



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

VIZIANAGARAM – 535 003 Andhra Pradesh (India)

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

B.Tech. – IV Year I Semester

S.No	Category	Course Code	Title	L	T	P	C
1	PC	R2341041	Microwave Engineering & Optical Communications	3	0	0	3
2	PC	R2341042	Digital Image and Video Processing	3	0	0	3
3	Management Course-II	R2341043	E-Waste Management	2	0	0	2
4	PE – IV	R2341044A	RADAR Engineering	3	0	0	3
		R2341044B	Low Power VLSI				
		R2341044C	Spectrum Sensing				
5	PE - V	R2341045A	Speech Signal Processing	3	0	0	3
		R2341045B	Wireless Sensor Networks & IoT Applications				
		R2341045V	Embedded System Design				
6	OE - III	R2341046A	Data Networks & Protocols	3	0	0	3
		R2341046B	Cryptography and Network Security				
		R2341046C	Soft Computing Techniques				
7	PC Lab-1	R2341047	Microwave Engineering & Optical Communications Lab	0	0	3	1.5
8	PC Lab-2	R2341048	Digital Image and Video Processing Lab	0	0	3	1.5
9	SEC	R234104SC	Machine Learning Lab	0	1	2	2
10	AC	R234104AC	Value Education	2	0	0	0
Total				19	1	8	22



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IV B. TECH I SEMESTER	Professional Core	L	T	P	C
		3	0	0	3
MICROWAVE ENGINEERING & OPTICAL COMMUNICATIONS					

Course objectives

1. To get familiarized with microwave frequency bands, their applications and to understand the limitations and losses of conventional tubes at these frequencies.
2. To distinguish between different types of microwave tubes, their structures and principles of microwave power generation.
3. To impart the knowledge of Scattering Matrix, its formulation and utility, and establish the S-Matrix for various types of microwave junctions.
4. Understand the utility of Optical Fibers in Communications.

UNIT - I

Microwave Tubes:

Limitations and Losses of conventional Tubes at Microwave Frequencies, Microwave Tubes O Type and M Type Classifications, O-type Tubes: 2 Cavity Klystrons Structure, Reentrant Cavities, Velocity Modulation Process and Applegate Diagram, Bunching Process and Small Signal Theory Expressions for O/P Power and Efficiency. Reflex Klystrons Structure, Velocity Modulation and Applegate Diagram, Mathematical Theory of Bunching, Power Output, Efficiency, Oscillating Modes and O/P Characteristics. Helix TWTs: Types and Characteristics of Slow Wave Structures; Structure of TWT and Amplification Process (qualitative treatment), Suppression of Oscillations, Gain Considerations.

UNIT - II

M-Type Tubes:

Introduction, Cross-field Effects, Magnetrons Different Types, Cylindrical Traveling Wave Magnetron Hull Cut-off and Hartree Conditions, Modes of Resonance and PI-Mode Operation, Separation of PIMode, o/p characteristics, Microwave Solid State Devices: Introduction, Classification, Applications. TEDs Introduction, Gunn Diodes Principle, RWH Theory, Characteristics, Modes of Operation - Gunn Oscillation Modes, Principle of operation of IMPATT and TRAPATT Devices.

UNIT - III

Waveguide Components:

Coupling Mechanisms Probe, Loop, Aperture types. Waveguide Discontinuities Waveguide Windows, Tuning Screws and Posts, Matched Loads. Waveguide Attenuators Different Types, Resistive Card and Rotary Vane Attenuators; Waveguide Phase Shifters Types, Dielectric and Rotary Vane Phase Shifters, Waveguide Multiport Junctions - E plane and H plane Tees.



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Ferrites Composition and Characteristics, Faraday Rotation, Ferrite Components Gyrator, Isolator.

UNIT - IV

Scattering matrix:

Scattering Matrix Properties, Directional Couplers 2 Hole, Bethe Hole, [s] matrix of Magic Tee and Circulator. Microwave Measurements: Description of Microwave Bench Different Blocks and their Features, Errors and Precautions, Measurement of Attenuation, Frequency. Standing Wave Measurements, measurement of Low and High VSWR, Cavity Q, Impedance Measurements.

UNIT - V

Optical Fiber Transmission Media:

Optical Fiber types, Light Propagation, Optical fiber Configurations, Optical fiber classifications, Losses in Optical Fiber cables, Light Sources, Optical Sources, Light Detectors, LASERS, WDM Concepts, Optical Fiber System link budget.

Textbooks:

1. Microwave Devices and Circuits Samuel Y. Liao, Pearson, 3rd Edition, 2003.
2. Electronic Communications Systems- Wayne Tomasi, Pearson, 5th Edition

References:

1. Optical Fiber Communication Gerd Keiser, TMH, 4thEd., 2008.
2. Microwave Engineering - David M. Pozar, John Wiley & Sons (Asia) Pvt Ltd., 1989, 3r ed., 2011 Reprint.
3. Microwave Engineering - G.S. Raghuvanshi, Cengage Learning India Pvt. Ltd., 2012.
4. Electronic Communication System George Kennedy, 6th Ed., McGraw Hill.

Course outcomes:

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

- 1 Able to Know the power generation at microwave frequencies and derive the performance characteristics.
- 2 Realize the need for solid state microwave sources and understand the principles of solid-state devices.
- 3 Distinguish between the different types of waveguide and ferrite components, and select proper components for engineering applications



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- 4 Understand the utility of S-parameters in microwave component design and learn the measurement procedure of various microwave parameters.
- 5 Understand the mechanism of light propagation through Optical Fibers.



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IV B.TECH I SEMESTER	Professional Core	L	T	P	C
		3	0	0	3
DIGITAL IMAGE AND VIDEO PROCESSING					

Course objectives:

- Understand the fundamentals of image processing including pixel relationships, sampling, quantization, and key image transforms.
- Explore image enhancement and segmentation techniques in spatial and frequency domains.
- Study various image compression techniques and standards including both lossy and lossless methods.
- Learn the basics of digital video processing, including video signal models and filtering.
- Understand motion estimation methods and their applications in video coding and compression.

UNIT I:

Fundamentals of Image processing and Image Transforms: Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels Image Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms

UNIT II:

Image Processing Techniques: Image Enhancement: Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation Image Compression Image compression fundamentals – coding Redundancy, spatial and temporal redundancy.

UNIT III:

Compression models: Lossy and Lossless, Huffmann coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding, wavelet coding, JPEG standards



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UNIT IV:

Basic Steps of Video Processing: Analog video, Digital Video, Time varying Image Formation models: 3D motion models, Geometric Image formation, Photometric Image formation, sampling of video signals, filtering operations

UNIT V:

2-D Motion Estimation: Optical flow, general methodologies, pixel-based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Waveform based coding, Block based transform coding, predictive coding, Application of motion estimation in video coding.

Textbooks

1. Gonzalez and Woods, "Digital Image Processing", 3rd edition, Pearson
2. Yao wang, Joem Ostarmann and Ya – quin Zhang, "Video processing and communication", 1st edition, PHI

References

1. M. Tekalp, "Digital video Processing", Prentice Hall International
2. Relf, Christopher G., "Image acquisition and processing with LabVIEW", CRC press
3. Aner ozdemi R, "Inverse Synthetic Aperture Radar Imaging with MATLAB Algorithms", JohnWiley & Sons
4. Chris Solomon, Toby Breckon, "Fundamentals of Digital Image Processing A Practical Approach with Examples in Matlab", John Wiley & Sons,

Course Outcomes:

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

- Explain the fundamental concepts of digital image processing, including image representation, sampling, quantization, and key image transforms like DFT, DCT, and DWT.
- Apply spatial and frequency domain enhancement techniques and perform image segmentation using edge detection, thresholding, and region-based methods.
- Compare and implement image compression algorithms, including Huffman, arithmetic, LZW, and JPEG compression standards.
- Describe the structure of analog and digital video systems and apply models for time-varying image formation and basic video sampling and filtering.
- Implement 2D motion estimation techniques such as block matching and optical flow, and apply them in video compression and motion analysis tasks.



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IV B.TECH I SEMESTER	Management Course-II	L	T	P	C
		2	0	0	2
E-WASTE MANAGEMENT					

UNIT-1:

Introduction. E- waste; composition and generation. Global context in e- waste; E-waste pollutants, E waste hazardous properties, Effects of pollutant (E- waste) on human health and surrounding environment, domestic e-waste disposal, Basic principles of E waste management, Component of E waste management, Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials, occupational and environmental health perspectives of recycling e-waste in India.

UNIT-2:

E-waste hazardous on Global trade Essential factors in global waste trade economy, Waste trading as a quint essential part of electronic recycling, Free trade agreements as a means of waste trading. Import of hazardous e-waste in India; India's stand on liberalizing import rules, E-waste economy in the organized and unorganized sector. Estimation and recycling of e-waste in metro cities of India.

UNIT-3:

E-waste control measures Need for stringent health safeguards and environmental protection laws in India, Extended Producers Responsibility (EPR), Import of e-waste permissions, Producer-Public-Government cooperation, Administrative Controls & Engineering controls, monitoring of compliance of Rules, Effective regulatory mechanism strengthened by manpower and technical expertise, Reduction of waste at source

UNIT-4:

E-waste (Management and Handling) Rules, 2011; and E-Waste (Management) Rules, 2016 - Salient Features and its likely implication. Government assistance for TSDFs.

UNIT-5:

The international legislation: The Basel Convention; The Bamako Convention. The Rotterdam Convention. Waste Electrical and Electronic Equipment (WEEE) Directive in the European Union, Restrictions of Hazardous Substances (RoHS) Directive

Text Books:

1.E-waste: implications, regulations, and management in India and current global best practices",Johri R., TERI Press, New Delhi



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Reference Books:

1. Electronic Waste – 1st Edition (Toxicology and Public Health Issues), Fowler B. 2017Elsevier
2. Electronic Waste Management. Science, Hester R.E., and Harrison R.M. 2009.



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IV B. TECH I SEMESTER	Professional Core Elective - IV	L	T	P	C
		3	0	0	3
RADAR ENGINEERING					

Course Objectives:

- Understand the basic principles, types, and performance metrics of radar systems.
- Explore the concepts of Continuous Wave (CW) radar and Frequency Modulated Continuous Wave (FM-CW) radar systems for range and velocity measurements.
- Analyze Moving Target Indicator (MTI) and Pulse Doppler radar systems for target detection in the presence of clutter.
- Understand the principles of tracking radars and compare various tracking techniques.
- Learn the methods for detecting radar signals in noise using matched filters and evaluate detection performance.

Unit I: Introduction

Nature of Radar, Maximum Unambiguous Range, Radar Waveforms, Radar Block Diagram and Operation, Simple form of Radar Equation, Radar Frequencies and Applications, Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise and SNR, Integration of Radar Pulses, Transmitter Power, Radar Cross Section of simple Targets, PRF and Range Ambiguities.

Radar Cross Section of complex Targets

Unit II: CW and MTI Radars

CW and Frequency Modulated Radar: Doppler Effect, CW Radar-Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Applications of CW radar, FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics for approaching and receding Targets, FM-CW altimeter, Multiple Frequency CW Radar.

Unit III: MTI and Pulse Doppler Radar:

Introduction, Principle, MTI Radar with Power Amplifier Transmitter, Delay Line Cancellers, Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs, Range Gated Doppler Filters, MTI Radar Parameters, Limitations to MTI Performance, Non-coherent MTI, MTI versus Pulse Doppler Radar. *MTI Radar with Power Oscillator Transmitter*

Unit IV: Tracking Radar

Sequential Lobing, Conical Scan, Amplitude Comparison monopulse radar using one coordinate system and Phase Comparison methods, Target Reflection Characteristics and Angular Accuracy, Tracking in Range, Acquisition and Scanning Patterns, Comparison of



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Trackers, Radomes, Frequency scan Arrays, Radar Display types, Branch type and Balanced type duplexers, Circulators as Duplexers. *Amplitude Comparison using two coordinate system*

Unit V: Detection of Radar Signals in Noise

Matched Filter Receiver: Response Characteristics and Derivation, Correlation detection, Detection criteria, Detector Characteristics, Automatic Detection, Constant False Alarm Rate Receiver. *Matched filter with non-white noise*

Textbook (s)

1. Merrill I. Skolnik Introduction to Radar Systems, McGraw-Hill, Second Edition, 1981
2. Merrill I. Skolnik Introduction to Radar Systems, Tata McGraw-Hill, Third Edition, 2001

Reference Books)

1. Gottapu Sasibhushana rao, Microwave & Radar Engineering, Pearson Education, 2013

Course Outcomes:

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

- Explain the operational principles of radar systems, including radar waveforms, radar equation, performance parameters, and target radar cross section.
- Demonstrate the working of CW and FM-CW radar systems, and evaluate their use in speed and altitude measurements.
- Analyze MTI and Pulse Doppler radar systems, including blind speed mitigation, Doppler filtering, and their limitations in real-world scenarios.
- Compare different tracking radar techniques, including monopulse and conical scanning methods, and understand angular tracking accuracy and radar display systems.
- Apply matched filter and correlation detection techniques for radar signal detection in noisy environments, and evaluate system performance using detection theory.



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IV B.TECH I SEMESTER	Professional Core Elective - IV	L	T	P	C
		3	0	0	3
LOW POWER VLSI					

Course Objectives:

1. Known the low power low voltage VLSI design
2. Understand the impact of power on system performances.
3. Known about different Design approaches.
4. Identify suitable techniques to reduce power dissipation in combinational and sequential circuits.
5. To gain Knowledge on low power design and power estimation techniques in CMOS circuits.
6. To understand the synthesis and software design for low power.

UNIT – I

Fundamentals: Need for Low Power Circuit Design, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

Unit II

Power Dissipation in CMOS Sources of power dissipation – Physics of power dissipation in MOSFET devices: The MIS structure, long channel MOSFET, Submicron MOSFET, gate induced drain leakage– Power dissipation in CMOS: short circuit dissipation, dynamic dissipation, load capacitance– Low power VLSI design: Limits – principles of low power design, hierarchy of limits, fundamental limit, material limit.

Unit III

Power Optimization Using Special Techniques Power Reduction in Clock Networks: Clock Gating, Reduced Swing Clock, Oscillator Circuit for Clock Generation, Frequency Division and Multiplication, Other Clock Power Reduction Techniques - CMOS Floating Node: Tristate Keeper Circuit, Blocking Gate, Low Power Bus: Low Swing Bus, Charge Recycling Bus, Delay Balancing - Low Power Techniques for SRAM: SRAM Cell, Memory Bank Partitioning.

Unit IV



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Design Of Low Power Circuits Transistor and Gate Sizing: Sizing an Inverter Chain, Transistor and Gate Sizing for Dynamic Power Reduction, Transistor Sizing for Leakage Power Reduction - Network Restructuring and Reorganization: Transistor Network Restructuring, Transistor Network Partitioning and Reorganization - Special Latches and Flip-flops : Self-gating Flip-flop, Combinational Flip-flop, Double Edge Triggered Flip-flop - Low Power Digital Cell Library : Cell Sizes and Spacing.

Unit V

Power Estimation Modelling of signals - signal probability calculation - Statistical techniques - estimation of glitching power Sensitivity analysis-Power estimation using input vector compaction, power dissipation in Domino logic, circuit reliability, power estimation at the circuit level, Estimation of maximum power: test generation-based approach.

Textbooks:

1. Kiat-Seng Yeo, Kaushik Roy, “Low-Voltage, Low-Power VLSI Subsystems”, TMH Professional Engineering.
2. A.P.Chandrasekaran and R.W.Brodersen, “Low power digital CMOS design”, Kluwer, 1995
3. Gary Yeap, “Practical low power digital VLSI design”, Kluwer, 1998
4. Rabaey, Pedram, “Low Power Design Methodologies” Kluwer Academic, 1997
5. Neil H. E. Weste, David Money Harris “CMOS VLSI Design 4e: A circuits and systems”, Pearson, 2015

Reference Books:

1. Dimitrios Soudris, Christians Pignet, Costas Goutis, “Designing CMOS Circuits for Low Power”, Kluwer, 2002
2. J.B.Kulo and J.H Lou, “Low voltage CMOS VLSI Circuits”, Wiley 1999
3. Abdelatif Belaouar, Mohamed.I.Elmasry, “Low power digital VLSI design”, Kluwer, 1995
4. James B.Kulo, Shih-Chia Lin, “Low voltage SOI CMOS VLSI devices and Circuits”, John Wiley and sons, inc. 2001
5. Steven M.Rubin, “Computer Aids for VLSI Design”, Addison Wesley Publishing

Course Outcomes:

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

- Explain the sources of power dissipation in CMOS
- Classify the special techniques to mitigate the power consumption in VLSI circuits



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- Demonstrate the power optimization techniques and power dissipation in CMOS circuits
- Outline the low power circuits
- Summarize the power optimization and trade-off techniques in digital circuits.
- Illustrate the power estimation at circuit level



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IV B.TECH I SEMESTER	Professional Core Elective - IV	L	T	P	C
		3	0	0	3
SPECTRUM SENSING					

Course Objectives:

- Introduce the fundamentals of spectrum scarcity and the need for dynamic spectrum access.
- Explain the principles and classification of spectrum sensing techniques.
- Develop understanding detection theory and its applications in signal detection.
- Explore cooperative and non-cooperative spectrum sensing strategies.
- Evaluate sensing performance under various channel impairments and practical constraints.

Unit I:

Introduction to Spectrum Sensing and Cognitive Radio: Spectrum scarcity and underutilization, Introduction to cognitive radio networks, Cognitive radio architecture, Spectrum management functions: sensing, decision, sharing, mobility, Role of spectrum sensing in dynamic spectrum access

Unit II:

Basics of Signal Detection and Detection Theory: Introduction to detection theory, Hypothesis testing: binary hypothesis testing, Probability of detection, probability of false alarm, probability of missed detection, Receiver Operating Characteristic (ROC) curves, Types of spectrum holes: temporal, spatial, frequency.

Unit III:

Spectrum Sensing Techniques: Energy detection: advantages, limitations, Matched filter detection, Cyclostationary feature detection, Wavelet-based detection, Eigenvalue-based detection,

Unit IV:

Cooperative and Non-Cooperative Sensing: Centralized vs. distributed sensing, Hard and soft combining techniques, Fusion rules: OR, AND, k-out-of-N, Challenges in cooperative sensing: reporting delays, errors, and malicious users, Sensing in MIMO and massive MIMO environments

Unit V:



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Practical Issues and Advanced Topics: Sensing under fading and shadowing, Noise uncertainty, Compressive sensing for spectrum sensing, Wideband sensing, Spectrum sensing in 5G and IoT networks, Regulatory perspectives and standards (IEEE 802.22, 802.11af)

Course Outcomes:

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

- Describe the fundamentals of spectrum sensing and cognitive radio systems and articulate the need for dynamic spectrum access.
- Apply detection theory to formulate and analyze signal detection problems in the context of cognitive radio networks.
- Compare and evaluate various spectrum sensing techniques such as energy, matched filter, and cyclostationary detection.
- Design and simulate cooperative spectrum sensing schemes using different fusion techniques and understand their trade-offs.
- Identify and solve practical challenges in implementing spectrum sensing, including noise uncertainty and fading, and explore advanced topics like compressive and wideband sensing.



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IV B.TECH I SEMESTER	Professional Core Elective - V	L	T	P	C
		3	0	0	3
SPEECH SIGNAL PROCESSING					

Course Objectives:

- Understand the fundamentals of human speech production and its relevance to automatic speech recognition (ASR).
- Apply signal processing techniques to analyze and extract features from speech.
- Explore various pattern comparison and matching techniques in speech signal analysis.
- Understand and implement Hidden Markov Models (HMMs) for speech recognition.
- Design components of large vocabulary continuous speech recognition systems using statistical language models and subword units.

Unit I: The Speech Signal:

Fundamentals of Speech recognition, the process of speech production and perception in human beings, the speech production process, representing speech in time and frequency domains, speech sounds and features.

Unit II: Signal Processing and Analysis methods for Speech Recognition:

Spectral analysis models, The Bank-of-filters front-end processor, Linear predictive coding model for Speech recognition, Vector quantization.

Unit III: Pattern Comparison Techniques:

Introduction, Speech detection, Distortion measures- Mathematical considerations, Distortion measures- Perceptual considerations, Spectral distortion measures.

Unit IV: Theory and Implementation of Hidden Markov Models:

Introduction, Discrete time Markov processes, Extensions to Hidden Markov models, Three basic problems for HMMs, Types of HMMs, Continuous observation densities in HMMs, comparison of HMMs, Implementation issues for HMMs, HMM system for isolated word recognition.

Unit V: Large Vocabulary continuous speech recognition:

Introduction, Sub word speech units, sub word unit models based on HMMs, Training of sub word units, Language models for Large vocabulary speech recognition, Statistical language modelling, Perplexity of the language model, Overall recognition system based on sub word units.



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Textbooks:

1. Lawrence Rabiner and Biing-Hwang Juang, Fundamentals of Speech Recognition, Pearson Education, 2007.

Reference Books:

1. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, Fundamentals of Speech Recognition, Pearson Education, 2009.
2. Claudio Becchetti and Lucio Prina Ricotti, Speech Recognition, John Wiley and Sons, 1999.
3. Frederick Jelinek, Statistical Methods of Speech Recognition, MIT Press, Cambridge, MA; London, England, 1997.
4. Daniel Jurafsky and James H Martin, Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Pearson Education, 1 st Ed., 2000.

e- Resources:

1. <https://nptel.ac.in/courses/117105145>
2. <https://ocw.mit.edu/courses/6-345-automatic-speech-recognition-spring-2003/>
3. <https://www.classcentral.com/course/youtube-digital-speech-processing-47859>

Course Outcomes:

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

- Explain the process of speech production and describe the time and frequency domain representations of speech signals.
- Apply and evaluate signal processing methods such as spectral analysis, linear predictive coding, and vector quantization in speech recognition systems.
- Compare various pattern comparison techniques and distortion measures used in speech detection and recognition.
- Implement and optimize Hidden Markov Models (HMMs) for isolated word speech recognition systems.
- Design and evaluate large vocabulary continuous speech recognition (LVCSR) systems using subword units and statistical language models.



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IV B.TECH I SEMESTER	Professional Core Elective - V	L	T	P	C
		3	0	0	3
WIRELESS SENSOR NETWORKS & IOT APPLICATIONS					

Course Objectives:

- To introduce the concepts, architecture, and protocols of Wireless Sensor Networks and their challenges.
- To understand the fundamentals of Internet of Things (IoT) and the role of WSN in enabling IoT applications.
- To learn various communication protocols and data aggregation strategies in WSN and IoT.
- To integrate sensor networks with IoT systems using hardware platforms.
- To explore real-world applications of IoT and address associated security challenges

Unit I:

Introduction to Wireless Sensor Networks (WSNs)

Overview of WSNs, Application areas: health, environment, smart cities, defence, agriculture, WSN architecture: sensor nodes, sink, gateway, Challenges in WSNs: energy constraints, scalability, node failure, Types of sensor networks: single-hop, multi-hop, static vs. mobile nodes

Unit II:

Sensor Network Protocols and Architecture

Communication architecture: layered design, Medium Access Control (MAC) protocols: S-MAC, T-MAC, Routing protocols: LEACH, PEGASIS, Directed Diffusion, Localization techniques: GPS-based and non-GPS-based methods, Time synchronization and sensor data aggregation

Unit III:

IOT Fundamentals

Introduction to Internet of Things (IoT), IoT architecture: sensing, network, data processing, application layer, Communication protocols for IoT: MQTT, CoAP, HTTP, IoT enabling technologies: RFID, Bluetooth, Zigbee, NB-IoT, LoRa, Role of cloud computing and edge computing in IoT



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Unit IV:

Integration of WSN with IoT

Interfacing sensors with microcontrollers (Arduino, Raspberry Pi), Sensor data transmission over IoT platforms, Case Study: Environmental monitoring using WSN-IoT integration, Power management strategies for IoT devices, IoT data analytics basics: preprocessing and visualization

Unit V:

IoT Applications and Security

Smart agriculture, smart health, smart homes, smart grid, Industrial IoT (IIoT) and predictive maintenance, IoT security issues: device-level, network-level, cloud-level, Security protocols and best practices, Future trends in WSN and IoT: AIoT, 6G integration, digital twins

Textbooks:

- 1 Kazem Sohraby, Daniel Minoli, Taieb Znati, Wireless Sensor Networks: Technology, Protocols, and Applications, Wiley.
- 2 Arshdeep Bahga and Vijay Madisetti, Internet of Things: A Hands-on Approach, VPT.
- 3 C. Siva Ram Murthy and B.S.Manoj, Ad Hoc Wireless Networks: Architectures and Protocols, PHI, 2004.
- 4 Jagannathan Sarangapani, Wireless Ad- hoc and Sensor Networks: Protocols. Performance and Control , CRC Press,2007
- 5 Holger Karl & Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley, 2005.

Reference books:

- Holger Karl and Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, Wiley.
- Rajkumar Buyya, Amir Vahid Dastjerdi, Internet of Things: Principles and Paradigms, Elsevier.
- KazernSohraby, Daniel Minoli, &TaiebZnati, Wireless Sensor Networks- Technology, Protocols and Applications John Wiley, 2007.



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- Feng Zhao & Leonidas J. Guibas, Wireless Sensor Networks- An Information Processing Approach, Elsevier, 2007.
- C.K. Toh , Ad- Hoc Mobile Wireless Networks: Protocols & Systems, Prentice Hall, 2002
- C. S. Raghavendra, Krishna M. Sivalingam, Wireless Sensor Networks, Springer, Ist Edition,2006
- S Anandamurugan ,Wireless Sensor Networks, Lakshmi Publications, 2010

Course Outcomes:

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

- Describe the architecture and operation of Wireless Sensor Networks and identify challenges in deployment.
- Analyze communication protocols and network designs for efficient WSN operation.
- Explain IoT concepts, architectures, and technologies for sensor-based systems.
- Develop and implement basic WSN-IoT integration systems using real-time platforms.
- Evaluate security challenges in IoT systems and propose suitable mitigation techniques.



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IV B.TECH I SEMESTER	Professional Core Elective - V	L	T	P	C
		3	0	0	3
EMBEDDED SYSTEM DESIGN					

Course Objectives:

- To provide an overview of Design Principles of Embedded System.
- To provide clear understanding about the role of firmware.
- To understand the necessity of operating systems in correlation with hardware systems.
- To learn the methods of interfacing and synchronization for tasking.

Unit -I Introduction to Embedded Systems:

Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

Unit -II: Typical Embedded System:

Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

Unit -III: Embedded Firmware:

Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

UNIT -IV: RTOS Based Embedded System Design:

Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multi processing and Multi tasking, Task Scheduling.

Unit -V: TASK COMMUNICATION:

Task communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets,

Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.



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Textbooks:

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

Reference Books:

1. Embedded Systems - Raj Kamal, TMH. systems.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems – Lyla, Pearson, 2013.
4. An Embedded Software Primer - David E. Simon, Pearson Education.

e-Resources:

1. <http://nptel.ac.in/courses/108102045/> NPTEL
2. Embedded Systems 1. <http://nptel.ac.in/courses/108102045/> GATE SYLLABUS

Course Outcomes:

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

1. Understand basic concept of embedded systems. Knowledge
2. Apply and analyze the applications in various processors and domains of embedded system.
3. Analyze and develop embedded hardware and software development cycles and tools.
4. Analyze to understand what a microcomputer, core of the embedded system.
5. Remember the definitions of ASICs, PLDs, memory, memory interface. Knowledge
6. Analyze to understand different concepts of a RTOS, sensors, memory interface, communication interface.



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IV B. TECH I SEMESTER	Open Elective - III	L	T	P	C
		3	0	0	3
DATA NETWORKS & PROTOCOLS					

Course Objectives

- Introduce the fundamental principles and components of data communication and networking.
- Explain network models, protocols, transmission media, and error control techniques.
- Provide insight into the working of different layers of the OSI and TCP/IP models.
- Analyze routing algorithms and addressing techniques used in networking.
- Familiarize students with transport and application layer protocols and services.

Unit - I Introduction to Data Communications:

Components, Data Representation, Data Flow, Network, Uses of Networks, Network Topologies, Categories of Networks, Multiplexing: FDM, TDM. Reference Models: TCP/IP Model, The OSI Model, Comparison of the OSI and TCP/IP reference model. Physical Layer: Guided Media, Unguided Media (wireless).

Unit- II Data Link Layer:

Design issues, Error Detection & Correction, Elementary Data Link Layer Protocols, Sliding window protocols Multiple Access Protocols - ALOHA, CSMA, CSMA/CD, CSMA/CA, Collision free protocols, Ethernet Physical Layer, Ethernet Mac Sub layer.

Unit- III The Network Layer:

Network Layer Design issues, Routing algorithms: optimality principle, shortest path, flooding, Distance Vector Routing, Count to Infinity Problem, Link State Routing, Hierarchical Routing; Congestion control algorithms, IP addresses, CIDR, Sub netting, Super Netting, IPv4, Packet Fragmentation, IPv6 Protocol, Transition from IPv4 to IPv6.

Unit-IV Transport Layer:

Services provided to the upper layer's elements of transport protocol, addressing, connection establishment, Connection release, Error Control & Flow Control. UDP, Introduction to TCP, The TCP Service Model, The TCP Segment Header, The Connection Establishment, The TCP Connection Release, The TCP Sliding Window, The TCP Congestion Control Algorithm.



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Unit-V Application Layer:

Introduction, services, Applications layer paradigms: Client-server model, HTTP, E-mail, WWW, TELNET, DNS.

Textbooks:

1. Kurose James F, Keith W- Computer Networking A Top-Down Approach, 6th Edition, Pearson.
2. Behrouz A. Forouzan - Data Communications and Networking, 4th Edition, McGraw-Hill Education

Reference Books:

1. Bhusan Trivedi - Data communication and Networks, Oxford university press, 2016
2. Andrew S Tanenbaum - Computer Networks, 4th Edition, Pearson Education
3. W. A. Shay - Understanding Communications and Networks, 3rd Edition, Cengage Learning.

Course Outcomes:

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

- Describe the components, data flow, and classification of networks, and compare OSI and TCP/IP models.
- Implement error detection and correction methods and evaluate various MAC layer protocols including Ethernet.
- Apply routing algorithms and IP addressing schemes for efficient network layer design and analyze IPv4/IPv6 functionalities.
- Illustrate how transport layer protocols like TCP and UDP manage connections, flow, and congestion control.
- Explain the functionality and protocols at the application layer including HTTP, DNS, and email protocols.



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IV B.TECH I SEMESTER	Open Elective - III	L	T	P	C
		3	0	0	3
CRYPTOGRAPHY AND NETWORK SECURITY					

Course Objectives

- Introduce the basic concepts and principles of cryptography and network security.
- Provide understanding of various symmetric and asymmetric cryptographic algorithms.
- Explain cryptographic hash functions, message authentication, and digital signature schemes.
- Explore key management techniques and security at transport and wireless levels.
- Introduce secure communication protocols and case studies in practical applications of cryptography.

Unit-I

Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security.

Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks.

Unit-II

Symmetric key Ciphers: Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipher operation, Stream ciphers, RC4.

Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Elgamal Cryptography, Diffie-Hellman Key Exchange, Knapsack Algorithm.

Unit-III

Cryptographic Hash Functions: Message Authentication, Secure Hash Algorithm (SHA512), Message authentication codes: Authentication requirements, HMAC, CMAC, Digital signatures, Elgamal Digital Signature Scheme.

Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption, Distribution of Public Keys, Kerberos, X.509 Authentication Service, Public – Key Infrastructure.

Unit-IV

Transport-level Security: Web security considerations, Secure Socket Layer and Transport Layer Security, HTTPS, Secure Shell (SSH).

Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN, IEEE 802.11i Wireless LAN Security.



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Unit-V

E-Mail Security: Pretty Good Privacy, S/MIME IP Security: IP Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, Combining security associations, Internet Key Exchange.

Case Studies on Cryptography and security: Secure Multiparty Calculation, Virtual Elections, Single sign On, Secure Inter-branch Payment Transactions.

Textbooks:

1. Cryptography and Network Security-Principles and Practice: William Stallings, Pearson Education, 6th Edition.
2. Cryptography and Network Security: Atul Kahate, Mc GrawHill, 3rd Edition.

Reference Books:

1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, WileyIndia, 1st Edition.
2. Cryptography and Network Security: Forouzan Mukhopadhyay, McGraw Hill, 3rd Edition.
3. Information Security, Principles, and Practice: Mark Stamp, Wiley India.
4. Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH.
5. Introduction to Network Security: Neal Krawetz, CENGAGE Learning.
6. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning

Course Objectives:

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

- Describe the fundamentals of network security, various types of attacks, and cryptographic techniques.
- Implement and compare symmetric and asymmetric encryption algorithms like DES, AES, RSA, and Elgamal.
- Analyze hash functions, digital signature schemes, and secure authentication protocols such as Kerberos and X.509.
- Evaluate transport-level and wireless network security protocols including SSL/TLS, HTTPS, SSH, and IEEE 802.11i.
- Apply security mechanisms in real-time scenarios like email security (PGP, S/MIME), IP security, and secure financial transactions.



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IV B.TECH I SEMESTER	Open Elective - III	L	T	P	C
		3	0	0	3
SOFT COMPUTING TECHNIQUES					

Course Objectives:

- To introduce the fundamentals and need of Soft Computing and differentiating it from conventional (hard) computing techniques.
- To understand neural network architectures, learning paradigms, and their applications.
- To explore fuzzy logic systems and their role in approximate reasoning and control.
- To comprehend genetic algorithms and the concept of evolutionary optimization.
- To study hybrid systems that integrate neural networks, fuzzy logic, and genetic algorithms for solving real-world complex problems.

Unit I:

Introduction: What is Soft Computing? Difference between Hard and Soft computing, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing.

Unit II:

Neural Networks: What is Neural Network, Learning rules and various activation functions, Single layer Perceptrons, Back Propagation networks, Architecture of Backpropagation (BP) Networks, Backpropagation Learning, Variation of Standard Back propagation Neural Network, Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications.

Unit III:

Fuzzy Systems: Fuzzy Set theory, Fuzzy versus Crisp set, Fuzzy Relation, Fuzzification, Minmax Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification.

Unit IV:

Genetic Algorithm: History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization.



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Hybrid Systems: Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems.

Unit: V

GA based Backpropagation Networks: GA based Weight Determination, K - factor determination in Columns.

Fuzzy Backpropagation Networks: LR type Fuzzy numbers, Fuzzy Neuron, Fuzzy BP Architecture, Learning in Fuzzy BP, Application of Fuzzy BP Networks.

Reference Books:

- 1 Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S.Rajasekaran, G. A. Vijayalakshami, PHI.
- 2 Genetic Algorithms: Search and Optimization, E. Goldberg. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI.
- 3 Build_Neural_Network_With_MS_Excel_sample by Joe choong.

Course Outcomes

At the end of the course the student will be able to

- Explain the concept of soft computing and differentiate it from hard computing paradigms.
- Design and implement neural networks for classification, pattern recognition, and regression problems.
- Apply fuzzy set theory and fuzzy logic in decision-making, control, and classification tasks.
- Solve optimization problems using genetic algorithms and understand their convergence properties.
- Develop and analyze hybrid systems like neuro-fuzzy and fuzzy-genetic models for advanced applications.



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IV B.TECH I SEMESTER	Professional Core Lab - 1	L	T	P	C
		0	0	3	1.5
MICROWAVE ENGINEERING & OPTICAL COMMUNICATIONS LAB					

Course Objectives:

- Defining the range of frequencies for operation in microwave engineering.
- Understand the functioning of microwave components
- Verify the various Characteristics of Active and Passive Microwave Devices Practically.
- Measure the characteristics optical devices.
- Measure the various parameters of the optical sources.

LIST OF EXPERIMENTS:

- 1 To verify Reflex Klystron Characteristics and to determine the frequency and tuning range of reflex klystron.
- 2 To verify Gunn Diode Characteristics.
- 3 To analyze the fixed and variable attenuator and plot the micrometer reading Vs attenuation.
- 4 To determine the coupling factors and directivity of directional coupler.
- 5 To measure the power distribution of various wave guide Tee i.e. E plane, H plane.
- 6 To measure the power distribution in Magic Tee.
- 7 VSWR Measurement and load impedance calculations using Smith chart.
- 8 Scattering parameters of Circulator.
- 9 Characterization of LED.
- 10 Characterization of Laser Diode.
- 11 Intensity modulation of Laser output through an optical fiber.
- 12 Measurement of Data rate for Digital Optical link.
- 13 Measurement of Numerical Aperture of fiber cable.
- 14 Measurement of losses for Analog Optical link.

Course Outcomes:

At the end of the course the student will be able to

- 1 Verify characteristics of Reflex Klystron.
- 2 Analyze various parameters of Waveguide Components.
- 3 Estimate the power measurements of RF Components such as directional Couplers.
- 4 Demonstrate characteristics of various optical sources.
- 5 Measure data Rate, Numerical Aperture and Losses in Optical Link.



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IV B.TECH I SEMESTER	Professional Core Lab – 2	L	T	P	C
		0	0	3	1.5
DIGITAL IMAGE AND VIDEO PROCESSING LAB					

Course Objectives:

- Provide hands-on experience in implementing fundamental image processing techniques.
- Familiarize students with pixel-based operations, image transformations, and enhancement techniques.
- Enable understanding and practical application of frequency domain processing (e.g., FFT, DCT).
- Explore compression techniques for image and video data.
- Develop skills in basic video acquisition, processing, and restoration methods.

List of Experiments:

- 1.Simulation and Display of an Image, Negative of an Image(Binary & Gray Scale)
2. Implementation of Relationships between Pixels
3. Implementation of Transformations of an Image
4. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization
5. Display of bit planes of an Image
6. Display of FFT(1-D & 2-D) of an image
7. Computation of Mean, Standard Deviation, Correlation coefficient of the given Image
8. Implementation of Image Smoothing Filters(Mean and Median filtering of an Image)
9. Implementation of image sharpening filters and Edge Detection using Gradient Filters
10. Image Compression by DCT,DPCM, HUFFMAN coding
11. Implementation of image restoring techniques
12. Implementation of Image Intensity slicing technique for image enhancement
13. Canny edge detection Algorithm
- 14.Video Acquisition
- 15.Video Manipulation
- 16.Video dejittering



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17.video inpainting

Course Outcomes

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

- Implement basic image operations such as negative, bit-plane slicing, and pixel relationships.
- Perform spatial and frequency domain transformations including FFT and DCT on image data.
- Apply contrast enhancement, histogram equalization, and filtering techniques for image smoothing and sharpening.
- CO4: Implement edge detection methods (e.g., gradient filters, Canny) and image compression techniques such as Huffman and DPCM.
- CO5: Acquire and manipulate video sequences, perform dejittering, inpainting, and evaluate video quality improvements using restoration techniques.



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IV B.TECH I SEMESTER	Skill Enhancement Course	L	T	P	C
		0	1	2	2
MACHINE LEARNING LAB					

Course objectives:

This course will enable students to

1. Make use of Data sets in implementing the machine learning algorithms
2. Implement the machine learning concepts and algorithms in any suitable language of choice.

List of Experiments:

- 1 The probability that it is Friday and that a student is absent is 3 %. Since there are 5 school days in a week, the probability that it is Friday is 20 %. What is the probability that a student is absent given that today is Friday? Apply Baye's rule in python to get the result.
(Ans: 15%)
- 2 Extract the data from database using python
- 3 Implement k-nearest neighbours classification using python
- 4 Given the following data, which specify classifications for nine combinations of VAR1 and VAR2 predict a classification for a case where VAR1=0.906 and VAR2=0.606, using the result of k-means clustering with 3 means (i.e., 3 centroids)

VAR1	VAR2	CLASS
1.713	1.586	0
0.180	1.786	1
0.353	1.240	1
0.940	1.566	0
1.486	0.759	1
1.266	1.106	0
1.540	0.419	1
0.459	1.799	1
0.773	0.186	1

- 5 The following training examples map descriptions of individuals onto high, medium and low credit-worthiness.

medium skiing design single twenties no ->highRisk
high golf trading married forties yes ->lowRisk



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ow speedway transport married thirties yes ->medRisk
medium football banking single thirties yes ->lowRisk
high flying media married fifties yes ->highRisk
ow football security single twenties no ->medRisk
medium golf media single thirties yes ->medRisk
medium golf transport married forties yes ->lowRisk
high skiing banking single thirties yes ->highRisk
ow golf unemployed married forties yes ->highRisk
Input attributes are (from left to right) income, recreation, job, status, agegroup, home-owner. Find the unconditional probability of 'golf' and the conditional probability of 'single' given 'medRisk' in the dataset?

- 6 Implement linear regression using python.
- 7 Implement Naïve Bayes theorem to classify the English text
- 8 Implement an algorithm to demonstrate the significance of genetic algorithm
- 9 Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
- 10 For a given set of training data examples stored in a .CSV file, implement and demonstrate the candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
- 11 Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
- 12 Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
- 13 Write a program to implement the naïve Bayesian classifier for a sample training dataset stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
- 14 Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
- 15 Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.



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- 16 Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
- 17 Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
- 18 Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Course outcomes:

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

1. Understand the implementation procedures for the machine learning algorithms.
2. Design Java/Python programs for various Learning algorithms.
3. Apply appropriate data sets to the Machine Learning algorithms.
4. Identify and apply Machine Learning algorithms to solve real world problems.



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IV B.TECH I SEMESTER	Skill Enhancement Course	L	T	P	C
		2	0	0	0
Value Education					

UNIT 1:

Introduction of Value Education

Introduction, Definition, Need for Value Education, Other reasons, Objectives of Value Education, Types of Values, Categorization of Values, Factors Influencing the Learning of Values, Value Education in India, Implementing the above in the school systems under the Central control, Initiatives from the Planning Commission, Approaches to teaching VE, The role of Teachers.

Assignment- 1

Introduce yourself in detail. What are the goals in your life? How do you set your goals in your life? What have been your achievements and shortcomings in your life?

UNIT 2:

Salient values for life

Truth, commitment, honesty and integrity, forgiveness and love, empathy and ability to sacrifice, care, unity, punctuality, Interpersonal and Intra personal relationship, Team work, Positive and creative thinking.

Assignment- 2: Give an example of scenario which explains you are a team player.

UNIT 3:

Human Rights

Universal Declaration of Human Rights, Right to Information Act -2005, National Integration, Peace and non-violence, Dr. A P J Kalam's ten points for enlightened Citizenship. The role of media in value building.

Assignment- 3

Visit Report: Visit to Non-Governmental Organizations (NGO)

UNIT 4: Environment and Ecology

Ecological balance, A Balanced Ecosystem - An Aquarium, Advantages, how to create a balanced ecosystem model, interdependence of all beings – living and non-living. Man, and nature, Environment conservation and enrichment.



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Assignment 4: Make a report on following activity

Group Discussion Topics: -

1. Energy and natural resource depletion,
2. Environmental pollution,
3. Global warming,
4. Ozone depletion,
5. Deforestation,
6. Soil degradation.

UNIT 5:

Social values & Ethical values

Social values - Social consciousness and responsibility, Consumer rights and responsibilities

Ethical values - Professional ethics, Code of ethics of engineers, Influence of ethics on family life, Leadership qualities and Personality development.

Assignment- 5

Write Code of ethics for engineers.

Assignment- 6

Report on guest Lecture: Presentation given by Teacher in the class on the Dr. A P J Kalam's ten points for enlightened Citizenship.

Reference Books:

1. M.G. Chitakra: Education and Human Values, A.P.H. Publishing Corporation, New Delhi, 2003.
2. Chakravarthy, S.K: Values and ethics for Organizations: Theory and Practice, Oxford University Press, New Delhi, 1999.
3. Satchidananda, M.K: Ethics, Education, Indian Unity and Culture, Ajantha Publications, Delhi, 1991.
4. Das, M.S. & Gupta, V.K.: Social Values among Young adults: A changing Scenario, M.D. Publications, New Delhi, 1995.
5. Bandiste, D.D.: Humanist Values: A Source Book, B.R. Publishing Corporation, Delhi, 1999.
6. Ruhela, S.P.: Human Values and education, Sterling Publications, New Delhi, 1986.



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7. Kaul, G.N.: Values and Education in Independent Indian, Associated Publishers, Mumbai, 1975.
8. NCERT, Education in Values, New Delhi, 1992.
9. Swami Budhananda (1983) How to Build Character A Primer: Ramakrishna Mission, New Delhi.
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