



SIDDAGANGA INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING

SCHEME & SYLLABUS

OF

V & VI SEMESTER

B.E.

Electronics & Telecommunication Engg.

2025 - 26

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 good academic ambience for faculty and students by establishing high-quality R & D labs leading to quality research in Electronics & Telecommunication Engineering and allied disciplines.
3. To prepare graduates with technological competence, necessary professional skills and ethics.

Program Educational Objectives (PEOs)**The graduates of Electronics & 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 Electronics & Telecommunication Engineering and allied disciplines.
- Display professional and ethical attitude, spiritual values with effective communication skills and leadership qualities.

Program Outcomes (POs):

1: Engineering Knowledge, 2: Problem analysis, 3: design/development of solutions, 4: conduct investigations of complex problems, 5: Engineering tool usage, 6: The engineer and The world, 7: Ethics, 8: Individual and Collaborative team work, 9: communication, 10: project management and finance, 11: Life-Long learning

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, VLSI/Embedded and IoT Systems.
- Identify, design and develop solutions for complex engineering problems related to, wired, wireless, or Optical communication systems, Security using analytical techniques, AI, 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	S5ETL02	Communication and Interface Protocol 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	56	4	3	50	50	100	2
7.	AEC	SHS04	Research Methodology and IPR (Board: IEM)	ETE	42	0	0	48	2	50	50	100	3
8.	HSMS	SHS05	Environmental Studies (Board: CV)	CV	28	0	0	32	2	50	50	100	2
9.	AEC	ARAS	Aptitude Related Analytical Skill	T&P	0	0	28	2	2	50	50	100	1
10.	NCMC	SMC01	National Service Scheme (NSS)	NSS CO	0	0	28	-	3	50	50	100	0
		SMC02	Physical Education (PE) (Sports and Athletics)	PED									
		SMC03	Yoga and Pranayama	PED									
		SMC04	National Cadets Corps	NCC	39	0	0	0	3	50	50	100	0
Total					238	0	196	284	24	550	450	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									
<p>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</p>													
Professional Elective Course (PEC) (Offered by the Department)													
SETE02	RF and Microwave Circuit Design			SETE06	Computer Organization and Architecture								
SETE03	Digital VLSI design			SETE07	Multimedia Communication								
SETE04	Introduction to photonics			SETE08	Artificial Neural Networks								

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 progression as 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 the Mini-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 the project 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 provide an 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.

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B.E. in ELECTRONICS & TELECOMMUNICATION ENGINEERING

SCHEME OF TEACHING AND EXAMINATION NEP-2

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	52	0	0	68	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	-	42	0	0	48	3	50	50	100	3
5.	PROJ	S6ETP1	Major Project Phase I	ETE	0	0	56	4	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	0	28	0	0	-	100	-	100	0
8.	NCMC	SMC01	National Service Scheme (NSS)	NSS CO	0	0	28	0		100	-	100	0
		SMC02	Physical Education (PE) (Sports and Athletics)	PED									
		SMC03	Yoga	PED									
		SMC04	National Cadet Corps	NCC									
9	SHS	SHS07	Indian Knowledge Systems	ETE	14	0	0	0	-	100	-	100	0
Total					178	28	140	220	18	550	250	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)

SETE01	Digital Image Processing	SETE11	Introduction to Data Science
SETE05	Analog VLSI Design	SETE12	Cryptography and Network Security
SETE09	Bio-Medical Signal Processing	SETE13	Optoelectronic Devices
SETE10	Machine Learning	SETE14	Automotive Radars

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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 semesterto 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 progression as 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 provide an 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:

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 Program Coordinator/ 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 the problem statement for the project work.

MANAGEMENT AND ENTREPRENEURSHIP

Contact Hours/ Week:	: 3(L)	Credits:	3
Total Lecture Hours:	: 42	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.

7 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

9 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.

6 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.

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.

Case studies

1. How Zomato is Leading in Foodtech? A Zomato Case Study
2. Ola case study: The story of a Millionaire without a car

6 Hours**TEXT BOOKS**

1	Harold Koontz, Heinz Weihric	Essentials of Management, McGraw Hill , Education, 10 th Edition, 2015.
2	Lucy C. Morse	Managing Engineering and Technology, Pearson Education, 6 th Edition, 2015.
3.	S.S. Khanka	Entrepreneurial Development, S. Chand Publishing, 4 th 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, 6 th Edition, 2018.
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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		

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.

Basic structures for IIR systems: Direct, Cascade, and Parallel structures.

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 BOOK**

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

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

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 Outcomes:

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.

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”, 3 rd Edition Pearson Education (Asia) Pvt. Ltd, 2021
2	K. Sam Shanmugam	Digital and Analog Communication Systems, John Wiley, 1 st Edition, 2019
3	Shu Lin and Daniel J Costello	Error Control Coding, Pearson Education Limited, 2 nd Edition, 2011

REFERENCE BOOKS

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

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 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.

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

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

COMMUNICATION AND INTERFACE PROTOCOL LAB

Contact Hours/ Week:	2 (P)	Credits:	1
Total Labs:	14	CIE Marks:	50
Sub. Code:	S5ETL02	SEE Marks:	50

Preamble: The goal of this Lab course is to broaden the student's understanding of circuits and ICs used communication systems and to explore various interface protocol for communication. interface beyond the basic concepts. It covers the understanding the requirements, analyzing the datasheets, selection of ICs, components, and choose relevant interface protocols. It aims at providing the exposure to develop prototype for real time problems

Course objectives:

This course will enable students to:

1. Understand and implement analog communication techniques such as AM and FM demodulation using appropriate circuits and ICs.
2. Design and analyze analog filters and oscillators including LPF, HPF, BPF, BSF, and crystal oscillators for communication applications.
3. Explore and develop communication protocols

Experiment List

1. Design and demonstrate demodulation of standard Amplitude Modulation using Envelop detector.
2. Design and demonstrate demodulation of Frequency Modulation using PLL.
3. Design and demonstrate II order Active LPF and HPF.
4. Design and demonstrate BPF and BSF.
5. Design and demonstrate LC and Crystal oscillators.
6. Develop communication Protocols using I2C, SPI and CAN

Course Outcomes:

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

- | | |
|-----|--|
| CO1 | Design and demonstration of Demodulation of AM and FM signals. |
| CO2 | Design and demonstration of Filters and Oscillators |
| CO3 | Choose of relevant protocol for communication to controllers. |
| CO4 | Develop skills to dynamically upgrade the solutions. |
| CO5 | Work in team and to carryout inter disciplinary projects. |

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	1
	2	3	3	2										2	1
	3	2	3	2											2
	4	2	2	3		3									2
	5	2	3	3							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., 2 nd 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

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 BOOK		
1	J.M. Rabaey, A. Chandrakasan and B. Nikolic	Digital Integrated Circuits- A Design Perspective, 2 nd Edn., Prentice Hall of India 2002

REFERENCE BOOKS		
1	N. Weste and D. Harris,	CMOS VLSI Design: A Circuits and Systems Perspective, 3 rd Edn., 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 rd Edn., McGraw Hill, 2003
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	

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

INTRODUCTION TO PHOTONICS

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. Understand the fundamentals of electromagnetism and wave propagation, including polarization and energy transport.
2. Analyze light propagation in different media, considering isotropic and anisotropic properties, and wave interactions.
3. Apply optical interference principles to systems like interferometers, gratings, and coherence analysis.
4. Explore dielectric waveguides and their components, including fiber optics, integrated optics, and waveguide devices.
5. Examine light-matter interactions in two-level systems, amplifiers, and semiconductors for applications in optical devices.

UNIT I

Electrodynamic Theory of Light

The Electromagnetic Field, Wave Equation , Complex Wave Functions and Amplitudes, Plane Waves, Propagation Velocities, Phase Velocity, Group Velocity, Beam Velocity, Energy Transport, Average Energy Flux Density, Energy Exchange Field/Matter, Energy Transport: Plane Waves, Polarization States, Jones Formalism, Polarization Optics, Transformation of Jones Vectors and Matrices, Elliptically Polarized States, Inhomogeneous Waves.

10 Hours

UNIT II

Wave Propagation in Matter

Transition Between Different Media, Phase Matching at a Boundary, Reflection and Transmission Coefficients, Total Reflection, Properties of Isotropic Media, Linear Oscillator Model, Absorption and Reflection, Free Electron Gas Model of Metals, Kramers–Kronig Relations, Wave Propagation in Anisotropic Media, Symmetry Properties of Crystals, Propagation Along the Principal Axes, Propagation in Arbitrary Directions, Electro-Optic Devices, Liquid Crystal Devices, Other Propagation Effects, Optical Activity, Magneto-Optic Faraday Effect, Wave Propagation in Moving Media.

8 Hours

UNIT III**Optical Interference**

Two Field Interference ,Michelson Interferometer, Mach–Zehnder and Sagnac Interferometers, S-Matrix,Young’s Double Slit, Multiple Wave Interference, Optical Gratings, Dielectric Multilayer Systems, Fabry–Perot Interferometer, Resonators, Spherical Mirror Resonators, Resonators, Coherence, Temporal Coherence, Spatial Coherence.

8 Hours**UNIT IV****Dielectric Waveguides**

Planar Waveguides, Eigenmodes, Transverse Mode Profile, Waveguide Dispersion, Fiber Waveguides, Step Index Fibers, Fiber Losses and Dispersion , Gradient Index Fibers, Integrated Optics, Waveguide Couplers, Splitters and Switches, Waveguide Gratings, Waveguide-Interferometers and Modulators, Active Waveguide Components, Photonic Band Gap Fibers.

8 Hours**UNIT V****Light–Matter Interaction**

Optical Interactions with Two Level Systems, Perturbations, Absorption and Stimulated Emission, Spontaneous Emission, Line Broadening, Saturation of Absorption, Light Amplification by Stimulated Emission, Four-Level Amplifier, Three-Level Amplifier, Pulse Amplification and Absorption, Optical Interactions with Semiconductors, Electronic States in Semiconductors, Optical Transitions in Semiconductors, Optical Gain Condition, Low Dimensional Semiconductors, Carrier Induced Refractive Index Change.

8 Hours**TEXT BOOKS**

1	Georg A. Reider	Photonics: An Introduction, 1st ed. Cham, Switzerland: Springer International Publishing, 2016. doi: 10.1007/978-3-319-26076-1
2	F. Graham Smith	Optics and Photonics: An Introduction, 2nd edition, John Wiley & sons, 2007.

REFERENCE BOOKS		
1	Thomas P Pearsall	Photonics Essentials, 1 st Edition, McGraw Hill, 2003
2	Bahaa E.A. Saleh and Malvin Carl Teich	Fundamentals of Photonics, 2 nd edition, Wiley-Interscience, 2012. ISBN: 9780471358329
3	Lukas Novotny and Bert Hecht	Principles of Nano-Optics, Cambridge University Press, 2012. ISBN: 9780511794193
Course Outcomes:		
Upon completion of this course the student will be able to:		
CO1	Apply electrodynamic principles to analyze wave propagation and energy transport in light, considering polarization states and phase velocity.	
CO2	Evaluate wave behaviour in different media, including isotropic and anisotropic, using models like the free electron gas and Kramers-Kronig relations.	
CO3	Analyze interference phenomena and solve problems related to interferometers, optical gratings, coherence, and resonators.	
CO4	Design dielectric waveguides and fiber optics, analysing waveguide modes, losses, dispersion, and integrated optical components.	
CO5	Evaluate light-matter interactions in semiconductors, applying concepts of absorption, stimulated emission, and optical amplification.	

Course Articulation Matrix

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

	POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	2	2											2
	CO2	2	2											2
	CO3	2	2											2
	CO4	2	2											2
	CO5	2	2											2

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

COMPUTER ORGANIZATION AND ARCHITECTURE

Contact Hours/ Week:	3(L)	Credits :	3
Total Lecture Hours:	42	CIE Marks :	50
Course Code:	SETE06	SEE Marks :	50

Course objectives:

This course will enable students to:

1. Discuss the basic concepts of register transfer logic and arithmetic operations and analysis of the design of arithmetic & logic unit, flow control and basic instruction sets.
2. Have a better idea on how to write assemble language programs.
3. Organization register and memory. Fundamentals of different Instruction Set Architectures and RISC, and the concepts of parallel processing and Pipelining

UNIT I**Overview of Register Transfer and Micro operations**

Register Transfer Language, Register transfer, Bus and Memory transfer, Arithmetic Micro-operations, Logic Micro-operations, Shift Micro-operations, Arithmetic Logic Shift UNIT.

10 Hours**UNIT II****Basic Computer Organization and Design**

Instruction codes, Computer registers, Computer instructions, Timing and Control, Instruction cycle, Memory-Reference Instructions, Input-output and interrupt, Design of Basic computer, Design of Accumulator UNIT.

8 Hours**UNIT III****Programming the Basic Computer**

Introduction, Machine Language, Assembly Language, the Assembler, Program loops. Programming Arithmetic and logic operations, Subroutines, I-O Programming.

8 Hours**UNIT VI****Central Processing UNIT**

Introduction, General Register Organization, Stack Organization, Instruction format, Addressing Modes, Data transfer and manipulation, Program Control, Reduced Instruction Set Computer (RISC).

8 Hours

UNIT VI	
Pipeline Processing	
Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline.	
8 Hours	

TEXT BOOKS		
1	M. Morris Mano.	Computer System Architecture, 3 rd Edition, 1992 Pearson Education
2	Tanenbaum.	Structured Computer Organization, 6 th Edition, 2012 Pearson Education

REFERENCE BOOKS		
1	Stallings	Computer Organization, 10 th Edition 2015, Pearson Education
2	John P. Hayes	Computer Architecture and Organization, 3 rd Edition 1998 McGraw-Hill
3	Ramesh S. Gaonkar	Microprocessor Architecture, Programming, and Applications with the 8085

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Understand the basic concepts of register transfer logic and arithmetic operations and analysis of the design of arithmetic & logic unit.
CO2	Understand the basic concepts Computer Organization, flow control and basic instruction sets.
CO3	Write assemble language programs.
CO4	Analyze the Organization register and memory. Fundamentals of different Instruction Set Architectures and RISC
CO5	Analyze the concepts of parallel processing and Pipelining

Course Articulation Matrix

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

		POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2	
COs	CO1	3	2												2
	CO2	3	2			1									2
	CO3	3	2			1									2
	CO4	3	2			1						1			2
	CO5	3	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. Introduce Fundamental Concepts and tools for multimedia
2. Understand graphics and image data representations available in multimedia
3. Apply lossless and lossy compression algorithms to 1-D and 2-D data
4. 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 BOOK		
1	Ze-Nian Li and Mark S. Drew	Fundamentals of Multimedia, Prentice Hall India Learning Private Limited, 2005

REFERENCE BOOK		
1	Khalid Sayood	Introduction to Data Compression: Elsevier, 3 rd 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			1			1		1
	2	1	3	1		1			1			1		2
	3	3	2	2		2			1			1	2	2
	4	3	2	2		2			1			1		1
	5	3	2	1		2			1			1	2	2

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

ARTIFICIAL NEURAL NETWORKS

Contact Hours/ Week:	3(L)	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

Introduction to Artificial Intelligence: Artificial Intelligence, Machine Learning, Deep Learning, Differences between Machine Learning and Deep Learning.

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.	
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	
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, 3 rd Edition, 2016
2	Robert J. Schalkoff	Artificial Neural Networks, Mcgraw-Hill Inc., 2011

E-Resources:

1	https://onlinecourses.nptel.ac.in/noc22_cs73/course
2	https://onlinecourses.nptel.ac.in/noc22_cs124

Course Outcomes:	
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

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										

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 literaturesurvey - 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): 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, 11 th Edition, 2012.
2.	Catherine J. Holland	"Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3.	David Hunt, Long Nguyen, Matthew Rodgers	"Patent searching: tools & techniques", Wiley, 2007.
4.	The Institute of Company Secretaries of India, Statutory body under an Act of parliament	"Professional Programme Intellectual Property Rights, Law and practice", September 2013.
5.	Peter S. Menel Mark A. Lemley, Robert P. Merges	"Intellectual Property in the New Technological-Vol. I perspectives, 2021.
6.	Laura R. Ford	"The Intellectual Property of Nations: Sociological and Historical Perspectives on a Modern Legal Institution Paperback -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 codes and 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)**

CO's		PO's											PSO's	
		1	2	3	4	5	6	7	8	9	10	11	1	2
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 (L)	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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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)

CO's		PO's											PSO's	
		1	2	3	4	5	6	7	8	9	10	11	1	2
1								2						
2								2						
3								2						
4								2						
5								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	: SMC04	SEE Marks	: 50

Course objectives:

This course will enable students to:

- | | |
|----|---|
| 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.

8 Hours**UNIT II**

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

8 Hours**UNIT III**

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

8 Hours**UNIT VI**

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

8 Hours**UNIT VI**

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

7 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.

REFERENCES:		
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>Ipv4</i> , <i>Ipv6</i> , 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
Application Layer: DNS: Name space, DNS in the Internet, Resolution, Electronic Mail, and World Wide Web.
 Introduction to Network Management Systems, Basics of SDM, AI in Networks.

8 Hours**TEXT BOOKS**

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

REFERENCE BOOKS

1	Andrew S Tanenbaum	Computer Networks – 5 th Edition, Pearson Education/PHI, 2010
2	William Stallings	Data and Computer Communication, 8 th 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)**

CO's		PO's											PSO's		
		1	2	3	4	5	6	7	8	9	10	11	1	2	
	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

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

MICROWAVE ENGINEERING AND ANTENNA DESIGN

Contact Hours/ Week:	4(L)	Credits:	4
Total Lecture Hours:	52	CIE Marks:	50
Sub. Code:	S6ET01	SEE Marks:	50

Microwave frequency spectrum have been increasingly used in many applications such as radio astronomy, cellular system, space navigation, radar systems, medical, and military applications. As a result of the of the fast growing microwave technology in research and industry, students who are preparing themselves for, and electronics engineers who are working in, the microwave area are need to understand the theory, design, analysis, and experiment of microwave devices and circuits.

Course objectives:

This course will enable students to:

1. The operating principles, theory, analysis, design, and construction of microwave active and passive devices.
2. The fundamental theory, operating principles and construction of antennas thereby providing relevant skills to design and analyze 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, PIN diode, Schottky barrier diodes (For all the device: only construction, operation, velocity modulation, transit time, current modulation, power output and efficiency, definition with explanation and end equations are included, derivations are excluded).

12 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. Lumped element Filter design using insertion loss method, Filter transformations, Impedance and Frequency Scaling, Bandpass and Bandstop Transformations, Filter implementation using transmission lines, Richards' Transformation, Kuroda's Identities, Low-pass filter design using stubs.

12 Hours

UNIT III**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. The Radio communication link, Field components (No derivation) and radiation resistance of short dipole and $\lambda/2$ antennas. Thin linear antennas and radiation patterns,

10 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 beamwidths. Array of two point sources. The principle of pattern multiplication. Planar array and array factor. Mutual impedance, phased arrays. Introduction to smart and MIMO antennas.

10 Hours**UNIT V****Resonant and Broadband Antennas:**

Construction, design, operational principle and applications of Yagi-Uda Antenna. Rectangular microstrip antenna. 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.

12 Hours**TEXT BOOKS**

1	C. A. Balanis	Antenna Theory Analysis and Design”, John Wiley, 2 nd Edition, 1997
2	D.M. Pozar	“Microwave Engineering”, Wiley publications, 3 rd Edition, 2004.
3	Samuel Liao	Microwave devices and circuits, Prentice Hall, 3 rd Edition, 2003.

REFERENCE BOOKS

1	John D Kraus R J Marhefka and Ahmed S Khan	“Antennas for all applications”, Tata McGraw Hiill India, 3 rd 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 and filters.
CO3	Explain various parameters of antennas & carryout investigation of link budget for radio wave propagation related to different applications and develop solutions to solve practical problems in antennas.
CO4	Demonstrate the operating theory, construction, and effective design of antennas for various wireless applications.
CO5	Analyze and 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								1	2
	2	1	2	2		2								1	2
	3	1	2	2		2								1	1
	4	1	2	2		2								2	2
	5	1	2	2		2								2	2

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)**

CO's		PO's											PSO's	
		1	2	3	4	5	6	7	8	9	10	11	1	2
1		2	3	3		3							1	2
2		1	3	2		3							1	2
3		2	3	2		2							2	1

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, 3 rd 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, 2 nd Edition. 2011.
2	S Jayaraman, S Esakkiranjan, T Veerakumar	Digital Image Processing, Tata Mcgraw Hill, 1 st 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)**

CO's		PO's											PSO's		
		1	2	3	4	5	6	7	8	9	10	11	1	2	
1		2	2											3	1
2		3	3		2									2	2
3		2	3	2		2									3
4		3	3	2		2				2					2
5		3	3	3	2	2				2	1	2			3

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

ANALOG VLSI DESIGN

Contact Hours/ Week:	3 (L)	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, 3 rd Edition 2013
2	Adel S. Sedra, Kenneth Carless Smith	“Microelectronic Circuits”, Oxford University. 7 th Edition. 2017

REFERENCE BOOK

1	Hurst, and S. Lewis,	Analog Integrated Circuit Design, John Wiley & Sons, 1997 Analysis and Design of Analog Integrated Circuits, John Wiley and Sons, 6 th Edition, 2013
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Course Outcomes:

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)**

CO's		PO's											PSO's		
		1	2	3	4	5	6	7	8	9	10	11	1	2	
	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	

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 BOOK

1	Rangaraj M. Rangayyan	Biomedical Signal Analysis a case study approaches, John Wiley publications.
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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	

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

MACHINE LEARNING

Contact Hours/ Week:	3(L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	SETE10	SEE Marks:	50

Course objectives:

This course will enable students to:

1. To make students understand the importance and significance of machine learning.
2. To differentiate between different types of machine learning techniques.
3. To understand how machine learning techniques can be used for practical applications.

UNIT I

Introduction to Machine Learning: What is Machine Learning?, Common Definitions of Machine Learning, Where is Machine Learning Used?, Applications of Machine Learning, Types of Machine Learning, Supervised Learning, Unsupervised Learning, Reinforcement Learning, **Data Preprocessing:** Data Cleaning, Filling in Missing Values, Cleaning and Filling Missing Data, Drop Missing Values, Smoothing Noisy Data, Removing Inconsistencies, Data Integration, Data Transformation, Data Reduction or Dimensionality Reduction, Principal Component Analysis

10 Hours**UNIT II**

Supervised Learning Algorithms-I: Introduction to Supervised Learning and Regression, Steps to Establish a Linear Regression, Evaluation of Model Estimators, Karl Pearson's Coefficient of Correlation, R-Square, Introduction to Logistic Regression, Scenarios Which Require Logistic Regression, Binary classification model, Odds and Odds ratio, Logit function, MLE, Problem Solving Using Decision Trees, Iterative Dichotomiser 3 (ID3), Issues in Decision Trees, Underfitting and Overfitting

8 Hours**UNIT III**

Supervised Learning Algorithms-II: Support Vector Machines, Linear Support Vector Machines, Optimal Hyperplane, Computation of the Margin of the Hyperplane, Bayesian Classification, Bayes' Theorem, Naive Bayes Classifier, k-Nearest Neighbor (KNN), Measuring Classifier Accuracy, Hidden Markov Model, Issues in Hidden Markov Model

8 Hours

UNIT IV

Unsupervised Learning Algorithms: Introduction to Clustering, Applications of Clustering, Requirements of Clustering, Types of Clustering, k-Means Algorithm, k-Medoids, Agglomerative Algorithms

8 Hours**UNIT V**

Introduction to Optimization: Statement of an Optimization Problem, Classification of Optimization Problems , Linear vs Nonlinear Programming Problems, Unconstrained Minimization Problems, Gradient-Based Methods, Steepest Descent (Cauchy) Method, Newton's Method

Artificial Neural Networks :Introduction , Introduction to Artificial Neural Networks, Use of Artificial Neural Networks, Evolution of Neural Networks, Biological Neuron, From Human Neurons to Artificial Neurons, Basics of Artificial Neural Networks, Network Architecture Learning, Activation Functions,Bipolar Activation Functions ,Unipolar Activation Functions,McCulloch–Pitts Neuron Model

8 Hours**TEXT BOOK**

1	Alpaydin Ethem	Introduction to Machine Learning, 2 nd Edition PHIPvt.Ltd-New Delhi,2010
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REFERENCE BOOKS

1	S.Theodoridis and K. Koutroumbas	Pattern Recognition, Academic Press, 4 th Edition., 2009.
2	Earl Gose, Richard Johnsonbaugh and Steve Jost	Pattern Recognition and Image Analysis, Prentice-Hall of India, 1 st Edition, 2003.

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Classify machine learning algorithms and approaches, and use Bayesian decision theory to determine the discriminant function for a two-class problem.
CO2	Apply linear regression models to predict the value of a continuous valued output given a training data consisting of univariate/multivariate input features.
CO3	Apply learning algorithms based on Clustering to perform dimensionality reduction.
CO4	Analyse the time and space complexity using density estimation, classification and regression of non parametric approaches.
CO5	Apply different learning algorithms using linear discriminants from a given labelled training sample.

Course Articulation Matrix

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

CO's		PO's											PSO's	
		1	2	3	4	5	6	7	8	9	10	11	1	2
CO's	1	2	3	1				1						2
	2		2	1			1	2						2
	3	2	2					1						2
	4		2	2										2
	5	1	2											2

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

INTRODUCTION TO DATA SCIENCE

Contact Hours/ Week:	: 3(L)	Credits:	3
Total Lecture Hours:	: 42	CIE Marks:	50
Sub. Code:	:SETE11	SEE Marks:	50

Course objectives:

This course will enable students to:

1. Describe the concept of data science, its scope in business and explain the available techniques.
2. Understand Predictive modeling, explain supervised segmentation and given data set should be able to select (through solving) the attribute for segmentation using the available techniques.
3. Explain the concept of Classification and classify (solve) a given data set.
4. Understand and describe the concept of similarity, neighbors and clustering and apply it for any real world data.
5. Explain the concepts of mining text and other data science tasks and techniques.
6. Describe the concept of data science, its scope in business and explain the available techniques.

UNIT I

Introduction: Data-Analytic Thinking: The Ubiquity of Data Opportunities, Example: Hurricane Frances, Example: Predicting Customer Churn. Data Science, Engineering, and Data- Driven Decision Making, Data Processing and “Big Data”, Data and Data Science Capability as a Strategic Asset, Data-Analytic Thinking.

Business Problems and Data Science Solutions: From Business Problems to Data MiningTasks, Supervised Versus Unsupervised Methods, Data Mining and Its Results, The Data Mining Process, Business Understanding, Data Understanding, Data Preparation, Modeling, Evaluation, Deployment, Other Analytics Techniques and Technologies: Statistics, Database Querying, Data Warehousing, Regression Analysis, Machine Learning and Data Mining.

10 Hours**UNIT II**

Introduction to Predictive Modeling: From Correlation to Supervised Segmentation Models, Induction, and Prediction, Supervised Segmentation, Selecting Informative Attributes Example: Attribute Selection with Information Gain, Supervised Segmentation with Tree-Structured Models, Visualizing Segmentations, Trees as Sets of Rules, Probability Estimation, Example: Addressing the Churn Problem with Tree Induction.

10 Hours

UNIT III

Fitting a Model to Data: Classification via Mathematical Functions: Linear Discriminant Functions, Optimizing an Objective Function, An Example of Mining a Linear Discriminant from Data, Linear Discriminant Functions for Scoring and Ranking Instances, Support Vector Machines briefly, Regression via Mathematical Functions, Class Probability Estimation and Logistic “Regression”. Logistic Regression: Some Technical Details. Example: Logistic Regression versus Tree Induction, Non Linear Functions, Support vector machines and Neural Networks. Over fitting and Its Avoidance: Fundamental Concepts, Exemplary Techniques, Regularization, Generalization, Over fitting, Over fitting Examined.

10 Hours**UNIT VI**

Similarity, Neighbors, and Clusters: Similarity and Distance, Nearest-Neighbor Reasoning, Example: Whiskey Analytics, Nearest Neighbors for Predictive Modeling, How Many Neighbors and How Much Influence? Geometric Interpretation, Overfitting, and Complexity Control. Issues with Nearest-Neighbor Methods. Some important Technical Details Relating to Similarities and neighbors. Clustering, Example: Whiskey Analytics Revisited, Hierarchical Clustering, Nearest Neighbors Revisited: Clustering Around Centroids. Understanding the Results of Clustering.

10 Hours**UNIT V**

Decision Analytic Thinking I: What is a Good Model?: Evaluating Classifiers Plain Accuracy and its Problems, The confusion matrix, Problems with unbalanced Classes, Problems with Unequal Costs and Benefits.

Representing and Mining Text:

Why Text Is Important? Why Text Is Difficult?

Representation, Bag of Words, Term Frequency, Measuring Sparseness: Inverse Document Frequency, Combining Them: TFIDF, Example: Jazz Musicians

Other Data Science Tasks and Techniques: Co-occurrences and Associations: Finding Items That Go Together, Measuring Surprise: Lift and Leverage, Example: Beer and Lottery Tickets, Associations Among Facebook Likes, Profiling: Finding Typical Behavior, Link Prediction and Social Recommendation

10 Hours

TEXT BOOK		
1	Foster Provost and Tom Fawcett	Data Science for Business, Published by O'ReillyMedia, Inc. First Edition, July 2013.

REFERENCE BOOKS		
Rachel O'Neil Schutt & Cathy	Doing Data Science, O'Reilly Media, First Edition, October 2013	
Hector Cuesta	Practical Data Analysis, published: October 2013 PACKT Publishing First,	
Michael R. Berthold, Christian Borgelt, Frank HIPPNER, Frank Klawonn	Guide to Intelligent Data Analysis, Springer-Verlag London Limited 2010.	

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Apply the knowledge of mathematics to explain the concept of data science, the available techniques in data science and its scope in business.
CO2	Develop a Decision tree based on supervised segmentation and predict the class for a given data set by selecting (through solving) the attribute for segmentation using the available techniques.
CO3	Analyze the given data set, and solve a problem by performing Classification using the basics of mathematics and data science.
CO4	Develop solutions to group entities in data set and apply it for the given real world data using the basic knowledge of similarity, neighbors and clustering.
CO5	Analyze the importance of mining text (social data) and formulate the association rules based on market basket analysis.

Course Articulation Matrix

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

	POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	3	1			3			2	2			2	
	CO2	3	2			3			2	2			2	
	CO3	3	2			3			2	2			2	
	CO4	3	2			3			2	2			2	
	CO5	3	2			3			2	2			2	

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

CRYPTOGRAPHY & NETWORK SECURITY

Contact Hours/ Week:	3(L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	SETE12	SEE Marks:	50

Course objectives:

This course will enable students to:

1. Understand the basic concept of Cryptography and Network Security along with their mathematical models.
2. Analyze security issues, services, goals and mechanisms.
3. Compare various key management and distribution protocols
4. Analyze public key cryptosystems, authentication protocols and key agreement protocols
5. Develop code to implement cryptographic algorithms

UNIT I

COMPUTER AND NETWORK SECURITY CONCEPTS: Computer Security concepts, The OSI Security Architecture, Security Attacks, Services and Mechanisms, A Model of Network Security.

SYMMETRIC CIPHERS: Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor machine, Steganography

10 Hours**UNIT II**

BLOCK CIPHER AND THE DATA ENCRYPTION STANDARD: Traditional Block Cipher Structures, The Data Encryption Standard, DES Example, Strength of DES, Block Cipher Design principles.

ADVANCED ENCRYPTION STANDARDS: Finite field Arithmetic, AES Structure, AES Transformation

Functions, AES key Expansion, An AES Example, AES Implementation.

BLOCK CIPHER OPERATION: Multiple Encryption and triple DES, Electronic Code Book, Cipher Block

8 Hours

UNIT III	
<p>RANDOM BIT GENERATION AND STREAM CIPHERS: Principles of Pseudorandom Number Generation, Pseudorandom Number Generators, Pseudorandom Number Generation using a block cipher, Stream Cipher, RC4.</p> <p>ASYMMETRIC CIPHERS: Public Key Cryptography and RSA: Principles of Public-Key Cryptosystems, The RSA Algorithm, Other Public Key Cryptosystems: Diffie-Hellman Key Exchange.</p> <p>CRYPTOGRAPHIC DATAINTEGRITY ALGORITHMS: Cryptographic Hash Functions: Applications of Cryptographic hash functions, Two simple hash Functions, Secure Hash Algorithm</p>	
8 Hours	

UNIT IV	
<p>MESSAGE AUTHENTICATION CODES: Authentication Requirements, Authentication Functions, Requirements for Message Authentication Codes, Security of MACs,</p> <p>DIGITAL SIGNATURES: Digital Signatures, NIST Digital Signature Algorithm.</p> <p>KEY MANAGEMENT AND DISTRIBUTION: Symmetric Key distribution using Symmetric encryption, Symmetric Key distribution using Asymmetric encryption, Distribution of public keys,</p>	
8 Hours	

UNIT V	
<p>TRANSPORT-LEVEL SECURITY: Web Security considerations, Transport Layer Security, HTTPS.</p> <p>ELECTRONIC MAIL SECURITY: Internet Mail Architecture, Email Formats, Email Threats and Comprehensive Email Security.</p> <p>IP SECURITY: Overview, IP Security Policy</p> <p>Cybersecurity : Overview & Cybersecurity Principles</p>	
8 Hours	

TEXT BOOKS		
1	William Stallings.	Cryptography and Network Security, 7 th Edition, Prentice Hall of India, 2017
2.	Wenyuan Xu, Ruoxi Jia, Cliff Wang, and Shouhuai Xu	Principles of Cyber-Physical Systems Security: Foundations, Principles, and Applications, 1st Edition, 2017, Wiley-IEEE Press ISBN-13: 978-1119223648

REFERENCE BOOKS		
1	Charlie Kaufman, Radia Perlman, Mike Speciner,	Network Security: Private Communication in a Public World, 3 rd Edition, Pearson Education Asia,2022
2	AtulKahate	Cryptography and Network Security, Tata Mc GrawHill, 4 th Edition 2019

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Apply the knowledge of mathematics to perceive the foundations of Cryptography and network security and explain the security principles.
CO2	Design solutions for problems on classical encryption techniques and illustrate symmetric and asymmetric cryptographic algorithms.
CO3	Develop solutions for problems on public key cryptosystems.
CO4	Analyze different authentication protocols, integrity protocols and key agreement protocols.
CO5	Apply the knowledge of engineering fundamentals to comprehend existing network security 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	2	1	1		1									2
	2	2	2	1											2
	3	2	2	1		1									2
	4	2	2	1											2
	5	2	1												2

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

OPTOELECTRONIC DEVICES

Contact Hours/ Week:	3(L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	SETE13	SEE Marks:	50

Course objectives:

This course will enable students to:

1. Understand optical resonators and their role in laser operation.
2. Understand optical resonator principles and laser oscillator dynamics.
3. Analyze noise sources in optical generation and detection processes
4. Explore the physics and performance characteristics of optical detectors.
5. Understand noise mechanisms and their impact on optical communication systems.

UNIT I**Guided Waves in Dielectric Slabs and Fibers**

TE and TM Confined modes in symmetric Slab Waveguides, TE and TM Confined modes in Asymmetric Slab Waveguides, Step Index circular Dielectric Waveguides, Effective Index theory, Waveguide dispersion in optical fibers

10 Hours**UNIT II****Optical Resonators**

Introduction, Fabry –Perot Laser, Oscillation Frequency, Three and Four level Lasers, Power in Laser Oscillators, Optimum Output coupling in Laser Oscillators, Multimode laser oscillation and mode locking

8 Hours**UNIT III****Theory of Laser Oscillation**

WLAN and Mobile WiMAX PHY Overview, WiFi OFDM and Mobile WiMAX Signals PAPR, Transmitter Impairments Simulation, Receiver Impairments Simulation, Adaptive Modulation Illustration

8 Hours**UNIT IV****Noise in Optical Detection and generation**

Introduction, limitations due to Noise Power, Shot Noise, Johnson Noise, Spontaneous emission noise in laser oscillators, Coherence and interference

8 Hours

UNIT V	
Detection of Optical Radiation	
Introduction, Optically Induced Transition rates, Photomultiplier, noise mechanisms in photomultipliers, Heterodyne detection with photomultipliers, Photoconductive detector, The P-n Junction, Semiconductor photodiodes, Avalanche Photodiodes	
8 Hours	

TEXT BOOKS		
1	Amnon Yariv & Pochi Yeh	Photonics: Optical Electronics in Modern Communications, 6 th Edition, New York : Oxford University Press, 2007, ISBN: 9780195687057
2	Bahaa E.A. Saleh and Malvin Carl Teich	Fundamentals of Photonics, 2nd edition, Wiley-Interscience, 2012. ISBN: 9780471358329

REFERENCE BOOKS		
1	S. O. Kasap	Optoelectronics and Photonics: Principles and Practices, 2nd ed. Pearson Education, 2013.
2	Jaspri Singh	Semiconductor Optoelectronics: Physics and Technology, McGraw Hill Education, First edition, 2019.

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Analyze TE and TM modes in dielectric slab and fiber waveguides and calculate waveguide dispersion characteristics.
CO2	Evaluate optical resonator properties and optimize laser oscillator design for maximum output power.
CO3	Interpret the theory of laser oscillations including three-level and four-level laser systems.
CO4	Differentiate the performance of various optical detectors based on device physics.
CO5	Quantify the responsivity and detectivity of different optical detectors using given parameters.

Course Articulation Matrix

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

	POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
COs	CO1	3	2												2
	CO2	3	2	2											2
	CO3	3	2												2
	CO4	3	2												2
	CO5	3	2												2

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

AUTOMOTIVE RADARS

Contact Hours/ Week	: 3 (L)	Credits :	3
Total Lecture Hours	: 42	CIE Marks :	50
Sub. Code	: SETE14	SEE Marks :	50

Course objectives:

This course will enable students to:

1. Understand the fundamentals of automotive radar signal processing.
2. Understand the effect of MIMO in automotive radars.
3. Know mutual interference in automotive radars and its mitigation.
4. Understand tracking concepts and fusion concepts.

UNIT I

Introduction, Basic radar functions, Automotive radar architecture, Signal models, Radar waveforms and signal processing, Detection fundamentals.

10 Hours**UNIT II**

MIMO radar technology: Virtual array synthesis via MIMO radar, Waveform orthogonality strategies in automotive MIMO radar, Angle finding in automotive MIMO radar, High-resolution imaging radar for autonomous driving, Challenges in automotive MIMO radar.

8 Hours**UNIT III**

Interference and interference mitigation: Automotive radar interference: Signal model for radar and the interference, Characteristics of automotive radar interference. Interference mitigation: Detection of interference, interference mitigation and avoidance.

8 Hours**UNIT IV**

mmWave radar tracking and sensor fusion with camera: Introduction, Radar-EKF: radar tracking methodology: FMCW radar, FMCW radar noise, EKF prediction, update, nonlinearity, radar-EKF workflow. Sensor fusion with camera: Coordinates and EBs, Camera preprocessing, HEM, Fusion-EKF, Data association and sensor synchronization, EB evaluation.

8 Hours**UNIT V**

Radar based gesture sensing: Introduction, Fundamentals of short-range radar, Radar systems for gesture sensing, FMCW radar, Radar in the IoT era.

8 Hours

Text Books:		
1	Zhengyu Peng, Changzhi Li and Faruk Uysal	“Modern radar for automotive applications” Scitech Publishing 2022
2	Matt Markel	“Radar for Fully Autonomous Driving”, Artech House, 2022.

Reference Book:		
1	Merrill I. Skolnik	Handbook of Radar Systems, McGraw Hill; 3rd edition, 2008.

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Explain the basic functions of radar systems, automotive radar architecture, signal models, waveforms, and detection fundamentals.
CO2	Analyze MIMO radar technology in automotive applications, including virtual array synthesis, waveform orthogonality, angle estimation, high-resolution imaging, and key implementation challenges.
CO3	Evaluate automotive radar interference models and apply interference detection, mitigation, and avoidance techniques to enhance radar performance.
CO4	Apply Extended Kalman Filter (EKF)-based tracking methods for mmWave FMCW radar and implement sensor fusion with camera data, including coordinate transformation, preprocessing, data association, and evaluation.
CO5	Understand the principles of short-range FMCW radar and its application in gesture sensing systems, including use cases in IoT environments.

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								2
	2	2	2												2
	3	2	2												2
	4	3	2												2
	5	2	2												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	: SMC04	SEE Marks	: 50

Course objectives:

This course will enable students to:

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**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

8 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

8 Hours**UNIT III**

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

8 Hours**UNIT VI**

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

8 Hours**UNIT VI**

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

8 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.

7 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.

REFERENCES:

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.

Indian Knowledge Systems			
Course Code :	SHS07	CIE :	100 Marks
L:T:P :	1: 0: 0	SEE :	-----
Total Hours :	15	SEE Duration :	-----
Course Learning Objectives: The students will be able to			
1	Rejuvenate and mainstream Indian Knowledge Systems by integrating it into the fabric of education research ecosystem.		
2	Bridge the gap between Traditional Indian Knowledge Systems and contemporary knowledge systems.		
3	Make a tangible difference to the contemporary world by mainstreaming Indian Knowledge Systems.		

Unit-I : Introduction to Indian Knowledge Systems (IKS)	05 Hrs
Overview: Need of IKS, Importance of ancient knowledge. Defining IKS, History of IKS, Indian philosophical systems- Development and unique features, Yoga-darsana, Number system in India-Historical evidence, salient features of Indian number system, the concept of zero and its importance Reference book- 1 : 1.1; 1.2; 1.5; 3.1; 3.3.2; 6.1; 6.2; 6.2.1	
Unit – II: Fundamental concepts in Science in IKS	05 Hrs
Knowledge: Framework and classification. The knowledge triangle. Prameya – A Vaisesikan approach to physical reality. Dravyas – the constituents of physical reality. Attributes – the properties of substances. Unique aspects of Indian Mathematics. Great Mathematicians and their contributions. Arithmetic. Square of a number. Unique aspects of Indian astronomy. Elements of Indian calendar. Pancanga – the Indian calendar system. Reference book- 1 : 7.1; 7.2; 7.2.1; 7.2.2; 8.1; 8.2; 8.3; 8.3.1; 9.1; 9.4; 9.6.	
Unit –III : Humanities and Social sciences in IKS	05 Hrs
Ayurveda-Definition of health, Tri-dosas - Relationship to health, yoga way of life –relevance to health and wellness, Indian approach to psychology, The tri-guna system, The body-mind-intellect – consciousness complex, consciousness- the true nature of an individual, Arthasastra- Governance and administration, the Kautilyan state Reference book- 1 : 13.1; 13.2;13.4;13.5; 13.6; 13.7; 13.8;14.1;14.2	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Analyse the continuous unbroken knowledge traditions of Bhārata since time immemorial.
CO2:	Provide holistic solutions by combining traditional wisdom with modern knowledge
CO3:	Recognize the relevance of traditional knowledge in different engineering domains.

Reference Books	
1	Introduction to Indian Knowledge System- concepts and applications , B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, 2022, PHI Learning Private Ltd, ISBN-978-93- 91818-21-0
2	Traditional Knowledge System in India , Amit Jha, 2009, Atlantic Publishers and Distributors (P) Ltd., ISBN-13: 978-8126912230,
3	Knowledge Traditions and Practices of India , Kapil Kapoor, Avadesh Kumar Singh, Vol. 1, 2005, DK Print World (P) Ltd., ISBN 81-246-0334,
Suggested Web Links:	
1.	https://www.youtube.com/watch?v=LZP1StpYEPM
2.	http://nptel.ac.in/courses/121106003/
3.	http://www.iitkgp.ac.in/department/KS;jsessionid=C5042785F727F6EB46CBF432D7683B63 (Centre of Excellence for Indian Knowledge System, IIT Kharagpur)
4.	https://www.wipo.int/pressroom/en/briefs/tk_ip.html
5.	https://unctad.org/system/files/official-document/ditcted10_en.pdf
6.	http://nbaindia.org/uploaded/docs/traditionalknowledge_190707.pdf
7.	https://unfoundation.org/what-we-do/issues/sustainable-development-goals/?gclid=EAlaIQobChMInp-Jtb_p8gIVTeN3Ch27LAmPEAAYASAAEgIm1vD_BwE

ASSESSMENT AND EVALUATION PATTERN

WEIGHTAGE	100% (CIE)
Test – I	Each test will be conducted for 50 Marks (MCQs)
Test – II	
Total Marks for the Course	100

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

High-3 : Medium-2 : Low-1