 |
| CO's | 1 | 1 | 3 | 1 | | | | | | | | | | 1 |
| | 2 | 1 | 3 | 1 | | | | | | | | | | 2 |
| | 3 | 3 | 2 | 2 | | | | | | | | | | 2 |
| | 4 | 3 | 2 | 2 | | | | | | | | | | 1 |
| | 5 | 3 | 2 | 1 | | | | | | | | | | 2 |
| | Avg. | 2 | 2 | 1 | | | | | | | | | | 1.6 |

**Note:** 1- Weak correlation 2-Medium correlation 3-Strong correlation

# ARTIFICIAL NEURAL NETWORK

| | | | |
|---|---|---|---|
| Contact Hours/ Week: | 3 | Credits: | 3 |
| Total Lecture Hours: | 42 | CIE Marks: | 50 |
| Sub. Code: | SETE08 | SEE Marks: | 50 |

**Course objectives:**

This course will enable students to:

| | |
|---|---|
| 1. | Understand basic differences between human and machine intelligence, the attractive features of the biological neural networks to realize some of features through parallel and distributed processing models |
| 2. | Explain the biological and mathematical foundations of neural network models |
| 3. | Learn different learning models to train an artificial neural network |
| 4. | Identify various pattern recognition tasks & select suitable neural network architectures |
| 5. | Design, build and train neural networks to solve various pattern recognition tasks |

**UNIT I**

**Review of Linear algebra**: Linear combination of vectors, linearly dependent and independent set of vectors, Vector space, subspace, basis, rank, Eigen vectors, orthogonal vectors, inner product, outer product.(No questions will appear in the end exam from these topics)

**Basics of Artificial Neural Networks**: Trends in computing, Pattern and Data, Pattern recognition tasks. Basic methods of pattern recognition, Basics of Artificial Neural Networks, Biological Neural Network, Models of neuron: McCulloch-Pitts Model, Perceptron, Adaline, topology, Supervised and unsupervised learning, Basic learning laws, Realization of logic functions using MP neuron

**10 Hours**

**UNIT II**

**Functional units of ANN & Single layer perceptron**: Basic ANN Models (architectures) for Pattern recognition task**,** Pattern recognition tasks by i) Feed-forward ii) Feed-back iii) competitive learning Neural networks. Feed-forward neural network: Linear associative network, Analysis of pattern classification networks, Linear separability, Perceptron convergence theorem

**8 Hours**

**UNIT III**

**Multi-Layer perceptron:** Linear Inseparability**:** Hard problems, MLFFNN: Back propagation learning, Draw backs of back propagation algorithm, Heuristics to improve the performance of Back propagation learning discussion on error back propagation, Convolution neural network (**CNN**).

**8 Hours**

| UNIT IV |
|---|
| **Feedback Neural Networks**: Analysis of pattern storage networks, The Hopfield Model, Energy analysis of Hopfield model, State transition diagram, Pattern storage: Hard problems, Stochastic Networks and simulated annealing.<br>**Competitive learning network**: Basic competitive learning, Analysis of pattern clustering Networks. Analysis of Feature Mapping Network |
| **8 Hours** |
| **UNIT V** |
| **Architectures for complex pattern recognition tasks**: Bidirectional associative memory, Architecture of Radial basis function (RBF) networks, Theorems for function approximation, RBF networks for function approximation, Covers theorem on separability of patterns, The XOR problem, RBF Networks for pattern Classification, comparison of RBF with MLP networks<br>**Introduction to Generative AI**: Overview of Generative Models, Natural Language Processing (NLP) Applications |
| **8 Hours** |

| **TEXT BOOKS** | | |
|---|---|---|
| 1 | B. Yegnanarayana | Artificial neural networks, PHI, 2010. |
| 2. | Ian Goodfellow, Yoshua Bengio, Aaron Courville | Deep Learning, MIT Press, 2016, ISBN-13: 978-0262035613 |

| **REFERENCE BOOKS** | | |
|---|---|---|
| 1 | Simon Haykin | Neural Networks for Pattern Recognition, Pearson Education Limited, 3rd Edition, 2016 |
| 2 | Robert J. Schalkoff | Artificial Neural Networks, Mcgraw-Hill Inc., 2011 |

| **Course Outcomes:**<br>Upon completion of this course the student will be able to: | |
|---|---|
| CO1 | Distinguish between human and machine intelligence |
| CO2 | Analyze various learning methods of neural networks. |
| CO3 | Illustrate the use of feed-forward neural network for simple pattern recognition tasks. |
| CO4 | Illustrate use of feed-back neural network for pattern storage problems. |
| CO5 | Apply Radial basis function networks for complex pattern recognition tasks |

**E-Resources:**

1 https://onlinecourses.nptel.ac.in/noc22_cs73/course

2 https://onlinecourses.nptel.ac.in/noc22_cs124

## Course Articulation Matrix

**Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)**

| | | PO's | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 1 | 2 |
| CO's | 1 | | | | 1 | | | | | | | | | |
| | 2 | 1 | 2 | 1 | | | | | | | | | | |
| | 3 | 1 | 1 | 2 | 2 | | | | | | | | | |
| | 4 | 2 | 2 | 2 | 2 | | | | | | | | | |
| | 5 | 2 | 2 | 2 | 2 | | | | | | | | | |
| | Avg. | 1.2 | 1.8 | 1.6 | 1.8 | | | | | | | | | |

**Note:** 1- Weak correlation 2-Medium correlation 3-Strong correlation

# BIOMEDICAL SIGNAL PROCESSING

| | | | |
|---|---|---|---|
| Contact Hours/ Week: | 3 (L) | Credits: | 3 |
| Total Lecture Hours: | 42 | CIE Marks: | 50 |
| Sub. Code: | SETE09 | SEE Marks: | 50 |

**Course objectives:**

This course will enable students to:

| | |
|---|---|
| 1. | Differentiate the characteristics of commonly used biomedical signals. |
| 2. | Apply data reduction techniques for biomedical signals and adaptive techniques for eliminating noise interferences in processing of biomedical signals. |
| 3. | Classify EEG patterns and human sleep EEG into various stages. |

**UNIT I**

**INTRODUCTION TO BIOMEDICAL SIGNALS:** Characteristics of medical data, Medical instrumentation system, Iterative definition of medicine, The nature of biomedical signals, Examples of biomedical signals: the action potential, origin of ECG, EEG, EMG, EOG and their characteristics, Objectives of biomedical signal analysis, Difficulties in biomedical signal analysis, Computer aided diagnosis

**10 Hours**

**UNIT II**

**CORDIOLOGICAL SIGNAL PROCESSING:** ECG data acquisition, ECG lead system, ECG QRS detection techniques: Power spectrum of the ECG, Bandpass filtering technique, Differentiation techniques, Template matching techniques, A QRS detection algorithm, Estimation of RR interval, ST segment analyzer, Portable arrhythmia monitor, Arrhythmia analysis monitoring, long term continuous ECG recording

**8 Hours**

**UNIT III**

**SIGNAL AVERAGING:** Basics of signal averaging, Signal averaging as a digital filter, A typical averager, Software for signal averaging.

**DATA REDUCTION TECHNIQUES:** Direct ECG data compression techniques: Turing point algorithm, AZTEC algorithm, CORTES and FAN algorithm. Other data compression techniques: Entropy coding, Huffman coding, Modified Huffman coding, Adaptive coding, Residual differencing, Run-length coding, and Differential pulse code modulation.

**8 Hours**

**UNIT IV**

**NEUROLOGICAL SIGNAL PROCESSING:** The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics, EEG analysis, Detection of EEG rhythms, Coherence analysis of EEG channels, Detection of EEG spike-and-wave complexes. **Sleep EEG:** Data acquisition and Classification of sleep stages, Dynamics of sleep-wake transitions.

**LINEAR PREDICTION THEORY:** Introduction, The Autoregressive (AR) method, Recursive estimation of AR parameters: The Levinson's algorithm. Spectral error measure, Adaptive segmentation, Transient detection and elimination. ARMA Model

**8 Hours**

**UNIT V**

**ADAPTIVE FILTERS:** A review of Wiener filtering problem, Principle of an Adaptive filter, The steepest descent algorithm, the Widrow-Hoff least mean square adaptive algorithm, Adaptive noise canceller, Cancellation of 50Hz interference in ECG, Canceling Donor-heart interference in Heart-transplant electrocardiography, Cancellation of ECG signal from the electrical activity of the chest muscles, canceling of maternal ECG in fetal ECG, Cancellation of High frequency noise in Electro-surgery

**8 Hours**

| | | |
|---|---|---|
| **TEXT BOOKS** | | |
| 1 | D C Reddy | Biomedical Signal Processing Principles and Techniques, Tata McGraw-Hill publications. |
| 2 | Willis J. Tompkins | Biomedical Digital Signal Processing, The Prentice Hall of India publications |
| **REFERENCE BOOKS** | | |
| 1 | Rangaraj M. Rangayyan | Biomedical Signal Analysis a case study approaches, John Wiley publications. |

| | |
|---|---|
| **Course Outcomes:** Upon completion of this course the student will be able to: | |
| CO1: | Differentiate origins and characteristics of some of the most commonly used biomedical signals like ECG, EEG, and EMG. |
| CO2: | Identify important morphologies of ECG waveforms and their measurements. Develop techniques for estimating parameters that characterize various morphologies of the ECG waveform. |
| CO3: | Apply data reduction techniques for computerized medical signal processing systems. |
| CO4: | Classify EEG patterns of clinical significance and human sleep EEG into various stages and use various tools for feature extraction of EEG signals using AR time series modeling. |
| CO5: | Apply adaptive techniques for eliminating noise interferences in processing of biomedical signals. |

# Course Articulation Matrix

**Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)**

| | | PO's | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **1** | **2** |
| **CO's** | **1** | 3 | | | | | | | | | 1 | | 2 | |
| | **2** | 3 | | | | | | | | | | | 2 | |
| | **3** | 3 | 2 | 1 | | | | | | | | | 2 | |
| | **4** | 3 | 2 | 2 | | | | | | | | | 2 | |
| | **5** | 3 | 2 | 1 | | | | | | | | | 2 | |
| | **Avg.** | **3** | **2** | **1.8** | | | | | | | | | **2** | |

**Note:** 1- Weak correlation 2-Medium correlation 3-Strong correlation

# NATIONAL CADET CORPS

| | | | |
|---|---|---|---|
| Contact Hours/Week | : 3+0+0 (L+T+P) | Credits | : 0 |
| Total Lecture Hours | : 39 | CIE Marks | : 50 |
| Course Code | : NMC04 | SEE Marks | : 50 |

The objectives of this course are:

6. Learn the concept of Field Engineering.
7. Acquire the knowledge on Obstacle Training.
8. Learn the basic concepts of Military communication
9. Learn the basic concepts of Home Nursing.
10. Acquire the basic knowledge on Religions and Customs in India

## UNIT I

**Drill:**

**Field Engineering:** Digging tool, Knots and Lashes: Characteristics of Proper Knots, Types of Knots, Uses of Knots and its application, Hands on training. Skill enhancement: NCC tent pitching.

**08 Hours**

## UNIT II

**Obstacle Training:** Types of Obstacle course: Straight balance, Clear Jump, Gate Vault, Zig-Zag balance, High Wall, Double stride Jump, Right hand vault, Left hand Vault, Ramp, Straight Balance, Hands on training

**08 Hours**

## UNIT III

**Military communication:** Main elements of communication process, Methods of communication, Types of information, Types of communication, Satellites, types and roles

**08 Hours**

## UNIT IV

**Home nursing:** Qualities of a nurse, Duties of Nurse, Common nursing instruments, Sick room, Taking pulse, respiration and Temperature, Feeding helpless patients, Medicine and their administration

**08 Hours**

## UNIT V

**Religions and Customs in India:** Indian Religions, Indian culture and traditional dance forms, Unity and diversity. Diversity in food, Language Diversity and other specific traditions and customs of India.

**07 Hours**

**Text Books:**


1. DG NCC — NCC Cadets Handbook – Common, Directorate General of NCC, New Delhi.
2. DG NCC — NCC Cadets Handbook – Special, Directorate General of NCC, New Delhi.


**Reference Books:**


1. Chandra B. Khanduri — "Field Marshal KM Cariappa: a biographical sketch", Dev Publications, 2000
2. Gautam Sharma — "Valour and Sacrifice: Famous Regiments of the Indian Army", Allied Publishers, 1990
3. Warren G. Bennis — "On Becoming a Leader", Perseus Books, 1989


**Course Outcomes:**

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

CO1 **Analyze** the concepts of Field Engineering to apply the same during difficult times.

CO2 **Analyze** and **Practice** Obstacle course that helps to keep body fit.

CO3 **Express** the general and technical concepts of Military communication.

CO4 **Relate** oneself to the concepts of Home Nursing and **practice** when needed.

CO5 **Compare** the various concepts related to Religions and Customs in India and practice upliftment of Unity and Diversity.