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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM**

VIZIANAGARAM – 535 003 Andhra Pradesh (India)

B. Tech ECE (R23-COURSE STRUCTURE & SYLLABUS)

III Year – II SEMESTER	Professional Core	L	T	P	C
		3	0	0	3
VLSI DESIGN					

Course Objectives:

- Explain the basic MOSFET circuits' operation and MOS fabrication Process
- Implement the layout diagrams for CMOS circuits
- Assess the effects of parasitics and Scaling of MOS circuits
- Interpret the operation of basic analog and digital MOSFET circuits
- Implement the Digital and Analog circuits with Full-custom and Semi-custom design flows.
- Interpret the VLSI implementation flows and the basics of VLSI testing

UNIT I:

Introduction and basic electrical properties of MOS circuits: Introduction to VLSI Design Flow, Introduction to IC technology, I_{ds} versus V_{ds} Relationships, Aspects of MOS transistor Threshold Voltage, MOS transistor conductance, Output Conductance and Figure of Merit. Fabrication process: nMOS, pMOS and CMOS. Alternate pull up forms in inverter circuits, Pull-up to Pull-down Ratio for nMOS inverter driven by another nMOS inverter, basic current mirror, CMOS Inverter, Latch-up in CMOS circuits.

UNIT II:

Basics of VLSI: Driving large capacitive loads, Cascaded CMOS inverters for delay optimization, Wiring Capacitances, Stick Diagrams, Design Rules and Layout, Layout Diagrams for MOS circuits, Sheet resistance, Gate capacitance, The Delay Unit, Inverter Delays, Scaling models and scaling factors, Scaling factors for device parameters, Limitations of scaling: performance improvement by CMOS scaling.

UNIT III:

Basic Digital and Analog Circuits: Cascode Voltage Switch Logic, Transmission Gates, Pass Transistor Logic, Domino logic, Metastability, setup time, hold time, small signal Modeling of transistor, body bias effect, biasing styles of MOSFET FET amplifiers, single stage amplifier with resistive load, Common Source amplifier, Common Drain amplifier, Common Gate amplifier.

UNIT IV:



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MOS Transistor Principles and CMOS Inverter MOSFET: Transistor Characteristic under Static and Dynamic Conditions, MOS Transistor Secondary Effects, CMOS Inverter - Static Characteristic, Dynamic Characteristic, Power, Energy, and Energy Delay parameters.

UNIT V:

VLSI Implementation Strategies and Testing: Introduction, ASIC Design flow, types of ASICs- Full custom, Standard cell-based Asics, Gate array-based ASICs, FPGAs, FPGA design flow, Basic FPGA Design Structure FPGA Programming Technologies: SRAM, EPROM, EEPROM; Introduction to testing, Manufacturing test principles, Design for testability (DFT) -Adhoc testing, Scan design, Built in self-test (BIST)

Textbooks:

1. Kamran Eshraghian, Douglas, A. Pucknell And Sholeh Eshraghian, “Essentials of VLSI Circuits and Systems” Prentice-Hall of India Private Limited, 2005 Edition.
2. Behzad Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill, 2003
3. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, Digital Integrated Circuits, Pearson Education, 2nd edition, 2016.
4. Weste and Eshraghian, Principles of CMOS VLSI Design, Pearson Education, 3rd Edition, 1999
5. Michael John Sebastian Smith, Application specification integrated circuits, Addison Wesley, 1st edition, 1997

Reference Books:

1. John P. Uyemura “Introduction to VLSI Circuits and Systems, John Wiley & Sons, reprint 2009.
2. Vinod Kumar Khanna, Integrated Nanoelectronics: Nanoscale CMOS, Post-CMOS and Allied Nanotechnologies, Springer India, 1st edition, 2016.
3. Michael John Sebastian Smith, Application Specific Integrated Circuits, Addison-Wesley, 1997.

Course Outcomes:

- Explain the basic MOSFET circuits operation and MOS fabrication Process
- Implement the layout diagrams for CMOS circuits
- Assess the effects of parasitic and scaling of MOS circuits
- Interpret the operation of basic analog and digital MOSFET circuits
- Implement the Digital and Analog circuits with Full-custom and Semi-custom design flows.
- Interpret the VLSI implementation flows and the basics of VLSI testing.



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III Year – II SEMESTER	Professional Core	L	T	P	C
		3	0	0	3
ADVANCED DIGITAL COMMUNICATIONS					

Course Objectives:

1. Provide an in-depth understanding of advanced digital modulation techniques and their performance in various channel conditions.
2. Introduce the fundamental principles of information theory
3. y including entropy, mutual information, and channel capacity.
4. Explore the architecture and implementation of multicarrier communication systems like OFDM.
5. Study spread spectrum techniques and their role in modern wireless communication systems.
6. Analyze the behavior of communication systems over fading channels and introduce diversity and MIMO techniques to enhance performance.

UNIT I:

Advanced Modulation Techniques: Review of basic digital modulation, M-ary Modulation Techniques: M-ASK, M-PSK, M-QAM, Power spectra and bandwidth efficiency, Performance analysis in AWGN and fading channels, Coherent vs Non-coherent detection.

UNIT II:

Information Theory: Discrete messages, concept of amount of information and its properties. Average information, Entropy and its properties, Information rate, Mutual information and its properties, Channel capacity: AWGN and binary symmetric channel

UNIT III:

Multicarrier Systems: Multi Carrier Communications, Orthogonal Frequency Division Multiplexing (OFDM), Modulation and Demodulation of OFDM system, Algorithm implementation IFFT/FFT of OFDM, Peak to average Power Ratio in multi carrier Modulation.

UNIT IV:

Spread Spectrum and Multi-Carrier Systems: Spread spectrum principles, Direct Sequence Spread Spectrum (DSSS), Frequency Hopping Spread Spectrum (FHSS), Code Division Multiple Access (CDMA), Orthogonal Frequency Division Multiplexing (OFDM), Applications in LTE, Wi-Fi, and 5G



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UNIT V:

Digital Communication over Fading Channels: Channel models: Rayleigh, Rician, Nakagami, Diversity techniques: Time, Frequency, Spatial diversity, Equalization techniques: Linear, Decision feedback, Performance analysis with fading, MIMO systems and spatial multiplexing

Textbooks:

1. **Simon Haykin**, *Digital Communications*, Wiley India, 3rd Edition, 2005.
2. **John G. Proakis and Masoud Salehi**, *Digital Communications*, McGraw-Hill Education, 5th Edition, 2007.
- 3.

Reference Books:

1. **Bernard Sklar and Fredric J. Harris**, *Digital Communications: Fundamentals and Applications*, Pearson, 2nd Edition, 2020.
2. **Andrea Goldsmith**, *Wireless Communications*, Cambridge University Press, 1st Edition, 2005.
3. **Theodore S. Rappaport**, *Wireless Communications: Principles and Practice*, Pearson, 2nd Edition, 2010.
4. **S. Haykin and Michael Moher**, *Modern Wireless Communications*, Pearson Education, 1st Edition, 2005.
5. **Robert G. Gallager**, *Information Theory and Reliable Communication*, Wiley, 1st Edition, 1968.
- 6.

Course Outcomes:

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

- Analyze and compare the performance of M-ary modulation techniques in both AWGN and fading environments.
- Apply the principles of information theory to compute entropy, mutual information, and determine channel capacity for various channels.
- Understand and implement multicarrier modulation systems like OFDM, including practical concerns such as PAPR.
- Explain the functioning of spread spectrum techniques and their applications in CDMA and modern wireless standards.
- Evaluate and improve digital communication system performance over fading channels using diversity and equalization techniques.



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III Year – II SEMESTER	Professional Core	L	T	P	C
		3	0	0	3
COMMUNICATION NETWORKS					

Course Objectives:

- To introduce the basics of computer network technology, typical network scenarios, layering models and service descriptions
- To demonstrate the data link layer aspects and physical layer technologies enabling the internet.
- To acquaint the unicast and multicast routing aspects of network layer
- To acquaint the principles and design issues of transport layer services and the protocols supporting the services for different network applications
- To familiarize the principles and usage of networking applications including web, HTTP, DNS

UNIT1:

Overview Of Communication and Networking: Analog and digital signal, Data communications, Networks, Circuit switching, Packet switching, The Internet, Protocols and standards, Layered tasks, OSI model, TCP/IP protocol Architecture.

UNIT2:

Physical Layer: Guided media, Unguided media, baseband and passband transmission of signals(briefly), Telephone modems, FDM, WDM, TDM, Telephone networks, DSL technology, Cable modem, Bluetooth, SONET, Traditional Ethernet, Fast Ethernet, Gigabit Ethernet, IEEE802.11, Connecting devices, Backbone network, Virtual LAN

UNIT3:

Data Link Layer: Types of errors, Detection, Error correction, Flow and error control, Stop and wait ARQ, go back n ARQ, Selective repeat ARQ, HDLC, Random access, Controlled access, Channelization

UNIT 4:

Network And Transport Layer: Network Layer: Internetworks, Addressing, Routing, ARP, IP, ICMP, IPV6, Unicast routing, Unicast routing protocol, Multicast routing, Multicast routing protocols. Transport layer: Process to process delivery, User datagram protocol (UDP), Transmission control protocol (TCP)



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UNIT 5:

Application Layer: DNS (ARP and RARP), Mail protocol (SMTP, POP, IMAP), DHCP, Web services (WWW, HTTP, HTTPS, FTP), telnet, DHCP, Client server and P2P application, Relation between Application layer and Transport Other technologies overview: PSTN, ISDN and its type, Frame relay, DSL and ADSL, VoIP, Bluetooth, Wi-Fi, Overview of GSM, Wi-Max, 3G and 4G(LTE), Near field Communication (NFC).

Textbook(s):

1. Ferouzan, Behrouz A., Data Communications and Networking, 5/e, TATA McGraw Hill, 2017
2. Stallings William, Data and Computer Communication, 10/e, Pearson Education, 2017

Reference(s):

1. Black, Ulylers D, Data Communication and Distributed Networks, 3/e, PHI, 1999
2. Tanenbaum, Andrew S., Computer Networks, 6/e, PHI, 2022.

Course Outcomes:

1. Distinguish Analog and digital signal in communication, and explain basics of networks and, role of each layer of OSI model and TCP/IP model.
2. Explain transmission media and network devices, multiplexing, data networks.
3. Apply channel allocation, framing, error and flow control techniques.
4. Describe about addressing, subnetting & Routing Mechanism in network layer, and process to process communication in transport layer with TCP and UDP protocols.



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III Year – II SEMESTER	Professional Core Elective-II	L	T	P	C
		3	0	0	3
DSP PROCESSORS AND ARCHITECTURES					

Course objectives

- To introduce architectural features of programmable DSP Processors of TI and Analog Devices.
- To recall digital transform techniques.
- To give practical examples of DSP Processor architectures for better understanding.
- To develop the programming knowledge using Instruction set of DSP Processors.
- To understand interfacing techniques to memory and I/O devices.

UNIT- I: Introduction to Digital Signal Processing:

Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation. Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

UNIT- II: Architectures for Programmable DSP Devices:

Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation UNIT, Programmability and Program Execution, Speed Issues, Features for External interfacing.

UNIT- III: Programmable Digital Signal Processors:

Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline operation of TMS320C54XX Processors.

UNIT – IV: Analog Devices Family of DSP Devices:

Analog Devices Family of DSP Devices – ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP 2100, ADSP-2181 high performance Processor. Introduction to Blackfin Processor - The Blackfin Processor, Introduction to Micro Signal Architecture, Overview of Hardware Processing Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals.



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UNIT – V: Interfacing Memory and I/O Peripherals to Programmable DSP Devices:

Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

Textbooks:

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. A Practical Approach to Digital Signal Processing - K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, New Age International, 2006/2009
3. Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-Seng Gan, Sen M. Kuo, Wiley-IEEE Press, 2007

Reference Books:

1. Digital Signal Processors, Architecture, Programming and Applications – B. Venkataramani and M. Bhaskar, 2002, TMH.
2. Digital Signal Processing – Jonatham Stein, 2005, John Wiley.
3. DSP Processor Fundamentals, Architectures & Features – Lapsley et al. 2000, S. Chand & Co.
4. Digital Signal Processing Applications Using the ADSP-2100 Family by The Applications Engineering Staff of Analog Devices, DSP Division, Edited by Amy Mar, PHI
5. The Scientist and Engineer's Guide to Digital Signal Processing by Steven W. Smith, Ph.D., California Technical Publishing, ISBN 0-9660176-3-3, 1997
6. Embedded Media Processing by David J. Katz and Rick Gentile of Analog Devices, Newnes, ISBN 0750679123, 2005

Course Outcomes:

After completion of the course, the student will be able to

1. To distinguish between the architectural features of general-purpose processors and DSP processors
2. Understand the architectures of TMS 320C54XX and ADSP2100 DSP devices
3. Able to write assembly language programs using instruction set of TMS320C54XX
4. Can interface various devices to DSP Processors



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III Year – II SEMESTER	Professional Core Elective-II	L	T	P	C
		3	0	0	3
BIOMEDICAL SIGNAL PROCESSING					

Course Objectives

- Understand the nature and sources of key biomedical signals such as ECG, EEG, and EMG.
- Apply signal processing techniques to analyze and extract features from cardiological and neurological signals.
- Learn methods for the classification and interpretation of biomedical signals using statistical and modeling techniques.
- Explore adaptive filtering techniques for noise and artifact removal in biomedical signals.
- Gain insight into diagnostic imaging technologies and their role in biomedical signal analysis.

Unit I:

Introduction to Biomedical Signals: The nature of biomedical signals, action potential, objectives of biomedical signal analysis, Difficulties in biomedical signal analysis, computer aided diagnosis, Basic electrocardiography, the brain and its potentials, the electrophysiological origin of brain waves, EEG signals and its characteristics, EEG analysis. Basic EMG. Electroneurogram, Phono cardiogram

Unit II:

Cardiological Signal Processing: Basic ECG, Electrical Activity of the heart, ECG data acquisition, ECG lead system, ECG parameters & their estimation, Use of multiscale analysis for ECG parameters estimation, Noise & Artifacts, arrhythmia analysis monitoring, long-term continuous ECG recording, direct ECG data compression techniques. Cardiotocography

Unit III:

Neurological Signal Processing: Basic EEG, Linear prediction theory, the autoregressive method, spectral error measure, adaptive segmentation, Sleep EEG: data acquisition and classification of sleep stages, the markov model and markov chains, template matching for EEG-spike-and-wave detection. Dynamics of sleep-wake transitions, Hypnogram model parameters

Unit IV:

Adaptive Interference/Noise Cancellation: The wiener filtering problem, principle of an adaptive filter, the Widrow Hoff least mean square adaptive algorithm, Adaptive noise canceller: cancellation of 50/60hz interference in ECG, cancelling donor heart interference in heart-transplant ECG, cancellation of high frequency noise in electro-surgery.



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UNIT V:

Diagnostic Imaging and Integration: Overview of diagnostic imaging modalities: X-ray imaging, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Role of signal processing in imaging, Integration of biomedical signals and imaging data, Data formats, storage, and ethical considerations in biomedical analysis

Textbooks:

1. D.C.Reddy, Biomedical Signal Processing: Principles and Technique's Tata McGraw Hill, 2005.
2. E.N. Bruce, Biomedical Signal Processing and Signal Modelling, John Wiley and Sons, 2007.
3. MetinAkay, Biomedical Signal Processing, Academic Press, 2012.

Reference Books:

1. Sörnmo,Bioelectrical Signal Processing in Cardiac & Neurological Applications, Academic Press,2005.
2. Rangayyan,Biomedical Signal Analysis,Wiley 2002.
3. I Enderle, Introduction to Biomedical Engineering, Elsevier, 2nd Edition, 2005

Course Outcomes

- **After completion of the course, the student will be able to**
- Explain the nature and origin of common biomedical signals and the physiological systems that generate them.
- Understand cardiological signals such as ECG and fetal heart rate using signal acquisition and processing techniques.
- Apply modeling and prediction techniques for processing neurological signals like EEG, including sleep stage classification.
- Design and implement adaptive filters for biomedical noise removal using LMS and Wiener filtering methods.
- Discuss and compare diagnostic imaging modalities and evaluate their integration with biomedical signal analysis in clinical settings.



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III Year – II SEMESTER	Professional Core Elective-II	L	T	P	C
		3	0	0	3
NEURAL NETWORKS					

Course Objectives

- Understand the architecture and functioning of biological and artificial neural networks.
- Analyze and implement feedback on neural networks and their learning algorithms.
- Apply various supervised, unsupervised, and reinforcement learning methods.
- Understand and implement convolutional and recurrent neural network architectures.
- Explore real-world applications of neural networks including classification, prediction, and anomaly detection.

UNIT I:

Introduction to Neural Networks: Introduction, structure and working of Biological Neural Network, Artificial Neuron Models, Trends in Computing Comparison of BNN and ANN Characteristics of ANN, McCulloch-Pitts Model, Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, Classification Taxonomy of ANN-Connectivity, Neural Dynamics: Activation and Synaptic, Learning Strategy: Supervised, Unsupervised, Reinforcement, Learning Process: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning. Applications of Memory Based Learning.

UNIT II:

Single & Multilayer Feed Forward Neural networks: Perception Models: Discrete, Continuous and Multi -Category, Training Algorithms: Discrete and Continuous Perception Networks, Perception Convergence theorem, Limitations of the Perception Model, Credit Assignment Problem, Generalized Delta Rule, Gradient Descent, Back propagation neural network, Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Feature Detection. Applications of BPNN

UNIT III:

Learning Algorithms: Supervised learning: Linear Regression, Logistic Regression, K Nearest Neighbour (KNN), Random Forest, Support Vector Machines (SVM), Un supervised learning: k-means, c-means, Apriori, Reinforcement learning: Q-Learning, Case Study. Risk Evaluation, Anomaly Detection

UNIT IV:

Convolutional Neural Networks and Recurrent Neural Networks: Introduction to CNNs, Convolution, Correlation, Filtering, Kernel filter, Principles behind CNNs, Multiple Filters, CNN architectures, Detection and Segmentation, Visualizing and Understanding, Advanced CNNs for computer vision, Introduction to RNNs, Unfolded RNNs. *RNN applications, CNN*



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applications

UNIT V:

Recurrent Neural Networks (RNNs) and Applications: Introduction to RNNs: structure, unfolding through time, Types of RNNs: Vanilla RNN, LSTM, GRU, Training RNNs: backpropagation through time, Applications of RNNs in NLP and time-series prediction, Comparison: RNNs vs CNNs, Real-world use cases and integration of neural networks in AI systems

Textbooks:

1. James A Freeman and Davis Skapura, Neural Networks, Pearson Education, 2002.
2. Simon Haykin, Neural Networks-Acomprehensive foundation, Pearson Education, 2001
3. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." An MIT Press book in preparation. (2015).

Reference Books:

1. S. N. Sivanandam, S. Sumathi, S. N. Deepa, Neural Networks using MATLAB 6.0, TMH, 2006
2. B Yegnanarayana, Artificial neural networks, Prentice Hall of India, 1stEdition, 2005.

Course Outcomes:

After completion of the course, the student will be able to

- Describe the structure and function of artificial and biological neural networks, including neuron models and learning mechanisms.
- Design and implement single-layer and multilayer feedforward networks using algorithms like Perceptron and Backpropagation.
- Apply various machine learning algorithms (supervised, unsupervised, reinforcement) to solve practical classification and prediction tasks.
- Develop and analyze convolutional neural network architectures for computer vision applications
- Understand and utilize recurrent neural networks for sequence modeling, natural language processing, and temporal data analysis.



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III Year – II SEMESTER	Professional Core Elective-III	L	T	P	C
		3	0	0	3
OPTIMIZATION TECHNIQUES					

Course Objectives

- Understand the basic principles of optimization and formulate real-world problems using design variables, constraints, and objective functions.
- Apply linear programming methods and analyze optimal solutions using classical techniques like Simplex and duality.
- Explore numerical methods for single-variable optimization and understand convergence behavior.
- Learn and implement multivariable and constrained optimization techniques using gradient-based and direct search approaches.
- Examine and apply intelligent optimization algorithms such as Genetic Algorithms, PSO, and Simulated Annealing for complex problem-solving.

Unit-I

Introduction to optimization: Introduction to Classical Methods & Linear Programming Problems Terminology, Design Variables, Constraints, Objective Function, Problem Formulation. Calculus method, Kuhn Tucker conditions, Method of Multipliers.

Unit-II

Linear Programming Problem: Linear Programming Problem, Simplex method, Two-phase method, Big-M method, duality, Integer linear Programming, Dynamic Programming, Sensitivity analysis.

Unit-III

Single Variable Optimization: Problems Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci Search Method, Golden Section Method. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method, Cubic search method.

Unit-IV

Multivariable and Constrained Optimization Techniques: Multi Variable and Constrained Optimization Technique, Optimality criteria , Direct search Method, Simplex search methods, Hooke-Jeeve's pattern search method, Powell's conjugate direction method, Gradient based method, Cauchy's Steepest descent method, Newton's method, Conjugate gradient method. Kuhn - Tucker conditions, Penalty Function, Concept of Lagrangian multiplier, Complex search method, Random search method

Unit-V



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Intelligent Optimization Techniques: Introduction to Intelligent Optimization, Genetic Algorithm: Types of reproduction operators, crossover & mutation, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO), Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

Textbooks:

1. S. S. Rao, Engineering Optimisation: Theory and Practice, Wiley, 2008.
2. K. Deb, Optimization for Engineering design algorithms and Examples, Prentice Hall, 2 nd edition 2012.

Reference Books

1. C.J. Ray, Optimum Design of Mechanical Elements, Wiley, 2007.
2. R. Saravanan, Manufacturing Optimization through Intelligent Techniques, Taylor & Francis Publications, 2006.
3. D. E. Goldberg, Genetic algorithms in Search, Optimization, and Machine Learning, Addison-Wesley Longman Publishing, 1989.

Course Outcomes

After completion of the course, the student will be able to

- Formulate optimization problems with appropriate objective functions and constraints for engineering and applied science domains.
- Solve linear and integer programming problems using methods like Simplex, Big-M, and Dynamic Programming, and interpret dual solutions.
- Apply bracketing and gradient-based methods to identify optimal solutions in single-variable optimization problems.
- Implement multivariable and constrained optimization techniques, including search methods and penalty approaches for nonlinear problems.
- Employ intelligent optimization techniques like GA, PSO, and GP to solve complex, non-deterministic, or large-scale optimization problems.



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III Year – II SEMESTER	Professional Core Elective-III	L	T	P	C
		3	0	0	3
MOBILE AND CELLULAR COMMUNICATION					

Course Objectives:

- To provide the students with an understanding of the cellular concept frequency reuse, handoff strategies.
- To enable the students to analyze and understand wireless and mobile cellular communication systems over stochastic fading channels.
- To provide the students with an understanding of Co-channel and Non-Co channel Interference.
- To give students an understanding of cell coverage for signal and traffic diversity techniques and mobile antennas.
- To give the students an understanding of frequency management channel assignment and types of handoff.

UNIT I:

Cellular Systems: Limitations of Conventional System, Basic Cellular Mobile System, First, second, third and fourth Generation cellular wireless systems. Operation of Cellular System. Uniqueness of Mobile Radio Environment –Fading, coherence bandwidth, Doppler Spread. Fundamentals of cellular Radio System Design: concept of frequency reuse channels, Co-channel Interference, Co-channel Interference Reduction Factor, desired C/I from a normal case in a Omni directional Antenna system. Trunking and grade of service.

UNIT II:

Co-Channel & Non-Co-Channel Interference: Measurement of Real Time Co-Channel Interference, design of Antenna system, Antenna parameters and their effects, diversity techniques: Space Diversity, Polarization diversity, frequency diversity and time diversity. Non-co channel interference-adjacent channel interference, Near End far end interference, effect on coverage and interference by power decrease, antenna height decrease

UNIT III:

Cell Coverage for Signal and Traffic: Signal reflections in flat and hilly terrain, effect of human made structures, phase difference between direct and reflected paths, constant standard deviation, straight line path loss slope, general formula for mobile propagation over water and flat open area, near and long-distance propagation.

UNIT IV:



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Cell Site and Mobile Antennas: Space diversity antennas, umbrella pattern antennas, minimum separation of cell site antennas, Mobile Antennas. Frequency Management and Channel Assignment: Numbering and grouping, setup access and paging channels, channel assignments to cell sites and mobile units, channel sharing and borrowing, sectorization, overlaid cells, non-fixed channel assignment

UNIT V:

Handoffs: Handoff Initiation, types of handoff, delaying handoff, advantages of Handoff, power difference handoff, forced handoff, mobile assisted and soft handoff. Intersystem handoff.

Textbooks:

1. Mobile Cellular Telecommunications – W.C.Y. Lee, Tata McGraw Hill, 2nd Edn., 2006.
2. Wireless Communications - Theodore. S. Rapport, Pearson education, 2nd Edn., 2002.

Reference Books:

1. Principles of Mobile Communications – Gordon L. Stuber, Springer International 2nd Edition, 2001.
2. Modern Wireless Communication –Simon Haykin Michael Moher, Persons Education,2005.
3. Wireless Communication theory and Techniques, Asrar U.H .Sheikh ,Springer,2004.

Course Outcomes:

After completion of the course, the student will be able to

- Understand impairments due to multipath fading channel
- Understand the fundamental techniques to overcome the different fading effects
- Understand co-channel and non-co-channel interferences
- Demonstrate cell coverage/signal and traffic, diversity techniques and mobile antennas
- Understand the frequency management, channel assignment and types of handoffs



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III Year – II SEMESTER	Professional Core Elective-III	L	T	P	C
		3	0	0	3
ARTIFICIAL INTELLIGENCE					

Course Objectives:

- 1 Understand the foundational principles and techniques of Artificial Intelligence.
- 2 Apply AI techniques for solving problems such as search, planning, and reasoning.
- 3 Gain insight into knowledge representation and inference mechanisms.
- 4 Explore machine learning and AI applications in real-world systems.
- 5 Analyze the ethical and societal implications of deploying AI technologies.

UNIT I:

Introduction to AI and Intelligent Agents: Definition and history of AI, Applications of AI: games, robotics, NLP, computer vision, expert systems, Foundations of AI: logic, probability, learning, biology, neuroscience, Types of AI: narrow vs general, weak vs strong, Rationality and structure of intelligent agents, PEAS framework, types of environments and agents

UNIT II:

Problem Solving and Search Techniques, Problem formulation and state space representation, Uninformed search strategies: Breadth-First Search (BFS), Depth-First Search (DFS), Uniform Cost Search, Informed search: Greedy Best-First, A* search, Heuristics and performance analysis, Constraint Satisfaction Problems (CSPs), Adversarial search and game playing: Minimax, Alpha-Beta Pruning

UNIT III:

Knowledge Representation and Reasoning: Propositional logic and inference, First-order predicate logic: syntax and semantics, Knowledge representation techniques: semantic networks, frames, ontologies, Forward and backward chaining, Rule-based systems and logic programming (introduction to Prolog), Resolution and unification.

UNIT IV:

Machine Learning Basics, Supervised vs unsupervised learning, Decision trees, k-nearest neighbours, Naïve Bayes classifiers, Neural networks (basic concepts), Introduction to reinforcement learning and Q-learning, Applications: classification, pattern recognition, spam filtering, recommendation systems

UNIT V:



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Advanced Topics and Ethical Aspects: Natural Language Processing (NLP): parsing, sentiment analysis, Robotics and computer vision: sensing, mapping, object recognition, Planning: classical planning, STRIPS, AI in healthcare, education, business, and industry, Ethical issues in AI: fairness, transparency, bias, privacy, AI and the future: risks, regulations, and human-AI interaction

Textbooks:

- 1 Artificial Intelligence: A Modern Approach- Stuart Russell and Peter Norvig, 4th Edition, Pearson
- 2 Artificial Intelligence- Elaine Rich, Kevin Knight, Shivashankar B. Nair, 3rd Edition, McGraw Hill

Reference Books:

- 1 Introduction to Artificial Intelligence and Expert Systems- Dan W. Patterson, Pearson
- 2 Introduction to Machine Learning- Ethem Alpaydin, MIT Press
- 3 Machine Learning: A Probabilistic Perspective- Kevin Murphy, MIT Press
- 4 Machine Learning, Tom Mitchell, McGraw Hill
- 5 Artificial Intelligence: Foundations of Computational Agents- David L. Poole and Alan Mackworth. Cambridge University Press

Course Outcomes)

After successful completion of the course, students will be able to:

- Explain the core concepts and historical evolution of AI and intelligent systems.
- Apply classical AI search techniques to solve problem-solving tasks and optimize solutions.
- Represent knowledge and perform logical reasoning using propositional and predicate logic systems.
- Implement and evaluate machine learning algorithms for pattern recognition and classification problems.
- Discuss advanced AI topics and assess the ethical and societal impacts of AI applications.



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III Year – II SEMESTER	Open Elective-II	L	T	P	C
		3	0	0	3
Machine Learning - Chip Design					

Course Objectives:

- To introduce the fundamentals of Machine Learning and its application in hardware design.
- To explore the integration of ML algorithms into ASIC/FPGA-based systems.
- To understand Hardware-aware ML and ML-driven EDA tools.
- To design and optimize ML accelerators and inference engines at chip-level.
- To expose students to industry trends in ML-SoC co-design, including edge AI.

UNIT I: Introduction to ML and Hardware Co-Design

Overview of Machine Learning: Supervised, Unsupervised, Reinforcement learning. Digital design basics: ASIC vs FPGA. Motivation for ML in hardware design. Embedded AI and edge computing.

UNIT II: Machine Learning Models and Hardware Mapping

Neural Networks, SVMs, Decision Trees overview. Model compression: pruning, quantization. Fixed-point arithmetic and bit-precision trade-offs. Case Study: Mapping ML models to hardware (e.g., CNN on FPGA).

UNIT III: Hardware-Aware ML & ML for EDA

Design space exploration using ML. ML for placement, routing, power and timing estimation. Bayesian optimization, reinforcement learning in EDA. ML-based RTL-level synthesis improvements.

UNIT IV: ML Accelerators Design

Architectural components: PE array, systolic arrays, buffers, DMA. Design of TPU-like architectures. Memory access optimization and dataflow mapping. FPGA implementation of ML inference engines.

UNIT V: Emerging Trends & Projects

Neuromorphic computing, spiking neural networks. Open-source ML hardware frameworks (e.g., TVM, MLIR). Case Studies: NVIDIA DLA, Google TPU, Intel NNP. Project-based learning: Deploying a trained model on embedded hardware (Raspberry Pi/Jetson Nano).

Textbooks

1. Hebron, P. (2016). *Machine Learning for Designers*. O'Reilly Media.
2. Fernandez-Baca, E. (2022). *AI Hardware Design: Challenges and Opportunities*. Springer.
3. Choi, D. (2021). *Machine Learning for Embedded System Design: A Practical Approach*. CRC Press.



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Reference Books

1. Xiao, P. (2018). *Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed*. Wiley.
2. Sze, V., Chen, Y.-H., Yang, T.-J., & Emer, J. S. (2020). *Efficient Processing of Deep Neural Networks: A Tutorial and Survey*. Morgan & Claypool.
3. Chien, A. A. (2022). *Computer Architecture for Scientists: Principles and Examples*. MIT Press.
4. Kumar, A., Tripathi, S. L., & Rao, K. S. (Eds.). (2023). *Machine Learning Techniques for VLSI Chip Design*. Wiley.

Course Outcomes:

On successful completion, students will be able to:

- Apply machine learning models for chip design and optimization tasks.
- Analyze and design ML-based hardware accelerators.
- Use EDA tools that incorporate ML-based optimization.
- Develop low-power and high-performance hardware for ML inference.
- Implement ML algorithms on FPGA or embedded systems.



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III Year – II SEMESTER	Open Elective-II	L	T	P	C
		3	0	0	3
BLOCK CHAIN TECHNOLOGIES					

Course Objectives

- Understand the origin, architecture, and functionality of blockchain and how it transforms traditional business networks.
- Comprehend the fundamentals of cryptography including hash functions and Merkle trees used in blockchain.
- Analyze the principles of digital signatures and how they enable secure cryptocurrency transactions.
- Compare centralized and decentralized systems, and understand the consensus mechanisms like proof-of-work.
- Evaluate Bitcoin's architecture, transaction mechanisms, storage options, mining process, and privacy features.

UNIT I:

Block chain Fundamentals: Tracing Block chain's Origin, Revolutionizing the Traditional Business Network, How Blockchain Works, What Makes a Blockchain Suitable for Business?

Introduction to Cryptography: Cryptographic Hash Functions, SHA256, Hash Pointers and Data Structures, Merkle tree.

UNIT II:

Digital Signatures: Elliptic Curve Digital Signature Algorithm (ECDSA), Public Keys as Identities, A Simple Crypto currency.

UNIT III:

Centralization vs. Decentralization, Distributed Consensus, Consensus without identity using a block chain, Incentives and proof of work.

Mechanics of Bit coin: Bit coin transactions, Bit coin Scripts, Applications of Bit coin scripts, Bit coin blocks, The Bit coin network.

UNIT IV:

Storage of and Usage of Bit coins: Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets.



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UNIT V:

Bit coin Mining: The Task of Bit coin miners, Mining Hardware, Mining pools, Mining incentives and strategies. Bit coin and Anonymity: Anonymity Basics, Mixing, Zero coin and Zero cash

Textbooks

1. Blockchain for dummies, Manav Gupta, Second IBM Limited Edition, 2018, John Wiley & Sons.
2. Bitcoin and Cryptocurrency Technologies, Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, 2016.

References

1. Blockchain: Blueprint for a New Economy, Melanie Swan, First edition, 2015, O'Reilly Media.
2. Bitcoin: Programming the Open Blockchain, Andreas M. Antonopoulos, Mastering, Second edition, 2017, O'Reilly Media.

e-Resources

1. <https://nptel.ac.in/courses/106/104/106104220/>
2. <https://nptel.ac.in/courses/106/105/106105184/>

Course Outcomes:

After completion of the course, the student will be able to

- Describe the core concepts of blockchain technology, including its structure, business utility, and role in decentralized systems.
- Explain the application of cryptographic techniques such as hash functions and Merkle trees in securing blockchain data.
- Apply digital signature techniques (e.g., ECDSA) to verify transactions and identities in cryptocurrencies.
- Analyze decentralized consensus mechanisms including proof-of-work and explore how Bitcoin ensures trust without a central authority.
- Evaluate methods of Bitcoin storage, usage, mining strategies, and privacy techniques for real-world blockchain applications.



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III Year – II SEMESTER	Open Elective-II	L	T	P	C
		3	0	0	3
DRONE TECHNOLOGY					

Course Objectives:

To understand the basics of drone concepts

- To learn and understand the fundamentals of design, fabrication and programming of drone.
- To impart the knowledge of a flying and operation of drone.
- To know about the various applications of drone.
- To understand the safety risks and guidelines of fly safely.

UNIT I:

Introduction To Drone Technology: Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability.

UNIT II:

Drone Design, Fabrication and Programming: Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts - Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.

UNIT III:

Drone Flying and Operation: Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool – Sensors-Onboard storage capacity -Removable storage devices- Linked mobile devices and applications.

UNIT IV:

Drone Commercial Applications: Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing.

UNIT V:



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Future Drones and Safety: The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms.

Course Outcomes:

Upon successful completion of the course, students should be able to:

- Know about a various type of drone technology, drone fabrication and programming.
- Execute the suitable operating procedures for functioning a drone.
- Select appropriate sensors and actuators for Drones.
- Develop a drone mechanism for specific applications.
- Create the programs for various drones.

Text Books

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

References

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



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III Year – II SEMESTER	Professional Core Lab	L	T	P	C
		0	0	3	1.5
VLSI Design Lab					

Course objectives:

- Introduction of mentor graphics tool and technology mapping
- Design of basic cell blocks
- Introduction of layout tools
- Introduction of simulation of combinational circuits
- Introduction of simulation of Sequential circuits

Note: The students are required to design the schematic diagrams using CMOS logic and to draw the layout diagrams to perform the following experiments using 130nm technology with the industry standard EDA Tools.

List of Experiments:

1. Design and Implementation of a Universal Gates
2. Design and Implementation of an Inverter
3. Design and Implementation of Full Adder
4. Design and Implementation of Full Subtract or
5. Design and Implementation of Decoder
6. Design and Implementation of RS-Latch
7. Design and Implementation of D-Latch
8. Design and Implementation asynchronous counter
9. Design and Implementation of static RAM cell
10. Design and Implementation of 8-bit DAC using R-2R latter network

Software Required:

1. Mentor Graphics Software / Equivalent Industry Standard Software.
2. Personal computer system with necessary software to run the programs and to implement.

Course Outcomes:

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



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- Able to design a schematic and simple layout for CMOS Inverter
- Able to design Entry & simulation of multiplexer circuit with test bench & functional verification.
- Able to design Entry & simulation of D flip-flop circuit with test bench & functional verification.
- Able to synthesize digital VLSI systems from register-transfer or higher-level descriptions Able to apply the Concept of design rules during the layout of a circuit and to understand current trends in semiconductor technology, and how it impacts scaling and Performance.



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III Year – II SEMESTER	Professional Core Lab	L	T	P	C
		0	0	3	1.5
Advanced Digital Communications Lab					

1. Study The Various Data Format.
(NRZ-L, NRZ-M, NRZ-S, RZ, Bi Phase-L, Bi Phase-M, Bi Phase-Differential Manchester, RZ-AMI)
2. Pseudo Noise sequence and recovery of the clock.
3. ASK generation and Detection.
4. FSK and Minimum Shift Keying generation and Detection.
5. Phase shift keying methods (BPSK, QPSK) generation and Detection.
6. Linear & Adaptive Delta Modulation and Demodulation
7. Differential Phase Shift Keying (DPSK)
8. BER of QPSK in AWGN channel
9. Designing an equalizer in the context of baseband binary data transmission
10. 8-QAM generation & detection
11. Direct Sequence Spread Spectrum
12. Frequency Hopping Spread Spectrum
13. Huffman Coding
14. Shannon Fano Coding
15. Linear Block Codes
16. Cyclic Code Encoder
17. Convolutional Codes

Note: Any of the 5 `Hardware related experiments` and 5 more `Simulation based experiments are performed by all the students of B.Tech- R23 Regulation Students.



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III Year – II SEMESTER	Skill Enhancement Course	L	T	P	C
		0	1	3	1.5
Hardware Modeling with HDLs					

Course Description:

This course introduces to design digital logic circuits using Verilog HDL. The various modeling styles in Verilog is explained for logic circuits. The use of Testbench and HDL synthesis in VLSI using System Verilog is provided

Course Educational Objectives:

1. To design combinational, sequential circuits using Verilog HDL
2. To understand behavioral and RTL modeling of digital circuits
3. To verify whether the design meets its timing constraint specifications
4. To analyze the program and their designs on a development board
5. To simulate, synthesize, and program their designs on a development board

UNIT 1:

Hardware Modeling basics

Lexical conventions, data types, system tasks and compiler directives, Modules, ports, hierarchical names encapsulation, modeling primitives, Models of propagation delay and net delay path delays and simulation

UNIT 2

Types of Modeling: Gate-Level Modeling: Gate types, gate delays, Dataflow Modeling: Continuous assignments, delays, expressions, operators, and operands, operator types, examples, Behavioral Modeling: Structured procedures, procedural assignments, timing controls, conditional statements, multiway branching, loops, sequential and parallel blocks, generate blocks

UNIT 3

Timing and Delays: Types of delay models, path delay modeling, timing checks, delay back annotation, BCD to 7-Segment Display Decoder, BCD Adder, 32-Bit Adders, Traffic Light Controller, Shift-and-Add Multiplier, Array Multiplier



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UNIT 4

Verilog Test benches: What is Verification, what is a Test bench, The Importance of Verification, Convergence Model, What Is Being Verified, Functional Verification Approaches, Testing Versus Verification, Design and Verification Reuse, The Cost of Verification

UNIT 5

HDL-based synthesis: Technology-independent design, styles for synthesis of combinational and sequential logic, synthesis of finite state machines, synthesis of gated clocks, design partitions and hierarchical structures

Simulation Assignments

This course shall involve Verilog Modelling and Simulation Assignments using Xilinx Vivado / Cadence INCISIV tools on the below topics (but not limited to)

1. Modeling and Simulation of Combinational Logic Circuits at Gate Level
2. Modeling Combinational Logic Circuits at Dataflow level
3. Modelling Combinational Logic Circuits at Behavioural Level
4. Modelling Combinational Logic Circuits at Structural Level
5. Verilog Modelling of Delays in Digital Circuits
6. Verilog Modelling of Sequential Logic Circuits
7. Verilog Modelling of Finite State Machines
8. Verilog Modelling using RTL Design methodology – GCD Processor Design
9. Case Study of RTL Modelling of Data Sorter, Min-Max Computation, Serial Communication Controller
10. Modeling Testbenches for Combinational and Sequential Logic Circuits
11. Using Assertions in Verilog

Textbooks:

1. Samir Palnitkar, Verilog HDL, 2/e, Pearson Education, 2013
2. Charles Roth, Digital Systems Design using Verilog, Cengage Learning, 2014
3. M. G. Arnold, “Verilog Digital – Computer Design”, Prentice Hall (PTR), 1999



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References:

1. Janick Bergeron, “Writing Test benches using System Verilog”, Springer, 2014
2. J. Bhasker, System Verilog HDL Primer, B.S. Publications, 2012
3. J. Bhasker, Verilog Synthesis Primer, B. S. Publications, 2011
4. M. Ciletti, Advanced Digital Design with Verilog HDL, 2/e. Pearson Education, 2012

Course Outcomes:

1. To understand the basic concepts of verilog HDL
2. To model digital systems in verilog HDL at different levels of abstraction
3. To understand the concept of timing and delay
4. To know the simulation techniques and test bench creation
5. To analyze the process of HDL synthesis.



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III Year – II SEMESTER	Audit Course	L	T	P	C
		2	0	0	0
TECHNICAL PAPER WRITING AND INTELLECTUAL PROPERTY RIGHTS					

COURSE OBJECTIVES

- Introduce students to research fundamentals, including topic selection, literature review, and the structured components of a technical paper.
- Familiarize students with research design, data collection methods, and statistical analysis, alongside proper citation and referencing styles.
- Develop students' skills in writing clear and concise technical papers and delivering professional presentations of research findings.
- Provide a comprehensive overview of intellectual property rights, covering patents, copyrights, trademarks, and trade secrets.
- Raise awareness of ethical considerations in research, emerging issues in IPR (such as digital rights and open access), and the importance of protecting intellectual property in collaborative settings.

UNIT-I

Introduction to Research and Technical Writing: Fundamentals of Research: Definition, objectives, types (basic and applied), and research methodology. Types of Technical Documents: Research papers, theses, and technical reports. Literature Review: Importance, methods for conducting surveys, and reviewing scholarly articles. Research Topic Selection: Identifying research gaps and formulating research questions.

UNIT-II

Research Design and Data Collection: Research Design: Types (exploratory and descriptive) and planning research. Data Collection: Primary vs. secondary data, qualitative and quantitative methods. Visual Data Representation: Graphs, tables, and charts. Citation Styles: Overview of APA and IEEE formats.

UNIT-III

Writing and Presenting Technical Papers: Writing Skills: Clarity, conciseness, and coherence in technical writing. Abstract and Conclusion: Techniques for writing effectively. Presentation Skills: Preparing presentations and using visual aids.

UNIT-IV



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Intellectual Property Rights (IPR): Fundamentals of IPR: Introduction to patents, copyrights, and trademarks. Patents: Basic criteria for patentability. Case Studies: Real-world applications of IPR in engineering.

UNIT-V

Ethical Considerations in Research: Ethical Issues: Plagiarism avoidance, responsible authorship, and ethical use of data.

Open Access: Introduction to Creative Commons and open-source research.

Reference Books:

1. Alred, G. J., Brusaw, C. T., & Oliu, W. E. (2020). The Handbook of Technical Writing (12th ed.). Bedford/St. Martin's.
2. Day, R. A., & Gastel, B. (2016). How to write and publish a scientific paper (8th ed.). Cambridge University Press.
3. Kothari, C. R., & Garg, G. (2019). Research methodology: Methods and techniques (4th ed.). New Age International Publishers.
4. Menell, P. S., Lemley, M. A., Merges, R. P., & Balganesh, S. (2020). Intellectual Property in the New Technological Age 2020: Vol. II Copyrights, Trademarks, and State IP Protections.
5. Singh, A. K. (2018). Intellectual property rights: Unleashing the knowledge economy. Springer.

Textbooks:

- 1) Kumar, R. (2018). Research methodology: A step-by-step guide for beginners (5th ed.). SAGE Publications.
- 2) Goold, P. R. (2022). A Critical Introduction to Intellectual Property Law. Cambridge University Press.
- 3) Creswell, J. W., & Creswell, J. D. (2018). Research design: Qualitative, quantitative, and mixed methods approach (5th ed.). SAGE Publications.
- 4) Glasman-Deal, H. (2020). Science Research Writing: For Native and Non-Native Speakers of English (2nd ed.). World Scientific Publishing Company.
