BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)

COLLEGE OF ENGINEERING, PUNE

B.Tech.(Electronics & Communication Engineering):Semester–V (2023 COURSE)

S. No.	Course	Teaching Scheme Hrs. Week			Examination Scheme-Marks						Credits			
		L	P	T	ESE	IA	TW	PR	OR	Total	Th	Pr/Or	Tut	Total
1.	Digital Signal Processing	3	2	-	60	40	25	-	25	150	3	1	0	4
2.	Machine Learning	3	-	1	60	40	-		-	100	3	0	1	4
3.	Information Theory & Coding	3	-	-	60	40	-	-	-	100	3	0	0	3
4.	Internet of things	3	2	-	60	40	25	25	-	150	3	1	0	4
5.	Computer Communication Network	3	2	-	60	40	25	-	25	150	3	1	0	4
6.	SBC-V Power Drives & Automation	-	2	-	-	-	25	-	25	50	0	1	0	1
7.	Environmental Studies	4	-	-	60	40	2	-	-	100	4	-	-	4
	Total	**19**	**08**	1	**360**	**240**	**100**	**25**	**75**	**800**	**19**	**4**	**1**	**24**

Bharati Vidyapeeth
(Deemed to be University)
College of Engineering, Pune

B. Tech (Electronics & Communication) Sem: V
DIGITAL SIGNAL PROCESSING

Teaching Scheme:	**Examination Scheme:**	**Credits Allotted:**
Theory: 03 Hrs./week	End Semester Examination (ESE): 60 Marks	Credits: 03
Practical:02 Hrs./week	Internal Assessment (IA): 40 Marks	
	TW:25 Marks	Credits: 01
	OR: 25 Marks	
	Total:150 Marks	Total Credits: 04

Course Pre-requisite:

The students should have knowledge of

1. Engineering Mathematics
2. Signals and Systems

Course Outcomes: After learning this course students will be able to

1	Compute Discrete Fourier transform for the analysis of digital signals & systems.
2	Implement FFT algorithms for computing the DFT
3	Design FIR digital filters for given specifications.
4	Design IIR digital filters for given specifications.
5	Apply Multirate signal processing for different sampling rate conversion application.
6	Apply the appropriate signal processing technique to analyze real world digital systems.

UNIT – I	**Discrete Fourier Transform**	**(06 Hours)**
	Overview of signals and systems, Discrete Fourier Transform (DFT), Matrix representation and its inverse, Properties of DFT, circular convolution, graphical and matrix method, Linear filtering with block convolution. Relation between DTFT, DFT and Z-Transform. Introduction to Discrete Cosine Transform (DCT)	
UNIT– II	**Fast Fourier Transform**	**(06 Hours)**
	Direct computation of DFT, computational complexity, FFT algorithms, Radix 2 FFT algorithms, Decimation-in-Time (DIT-FFT), Decimation-in-Frequency (DIF-FFT), Inverse radix-2 algorithms, Goertzel's algorithm, Chirp-z Transform, FFT applications.	
UNIT – III	**Finite Impulse Response Filter**	**(06 Hours)**
	FIR Filter Design, Ideal filter requirements, Gibbs phenomenon, windowing techniques, characteristics and comparison of different window functions, Design of linear phase FIR filter using windows and frequency sampling method. FIR filter realization using direct form, cascade form and lattice form.	
UNIT – IV	**Infinite Impulse Response Filters**	**(06 Hours)**
	IIR filter design from analog filters using approximation of derivatives, impulse invariance, Bilinear transform method, warping	

	effect. IIR filters design using pole zero plots, Characteristics of Butterworth filters, Chebyshev filters, Butterworth filter design, IIR filter realization using direct form, cascade form and parallel form.	
UNIT – V	**Multirate signal Processing**	**(06 Hours)**
	Introduction to Multirate signal processing, Decimation, Interpolation, Sampling rate conversion by a rational factor I/D, Anti-aliasing and anti-imaging filters, Applications of multirate DSP	
UNIT – VI	**Introduction to DSP Processors and Applications**	**(06 Hours)**
	Introduction to DSP Processor TMS320C6xxx, Features, architecture, Multiplier-Accumulator (MAC), Registers Addressing modes, Introduction to Code composer studio (CCS), Application of DSP in speech and Image processing.	

Term Work:

The term work shall consist of record of minimum eight experiments

1. Perform DFT and IDFT on Discrete time signals
2. Find the frequency response and stability of discrete time system using convolution
3. Perform linear convolution using overlap add and save method.
4. Compute circular convolution of given sequences.
5. Generate a pole-zero plot of the Z-domain based on the transfer function
6. Design FIR filter using frequency sampling method
7. Plot the frequency response for the rectangular and Hamming window.
8. Design IIR filter using bilinear - transformation method.
9. Perform Interpolation & decimation of a given sequence.
10. Plot the spectrogram of the speech signal.
11. Implement Linear Convolution and Circular convolution using DSP processor.
12. Generate sine wave using DSP processor.

Text Book/ Reference Books:

1. Oppenheim and R. W. Shafer, Discrete-Time Signal Processing, 3rd edition. Pearson, 2014.
2. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4th edition. Pearson, 2007.
3. S. Salivahanan, A. Vallavaraj and C. Gnanapriya, Digital Signal Processing, 4th edition, TMH, 2009.
4. Emmanuel C. Ifeachor and B. W. Jervis, Digital Signal Processing - A Practical approach, 2nd Edition, Pearson Education, 2009.

Project Based Learning:

Students are expected to perform a project (in a group) based on the course and prepare a report for the same. The report should be as per the standard guidelines.

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B.Tech (Electronics & Communication) Sem: V
MACHINE LEARNING

Teaching Scheme:	**Examination Scheme:**	**Credits Allotted:**
Theory: 03Hrs./week	End Semester Examination (Theory): 60 Marks	Credits: 03
Tutorial:01hr/week	Internal Assessment (IA): 40 Marks	Credits: 01
	Total:100 Marks	Total Credits: 04

Course Pre-requisite:

The students should have knowledge of

1. Computer Programming-II

Course Outcomes: After learning this course students will be able to

1	Understand the Fundamentals of Machine Learning
2	Apply Supervised Learning Techniques
3	Analyze and Implement Unsupervised Learning Approaches
4	Demonstrate Understanding of Artificial Neural Networks (ANNs)
5	Develop and Optimize Deep Learning Models
6	Apply Machine Learning to Real-World Problems

UNIT – I	**Introduction to Machine Learning**	**(06 Hours)**
	Types of learning: supervised, unsupervised, reinforcement, Data Types: Structured, Unstructured, and Semi-structured data, Steps in ML: Data Collection, preprocessing, selecting model, training, testing, Model validation: under fitting, over fitting, bias- variance trade-off, features: selection, transformation, and encoding	
UNIT– II	**Supervised Learning**	**(06 Hours)**
	Classification: Binary Classification- Assessing Performance using metrics such as Precision, Recall, F1-score, ROC-AUC curves. Classification algorithms: K Nearest Neighbor, Decision Tree, Random Forest model, Support vector machines. Probabilistic Models: Naïve Bayes Classifier. Regression: linear regression, logistic Regression. Multiple Linear Regression, polynomial. Ensemble Learning: Introduction to XGBoost and LightGBM. Performance evaluation of supervised learning models.	
UNIT – III	**Unsupervised Learning**	**(06 Hours)**
	Unsupervised Vs supervised learning, Applications: Data clustering, Anomaly detection, Clustering: K-Means, K-Medoids, Hierarchical Clustering, DBSCAN, Association Rule Learning: Apriori Algorithm, Pattern Finding using Association Rules, Dimensionality Reduction: PCA, t-SNE. Performance evaluation of unsupervised learning models	
UNIT – IV	**Artificial Neural Networks**	**(06 Hours)**
	Fundamentals of neural networks: neuron structure, weights, bias, activation functions. Perceptron model: Multi-Layer Perceptron (MLP) and Backpropagation, Optimization Algorithms: Stochastic Gradient Descent (SGD), Adam Optimizer, Overfitting & Regularization Techniques: L1/L2 regularization, Dropout	

UNIT – V	**Deep Learning**	**(06 Hours)**
	Vanishing gradients, essential activation functions, Training techniques: loss functions, back-propagation, regularization techniques: dropout and batch normalization, Convolutional Neural Networks (CNNs): Introduction and key concepts convolution, Introduction to Transformers.	
UNIT – VI	**Applications of Machine Learning**	**(06 Hours)**
	Email Spam and Malware Filtering, Image recognition, Speech Recognition, Traffic Prediction, Self-driving Cars, Virtual Personal Assistant, Medical Diagnosis. Frameworks and Tools to be used: OpenCV, TensorFlow, PyTorch, scikit-learn	

Text Book/ Reference Books:

1. Tom Mitchell, "Machine Learning", McGraw Hill, 3rdEdition, 1997.
2. Peter Flach: Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, Edition 2012.
3. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Prentice Hall of India, 3rd Edition2014.
4. Dutt, Chandramouli, Das, "Machine Learning" Pearson publication, Eighth Impression, 2022.
5. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar" Foundations of Machine Learning", MIT Press,2012.
6. Machine Learning Mastery With Python 2016 by Jason Brownlee

Project Based Learning:

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B. Tech. (Electronics & Communication Engineering) Sem: V
INFORMATION THEORY AND CODING

Teaching Scheme:	**Examination Scheme:**	**Credits Allotted:**
Theory: 03 Hrs/week	End Semester Examination (ESE):60Marks	Credits: 03
	Internal Assessment (IA): 40 Marks	
	Total:100 Marks	Total Credits: 03

Course Pre-requisites:

The students should have knowledge of

1	Digital Communication

Course Outcomes: After learning this course students will be able to

1	Differentiate between Dependent & Independent Sources, Entropy & Rate of Information.
2	Encode the information using Shannon, Shannon Fano, Prefix, and Huffman coding Algorithms.
3	Model the continuous and discrete communication channels using input, output, and joint probabilities.
4	Determine a codeword comprising of the check bits computed using Linear Block codes, cyclic codes & convolutional codes, BCH, and Golay codes.
5	Develop the encoding and decoding using various compression coding techniques.
6	Design a multimedia communication system using compression and decompression techniques.

UNIT – I	**Information Theory**	**(06 Hours)**
	Introduction, Measure of a information, Information content of message, Average Information content of symbols in Long Independent sequences, Average Information content of symbols in Long dependent sequences, Markov Statistical Model of Information Sources, Entropy and Information rate of Markoff Sources	
UNIT – II	**Source Coding**	**(06 Hours)**
	Source coding theorem, Prefix Codes, Kraft McMillan Inequality property – KMI, Encoding of the Source Output, Shannon's Encoding Algorithm. Shannon Fano Encoding Algorithm, Huffman codes, Extended Huffman coding, Arithmetic Coding, Lempel – Ziv Algorithm	
UNIT – III	**Channel Characteristics**	**(06 Hours)**
	Communication, Channel Models, Channel Matrix, Joint probability Matrix, Binary Symmetric Channel, System Entropies, Mutual Information, Channel Capacity, Channel Capacity of: Binary Symmetric Channel, Binary Erasure Channel, Muroga's Theorem, Continuous Channels	
UNIT – IV	**Error Control Coding**	**(08 Hours)**
	Methods of Controlling Errors, Types of Errors, types of Codes, Linear Block codes – Syndrome Decoding – Minimum distance consideration – cyclic codes – Generator Polynomial – Parity check polynomial – Encoder for cyclic codes – calculation of syndrome –	

	Convolutional codes. Binary Cyclic Codes, BCH Codes, Convolution Codes: Convolution Encoder, Code Tree, Trellis and State Diagram, Viterbi Algorithm	
UNIT – V	**Compression Techniques**	**(05 Hours)**
	Principles – Text compression – Static Huffman Coding – Dynamic Huffman coding – Arithmetic coding – Image Compression – Graphics Interchange format – Tagged Image File Format – Digitized documents – Introduction to JPEG standards.	
UNIT – VI	**Audio And Video Coding**	**(05 Hours)**
	Linear Predictive coding – code excited LPC – Perceptual coding, MPEG audio coders – Dolby audio coders – Video compression – Principles – Introduction to H.26x & MPEG Video standards.	

Text Book/ Reference Books:

1. Digital and analog communication systems, K. Sam Shanmugam, John Wiley India Pvt. Ltd, 1996.
2. Digital communication, Simon Haykin, John Wiley India Pvt. Ltd, 2008. 3. Information Theory and Coding, Muralidhar Kulkarni, K.S. Shivaprakasha, Wiley India Pvt. Ltd, 2015, ISBN:978-81-265-5305-1.
3. Fred Halsall, Multimedia Communications, Applications Networks Protocols and Standards, Pearson Education, Asia 2002; Chapters: 3,4,5.
4. Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods ,4rd edition
5. ITC and Cryptography, Ranjan Bose, TMH, II edition, 2007
6. Principles of digital communication, J. Das, S. K. Mullick, P. K. Chatterjee, Wiley, 1986 - Technology & Engineering
7. Digital Communications – Fundamentals and Applications, Bernard Sklar, Second Edition, Pearson Education, 2016, ISBN: 9780134724058.
8. Information Theory and Coding, K. N. Haribhat, D. Ganesh Rao, Cengage Learning, 2017.
9. Mark Nelson, “Data Compression Book”, BPB Publication 1992.
10. Watkinson J, “Compression in Video and Audio”, Focal Press, London, 1995.

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B.Tech (Electronics & Communication) Sem: V
INTERNET OF THINGS

Teaching Scheme:	**Examination Scheme:**	**Credits Allotted:**
Theory: 03 Hrs/week	End Semester Examination (ESE): 60 Marks	Credits:03
Practical:02 Hrs/week	Internal Assessment (IA): 40 Marks	
	TW: 25 Marks	Credits:01
	PR: 25 Marks	
	Total:150 Marks	Total Credits: 04

Course Pre-requisite:

The students should have knowledge of

1.Embedded systems

Course Outcomes: After learning this course students will be able to

1	Choose the IoT components for any application
2	Interface the analog & digital sensors to the controller boards
3	Explore the various technologies which enable the IoT
4	Use platforms for communication of data with cloud
5	Select protocols for specific IoT application
6	Demonstrate the publish-subscribe model using MQTT

UNIT – I	**Introduction to IoT**	**(06 Hours)**
	Fundamentals of IoT,Basic principles, architecture and components of IoT like Devices, sensors and software., IoT – Advantages & Stages of development, IoT communication and networking protocols, Role of wired and wireless communication. M2M Communication, IoT services and applications. Introduction to Arduino IDE, Introduction to Micropython (Upycraft,Thonny IDE).	
UNIT– II	**Hardware systems for IoT**	**(06 Hours)**
	Introduction to controller boards - Arduino UNO,ESP 8266,ESP32,interfacing of sensors to boards using Arduino IDE ,Micropython-(LED, seven segment display, push button, potentiometer, DHT 11,LM 35 LCD etc.)	
UNIT – III	**IoT Enabling Technologies**	**(06 Hours)**
	RFID and NFC (Near-Field Communication), Bluetooth Low Energy (BLE), LiFi, 6LowPAN,Z-Wave, LoRa, Protocols, HTTP, WebSocket, MQTT, CoAP, Node-RED,Eclipse IoT, AWS IoT, Microsoft Azure IoT Suite, Google Cloud IoT	
UNIT – IV	**IoT platforms & connectivity**	**(06 Hours)**
	Concepts of Cloud & Services IoT-Cloud Servers- Introduction to Thingspeak Server Thinkspeak & Demonstration, Arduino IoT cloud,	

	AWS IoT, REST API-GET, POST, MQTT),Introduction To Blynk IoT Platform, Blynk Interfacing , Interfacing ESP with the Cloud.	
UNIT – V	**IoT protocols and standards**	**(06 Hours)**
	Physical & MAC layers of IEEE 802.15.4 protocol. Integration with IoT standards like 6LoWPAN,IPv6 use in constrained IoT environments with 6LoWPAN.Routing protocol RPL for reliable communication. Transport & session layer protocols (TCP,UDP, TLS,DTLS, HTTP CoAP, MQTT,RFID)	
UNIT – VI	**IoT application protocols**	**(06 Hours)**
	CoAP and LWM2M architecture for low power devices. Security features and reliability for constrained environments. MQTT-Publish-subscribe model for efficient data transfer. QoS for reliable message delivery. Application of MQTT in real world.	

Term Work:

The term work shall consist of record of minimum eight experiments.
Experiments to be performed using Arduino/ESP 8266/ESP 32

1.Familiarize with IoT softwares, components. Interface LED/buzzer and write a program to turn ON LED after every 5 seconds.

2.To interface digital sensor (LDR/IR),push button & write program to turn ON LED when push button is pressed or at sensor detection

3.Display text message, sensor values on LCD. Calculate the distance to an object with help of ultrasonic transducer & display on LCD

4. Control the relay state based on IR sensor or ambient levels using LDR sensor

5. Control the blink rate of LED by interfacing with potentiometer

6. Upload analog data(potentiometer), temperature & humidity data to Thing speak cloud

7.Directional control of DC motor

8.Publish & subscribe to data over the internet using MQTT protocol

9.Display various sensor readings on simple web page hosted by ESP 32

10. Hosting basic server from ESP 32 to control actuators (LED,buzzer,relay) from a simple web page.

Textbook/ Reference Books:

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. "Internet of Things: A Hands-on Approach," by Arshdeep Bahga and Vijay Madisetti (Universities Press)
3. Kamal, R., "Internet of Things – Architecture and Design Principles," 1st Edition, Mcgraw Hill,2017. 2. Simone Cirani," Internet of Things- Architectures, Protocols and Standards", WILEY,2018. 3. Alessandro Bassi," Enabling Things to Talk- Designing IoT solutions with the IoT Architectural Reference Model", Springer,2013.
4. Simone Cirani," Internet of Things- Architectures, Protocols and Standards", WILEY,2018.
5. Alessandro Bassi," Enabling Things to Talk- Designing IoT solutions with the IoT Architectural Reference Model", Springer,2013.

Project Based Learning:

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B. Tech. (Electronics & Communication Engineering) Sem:V
COMPUTER COMMUNICATION NETWORKS

Teaching Scheme	Examination Scheme	Credits Allotted
Theory: 03hrs./week	End Semester Examination (ESE): 60 Marks	Credits: 03
Practical: 02hrs./week	Internal Assessment (IA): 40 Marks	
	TW: 25 Marks	Credits: 01
	OR: 25 Marks	
	Total: 150 Marks	Total Credits: 04

Course Pre-requisites:

The students should have knowledge of

1	Introduction to Electronics Communication

Course Outcomes: After learning this course students will be able to

1	Explain the functionality of each layer in the OSI reference model and TCP/IP protocol suite
2	Enumerate the functionality of Data Link Layer protocols and services.
3	Identify the key responsibilities of the Network Layer in managing data transmission.
4	Describe the protocols and functions associated with the transport layer.
5	Explain the different protocols used in the application layer.
6	Configure wireless networks based on IEEE 802.11 standards for secure and efficient connectivity.

UNIT – I	**Data Communications and Network Model**	**(05 Hours)**
	Data Communication Components - devices, medium, protocols, Network Types: LAN, MAN, WAN etc., Transmission medium: Guided & Unguided, Network Models: OSI Reference Model & TCP/IP Protocol Suite- Layered Architecture, Circuit switching, Packet switching, virtual circuit switching.	
UNIT – II	**Data-Link Layer**	**(06 Hours)**
	DLL Design issues, error detection and correction, sliding window protocols, data link protocols - HDLC, PPP. Medium access sublayer: Channel allocations problem, multiple access protocols- Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA. Controlled Access: Reservation, Polling, Token Passing, Ethernet, Data Link Layer switching. Wired LANs: Ethernet: Ethernet Protocol: IEEE802, Ethernet Evolution, Characteristics, Addressing, Access Methods.	

UNIT – III	**Network Layer**	**(07 Hours)**
	Network Layer services, Packet Switching: Datagram Approach, Virtual Circuit Approach, IPV4 Addresses: Address Space, Classful Addressing, Classless Addressing, DHCP, Network Address Resolution, IPV4 , IPV6 Addressing, Datagram format, Network Layer Protocols: Internet Protocol (IP): Datagram Format, , ICMPv4, Mobile IP , Routing algorithms: Distance Vector Routing, Link State Routing, Routing Information Protocol, Open Shortest Path First, Border gateway protocol (BGP), Hot potato routing.	
UNIT – IV	**Transport Layer**	**(06 Hours)**
	Transport Layer Services, Connectionless and Connection-Oriented Protocols, Transport Layer Sliding Window Protocols, User Datagram Protocol (UDP): UDP Services, UDP Applications, Transmission Control Protocol (TCP): TCP Services, TCP Features, TCP Segment, TCP Connection, TCP State Transition Diagram, Windows in TCP, Flow Control, Error Control in TCP, TCP Congestion Control.	
UNIT – V	**Application layer and Security**	**(06 Hours)**
	Domain name system, electronic mail, World Wide Web: dynamic web document and http. Application layer protocols: Simple Network Management Protocol, File Transfer Protocol, Simple Mail Transfer Protocol, Telnet, Cryptography, Digital Signatures, Firewalls and Packet Filtering, Packet Filtering, Proxy Server.	
UNIT – VI	**Wireless LAN**	**(06 Hours)**
	Introduction: Architectural Comparison, Characteristics, IEEE 802.11: Architecture, MAC Sublayer, Addressing Mechanism, Physical Layer, Bluetooth and Zigbee: Architecture, Layers, Case Studies in Internet of Things and Cloud Computing.	

Term Work: The term work shall consist of a record of a minimum of eight experiments.
1. Study of LAN and its components, prepare the cross-wired cable and straight through cable using clamping tool.
2. Configure IPv4 on Devices. Test the IPv4 communication between devices.
3. Configure a simple LAN infrastructure with PCs, a switch, and a router, and verify network connectivity.
4. Simulate various topologies using CISCO packet Tracer.
5. Configure WEP on a wireless router in Cisco Packet Tracer and ensure secure wireless connectivity.
6. Simulate Network-based Firewalls using CISCO Packet Tracer.
7. Configure Virtual LANs using CISCO Packet Tracer.
8. Set up a DHCP server on a router to automatically assign IP addresses to devices in the network.

9. Set up a Wi-Fi network using a wireless router and connect wireless devices to it. using CISCO Packet Tracer
10. Simulate UDP and TCP communication between devices.
Text Books / Reference Books:
1. Forouzan, Data Communications and Networking, 6th Edition, McGraw Hill, 2021, ISBN: 978-1260597820
2. Kurose James, Keith W. Computer Networking a Top-Down Approach, 7th Edition, Pearson, 2016.ISBN: 978-0133594140
3. Stallings Willim, Cryptography and Network Security - Principles and Practice, 7th Edition Pearson, 2020, ISBN: 9780135764213
4. Wayarles Tomasi, Introduction to Data Communication and Networking,1st edition, Pearson Education, 2007, ISBN:0130138282
5. Andrew Tanenbaum, Computer Networks,4th Edition, Prentice Hall.
Project Based Learning:
Students are expected to perform a project (in a group) based on the course and prepare a report for the same. The report should be as per the standard guidelines. Use CISCO Packet Tracer for simulation.

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B. Tech (Electronics& Communication Engineering) Sem:V
SBC-V: POWER DRIVES & AUTOMATION

Teaching Scheme:	**Examination Scheme:**	**Credits Allotted:**
Practical: 02 Hrs./week	TW: 25 Marks	Credits:01
	OR:25Marks	
	Total:50 Marks	Total Credits :01

Course Pre-requisites:

The students should have basic knowledge of

1. Analog Electronics and applications.
2. Sensor & Control system.

Course Outcomes: After learning this course students will be able to

1	Identify and compare various power semiconductor devices.
2	Perform the operations of single-phase and Three phase converters
3	Perform the operations of single and three-phase inverters and dc-to-dc converters
4	Use the ladder logic operations using logical & mathematical instructions.
5	Use ladder logic operations using program & data flow instructions.
6	Interface digital & analog input/output to the PLC.

Term Work:

The term work shall consist of eight experiments

1. To study V-I characteristics of SCR and measure latching and holding currents
2. Study of (R/RC/UJT) triggering for SCR
3. To study operation of Single phase fully controlled converter
4. To study MOSFET/IGBT based single phase inverter
5. To study operation of IGBT/MOSFET chopper circuit.
6. To Study of speed control of motor.
7. To study Implementation of Logic Gates using PLC Program.

8. To study Application examples based on timers & counters in PLC
9. To study Design & implement ON-OFF controller circuit in PLC.
10.To Study control and operation of SCADA and HMI.
Text /References Books:
1. Power Electronics- M D Singh & K B Khanchandani, TMH, New Delhi
2. Modern Power Electronics- P. C. Sen, S. Chand & Co., New Delhi
3. Electrical Machine Drives: Fundamental Basics and Practices-Claiton Moro Franchi, CRC Press
4**.** John W. Webb, Ronold A Reis, "Programmable Logic Controllers, Principles and Applications"; 5th Edition, Prentice Hall of India Pvt. Ltd
5**.** Madhuchhanda Mitra, Samarjit Sen Gupta, "Programmable Logic controllers and Industrial Automation"; Penram International Publishing India Pvt. Ltd

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COLLEGE OF ENGINEERING, PUNE

B.Tech.(Electronics & Communication Engineering):Semester–VI (2023 COURSE)

S. No.	Course	Teaching Scheme Hrs. Week			Examination Scheme-Marks						Credits			
		L	P	T	ESE	IA	TW	PR	OR	Total	Th	Pr/Or	Tut	Total
1.	Embedded system design	3	2	-	60	40	25	-	-	125	3	1	0	4
2.	VLSI Design Technology	3	2	-	60	40	25	-	25	150	3	1	0	4
3.	Data Analytics	3	-	-	60	40	-	-	-	100	3	0	0	3
4.	Cellular Communication-I	3	2	-	60	40	25	25	-	150	3	1	0	4
5.	Optical Fiber Communication	3	-	-	60	40	-	-	-	100	3	0	0	3
6.	Professional skills		2	-	-	-	25	-	-	25	-	1	-	1
7.	SBC-VI R Programming	-	2	-	-	-	25	-	25	50	0	1	0	1
	Total	**15**	**10**	**-**	**300**	**200**	**125**	**25**	**50**	**700**	**15**	**5**	**-**	**20**
8.	Value Added Course- II**	**2**	**-**	**-**	**-**	**50**	**-**	**-**	**-**	**50**	**2**	**-**	**-**	**2**
9.	MOOC – II**	**-**	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

****indicate this is mandatory but the credits will not be considered in SGPA/CGPA**

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B.Tech (Electronics & Communication) Sem: VI
EMBEDDED SYSTEM DESIGN

Teaching Scheme:	**Examination Scheme:**	**Credits Allotted:**
Theory: 03 Hrs/week	End Semester Examination (Theory):60Marks	Credits: 03
Practicals:02 Hrs/week	Internal Assessment (IA): 40 Marks	
	TW: 25 Marks	Credit: 01
	Total:125 Marks	Total Credits: 04

Course Pre-requisites:

The students should have knowledge of

1.	Embedded systems
2.	Internet of things

Course Outcomes: After learning this course students will be able to

1	Explain the importance of ARM and ARM Cortex based microcontrollers
2	Acquire knowledge of STM32 ARM Cortex family, architecture
3	Write code for configuring & controlling peripherals
4	Develop applications using GPIO, timers, and PWM in STM32
5	Develop applications using ADC & DAC in STM32
6	Implement application using communication protocol

UNIT – I	**ARM Processor Review**	**(06 Hours)**
	RISC design philosophy, ARMs approach towards RISC, ARM processors and its versions, ARM7, ARM9 ARM11 features, advantages. Introduction to ARM CORTEX series processors, Features Applications, Improvement of CORTEX over classical series, Survey on ARM Cortex based microcontrollers, its features and comparison, CORTEX-M4 Core architecture.	
UNIT– II	**Introduction to STM32 ARM Cortex-M Microcontrollers**	**(06 Hours)**
	Introduction to STM32 ARM cortex family, STM 32 Internal Architecture and Interface Protocol, STM32 and the STMicroelectronics platform, Understand the core architecture, features, and peripherals of STM32 microcontrollers., Applications of STM 32	

UNIT – III	**STM32 GPIO Programming & interfacing**	**(06 Hours)**
	Getting Started with STM32 family STM32 GPIO Configuration, interfacing with (LED,Switch,7-segment,LCD, Matrix keypad)	
UNIT – IV	**Timers configuration & programming**	**(06 Hours)**
	STM32 Timers configuration & programming, Timer implementation in STM, interrupts, Configuring Counter Mode in Timers, Using and programming watchdog Timers	
UNIT – V	**Analogue to Digital Converters (ADCs) in STM32 Microcontrollers**	**(06 Hours)**
	STM32 ADC interfacing, Sensor Interfacing: Analog and Digital sensors ADC with PWM, Use of DAC in STM32, Analog Waveform Generation using DAC	
UNIT – VI	**Communication protocols**	**(08 Hours)**
	UART,I2C,SPI,CAN protocols, SPI with EEPROM,I2C With OLED, Bluetooth module, GSM module interfacing, GPS, Lora module interfacing , RFID interfacing	

Term Work:
Term Work: The term work shall consist of record of minimum eight experiments.
1.Blink LED to get familiar with GPIO pins.
2.Read button state and demonstrate basic interrupt handling
3. Read analog values from sensor and display on serial terminal or LCD
4. Control brightness of LED or speed of motor using PWM
5. Establish serial communication between STM 32 and computer enabling data logging or simple control
6.Interface with sensors like temperature, EEPROMS or peripherals that use I2C protocol
7.Communicate with peripherals like SD cards, displays that use SPI protocol
8.Display information on LCD screen requiring knowledge of LCD drivers and communication protocols
9.Control DC motor or stepper motor using PWM and appropriate motor circuitry
10.Implement simple machine learning algorithm on STM 32 to process sensor data in real time
11.Integarte two sensors and process their data
12.Any application to communicate wirelessly using BLE or Wi-fi
Text / Reference Books:
1. “STM ARM programming for Embedded systems,”Muhammad Ali Mazidi,Shujen Chen,Eshragh Ghaemi

2. “Advanced Programming with STM32 Microcontrollers”,Majid Pakdel,Elektor publication
3. “Programming with STM32”,Donald Norris,Mc GrawHill Publication
Project Based Learning:
Students are expected to perform a project (in a group) based on the course and prepare a report for the same. The report should be as per the standard guidelines.

Bharati Vidyapeeth
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College of Engineering, Pune

B.Tech(Electronics & Communication) Sem: VI
VLSI DESIGN TECHNOLOGY

Teaching Scheme:	**Examination Scheme:**	**Credits Allotted:**
Theory: 03 Hrs/week	End Semester Examination (ESE): 60 Marks	Credits: 03
Practicals:02 Hrs/week	Internal Assessment (IA): 40 Marks	
	TW: 25 Marks	Credits:01
	OR: 25 Marks	
	Total:150Marks	Total Credits: 04

Course Pre-requisites:

The students should have knowledge of

1	Analog Electronics
2	Switching Theory and Logic Design

Course Outcomes: After learning this course students will be able to

1.	Analyze the fundamentals of IC technologies, including MOS, PMOS, NMOS, CMOS, and BiCMOS.
2.	Apply stick diagrams and λ-based design rules for efficient layout design.
3.	Evaluate inverter delays, wiring capacitance, and techniques for driving large capacitive loads.
4.	Apply different modeling styles (Data Flow, Structural, Behavioral, and Mixed) for digital circuit design.
5.	Design and implement multiplexers, demultiplexers, encoders, and decoders using VHDL.
6.	Design and analyze dynamic and static memory elements, including DRAM (3T, 1T), SRAM (6T), and ROM architectures using NOR and NAND logic.

UNIT - I	**Introduction**	**(06 Hours)**
	Brief Introduction to IC technology MOS, PMOS, NMOS, CMOS & BiCMOS Technologies Basic Electrical Properties of MOS and BiCMOS Circuits: IDS - VDS relationships, MOS transistor Threshold Voltage-VT, figure of merit-ω0, Transconductance-gm, gds; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.	
UNIT - II	**VLSI Circuit Design Processes**	**(06 Hours)**
	VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, Lambda(λ)-based design rules for wires, contacts and Transistors, Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.	

UNIT -III	**Gate level Design**	**(06 Hours)**
	Logic gates and other complex gates, Switch logic, Alternate gate circuits. Basic Circuit Concepts: Sheet Resistance Rs and its concepts to MOS, Area Capacitances calculations, Inverter Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-in and fan-out.	
UNIT -IV	**Introduction to VHDL**	**(06 Hours)**
	Brief description of VHDL, Entity Declaration, Architecture Declaration, Modelling styles: Data Flow, Structural, Behavioural and Mixed Style. Assignment Statements, Select Signal Assignment, Conditional Signal Assignment, Component Declaration, Generate Statements, Concurrent and Sequential Assignment Statement, Process Statement, Case Statement. VHDL programming of basic logic gates and Boolean Algebra, Design of adder/substractor.	
UNIT - V	**Implementation of Combinational Circuit using VHDL**	**(06Hours)**
	Introduction to Combinational Circuits in VLSI, Multiplexers and De-multiplexers, Encoders and Decoders, Comparators, Parity Generator and Parity Checker, Arithmetic Logic Unit (ALU) Design, Combinational Circuit Design Using CMOS Logic.	
UNIT -VI	**Memories**	**(06Hours)**
	Design of Dynamic Register Element, 3T, 1T Dynamic RAM Cell, 6T Static RAM Cell, NOR and NAND based ROM Memory Design.	

Term Work:

The term work shall consist of record of minimum eight experiments using VHDL

1. To model all basic logic gates: AND, OR, NAND, NOR, XOR, XNOR.
2. To model adder and subtractor.
3. To model 8:1mux, 1:8 demux, 3:8 line decoder, 8:3 encoder using VHDL.
4. To model synchronous and asynchronous D FF.
5. To model 4- bit universal shift register.
6. To model 4-bit counter .
7. To model bidirectional buffer.
8. To model parity generator and checker.
9. Study of RAM/FIFO.
10. Study of Temperature sensing using ADC.

Text Book/ Reference Books:

1. Kamran Eshraghian, Douglas A. Pucknell (2011), Essentials of VLSI circuits and systems,PHI.
2. John P. Uyemura,(2011),Introduction to VLSI circuits and systems, John Wiley and Sons.
3. W. Wolf, (2002), Modern VLSI Design- System on Chip design, 3/e, Pearson Education.
4. Neil H.E. Weste, David Harris (2006) , CMOS VLSI Design-A circuit and system Perspective, Pearson Education.

Project Based Learning:

Students are expected to perform a project (in a group) based on the course and prepare a report for the same. The report should be as per the standard guidelines.

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B.Tech(Electronics & Communication) Sem: VI
DATA ANALYTICS

Teaching Scheme:	**Examination Scheme:**	**Credits Allotted:**
Theory: 03 Hrs/week	End Semester Examination (ESE): 60 Marks	Credits: 03
	Internal Assessment (IA): 40 Marks	
	Total:100 Marks	Total Credits: 03

Course Pre-requisite:

The students should have knowledge of

1. Computer Programming-II

Course Outcomes: After learning this course students will be able to

1	Interpret data from geometric, algebraic, and probabilistic perspectives.
2	Apply Data Pre-processing Techniques to Various Data Types
3	Evaluate basic statistical descriptors associated with data
4	Calculate similarity and dissimilarity measures for different data types
5	Analyse the methods used for pre-processing of the data and feature extraction process
6	Present case studies for data analytics and business analytics applications and can design simple steps for new data analytics application

UNIT – I	**Understanding Data and Data Processing**	**(06 Hours)**
	Data; structured, semi-structured, or unstructured. Data extraction: cleaning, transforming, and analysis. Data matrix: pattern detection, clustering and correlation analysis. Attributes: nominal, ordinal, discrete, continuous. Data viewing: geometrically, algebraically and probabilistically (via distributions).	
UNIT– II	**Data Objects and Attribute Types**	**(06 Hours)**
	Non-dependency-oriented data, dependency-oriented data, quantitative multidimensional data, categorical and mixed attribute data, binary and set data, text data, time-series data, discrete sequences and strings, spatial data, spatiotemporal data, network and graph data	

UNIT – III	**Basic Statistical Descriptions of Data**	**(06 Hours)**
	Measuring the central tendency, measuring the dispersion of data, boxplots, and outliers, variance and standard deviation, univariate analysis, multivariate analysis, graphic displays of basic statistical descriptions of data - quantile plot, histograms, scatter plots and data correlation	
UNIT – IV	**Measuring Data Similarity and Dissimilarity**	**(06 Hours)**
	Data matrix versus dissimilarity matrix, proximity measures for nominal attributes, proximity measures for binary attributes, Minkowski distance, proximity measures for ordinal attributes, dissimilarity for attributes of mixed types	
UNIT – V	**Data Pre-processing**	**(06 Hours)**
	Data pre-processing: an overview, data cleaning, data integration, data transformation and data discretization, feature extraction, data type portability, data cleaning, sampling, dimensionality reduction	
UNIT – VI	**Exploratory Data Analysis**	**(06 Hours)**
	Data mining, exploratory data analysis, frequent pattern mining, clustering, classification, outlier detection, business analytics data visualization tools to be used : Tableau, Power BI, Flunk, AWS, Google CoLab, Intelligent Cloud	

Text Books/ Reference Books:

1. Maheshwari, Anil. Data analytics. McGraw-Hill, 2017.
2. Aggarwal, Charu C. Data mining: the textbook. Vol. 1. No. 3. New York: springer, 2015.
3. Moreira, João, Andre Carvalho, and Tomás Horvath. A general introduction to data analytics. John Wiley & Sons, 2018.
4. Han, Jiawei, Jian Pei, and Hanghang Tong. Data mining: concepts and techniques. Morgan kaufmann, 2022.
5. Zaki, Mohammed J., Wagner Meira Jr, and Wagner Meira. Data mining and machine learning: Fundamental concepts and algorithms. Cambridge University Press, 2020.

Project Based Learning:

Students are expected to perform a project (in a group) based on the course and prepare a report for the same. The report should be as per the standard guidelines.

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B. Tech. Electronics & Communication Engineering Sem:VI
CELLULAR COMMUNICATION-I

Teaching Scheme:	**Examination Scheme:**	**Credits Allotted:**
Theory: 03 Hrs/week	End Semester Examination (ESE):60 marks	Credit:02
Practical:02 Hrs/week	Internal Assessment (IA):40 Marks	
	TW:25 Marks	Credit:01
	PR:25 Marks	
	Total:150 Marks	Total Credits: 04

Course Pre-requisites:

The students should have basic knowledge of

1.	Analog communication
2.	Digital Communication

Course Outcomes: After learning this course students will be able to

1	Describe the cellular system and identify the methods to improve the coverage and capacity of a system.
2	Analyze various losses in mobile radio propagations.
3	Examine multiple access schemes sharing radio spectrum.
4	Describe GSM - architecture, frame structure, system capacity and services provided.
5	Classify the 2G, 3G and future communication technology's evolution.
6	Analyze emerging technologies required for fourth generation mobile systems such as Long-Term Evolution (LTE).

UNIT - I	**Introduction to Cellular Communication**	**(06 Hours)**
	Introduction to wireless communication systems The Cellular Engineering Fundamentals: Introduction, Frequency Re-use, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, trunking and grade of service, Cochannel Interference (CCI), Adjacent Channel Interference (ACI), Cell Splitting, Sectoring Microcell Zone concept, Repeaters. Cordless transmission technique.	
UNIT - II	**Mobile Radio Propagation**	**(06 Hours)**
	Large scale path loss, Free space propagation model, ground reflection model (two ray model), diffraction, Practical Link Budget using path loss model, Small scale fading and multipath	

	small scale multipath propagation, parameter of multipath channels, types of small scale fading.	
UNIT -III	**Multiple Access Technique in Wireless Communications**	**(06 Hours)**
	Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Spread Spectrum Multiple Access (SSMA), Space Division Multiple Access (SDMA), Orthogonal Frequency Division Multiple Access (OFDMA).	
UNIT - IV	**GSM**	**(06 Hours)**
	GSM Network architecture, signaling protocol architecture, identifiers, channels, Frame structure, speech coding, authentication and security, call procedure, handoff procedure, services and features. Mobile data networks, GPRS and higher data rates, SMS in GSM.	
UNIT - V	**CDMA Digital Cellular Standard (IS-95) & IMT – 2000**	**(06 Hours)**
	Frequency and channel specifications of IS-95, forward and reverse CDMA channel, packet and frame formats, mobility and radio resource management. Forward and reverse channels in WCDMA and CDMA-2000, Handoff and power control in 3G system.	
UNIT - VI	**Introduction to LTE**	**(06 Hours)**
	4G Introduction and vision, LTE Architecture, Elements of LTE- EPS, LTE Radio / air interface Modulation and features, LTE Channels, 4G Architecture.	

Term Work:

The term work shall consist of a record of a minimum of eight experiments.

1. Write a program in MATLAB/Scilab to Calculate Frequency Reuse Distance. Co-Channel Interference reduction factor. Cellular System Capacity, S/I Ratio for a given variable
2. Write a Program in MATLAB/Scilab to calculate maximum traffic intensity and maximum no. of users accommodated in Erlang B and Erlang C system for given no of channels.
3. Write a Program in MATLAB/Scilab to calculate Bit Error rate performance of BPSK modulated signal over only AWGN channel and AWGN and Rayleigh channel both
4. Write a Program in MATLAB/Scilab to simulate Wireless Channel including fading and Doppler effects.
5. Write a program in MATLAB to generate GSM Waveform
6. Write a Program in MATLAB/ Scilab to Generate Walsh Codes and then spread the user information using it.
7. Write a Program in MATLAB/Scilab to Generate PN Sequence for CDMA Systems
8. Write a Program in NS3 to connect WIFI TO BUS (CSMA) Network.

9. Write a Program in NS3 to create WIFI Network in SIMPLE INFRASTUCTURE MODE (of nodes).
10. Write a Program in NS3 to Create a wireless mobile ad-hoc network between three nodes.
11. Write a program in MATLAB/Scilab to simulate 3G WCDMA transmission and reception. Plot the graph for each stage.
12. Write a Program in MATLAB/Scilab to study the variation in channel capacities of 4G MIMO systems.
Text /Reference Books:
1. Jochen Schiller, “Mobile Communications”, Pearson Education, Second Edition, 2012.
2. G. Sasibhushana Rao, "Mobile Cellular Communication", Pearson, 2013.
3. Theodore S. Rappaport, “Wireless Communications: Principles and Practice”, PTR Publications, Second Edition, 2014.
4. D. P. Agarwal.” Wireless Communication”, Thomson Learning, 2nd Edition, 2007.
5. K. Singhal.” Wireless Communication”, Tata McGraw-Hill, 1st Edition, 2006.
6. G. K. Behera & Lopamudra Das,“Mobile Communications”,Scitech Publications, 1st Edition, 2012.
7. V.K.Garg, J.E.Wilkes, “Principle and Application of GSM”, Pearson Education, 5th edition, 2008.
8. 4G LTE/LTE – Advanced for Mobile Broadband, Erik Dahlman, Stefan Parkvall, Johan Skold, Academic Press 2011.
Project based learning:
The **s**tudents are expected to perform a project (in a group) based on the course and prepare a report for the same. The report should be as per standard guidelines.

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B.Tech(Electronics & Communication) Sem:VI
OPTICAL FIBER COMMUNICATION

Teaching Scheme:	**Examination Scheme:**	**Credits Allotted:**
Theory: 03 Hrs/week	End Semester Examination (Theory): 60 Marks	Credits: 03
	Internal Assessment (IA) : 40 Marks	
	Total:100 Marks	Total Credits: 03

Course Pre-requisite:

The students should have knowledge of

1. Electronics Instrumentation
2. Analog Circuits
3. Digital Communication

Course Outcomes: After learning this course students will be able to

1	Recognize and classify the structures of Optical fiber communication
2	Identify the various optical sources and detectors along with their working principle.
3	Analyze the performance of various digital and analogue fiber-optic access solutions.
4	Analyze various losses and Design considerations of Analog and Digital Links.
5	Compare the factors affecting the performance of different optical fiber communication systems.
6	Design optical fiber communication system.

UNIT – I	**Overview Of Optical Fiber Communication**	**(06 Hours)**
	Introduction, Historical development, general system, advantages, disadvantages, and applications of optical fiber communication ,Components ,optical fiber waveguides, Ray theory, types of fiber, cut-off wave length ,FTTH.	
UNIT– II	**Optical Transmitter and Receiver**	**(06 Hours)**
	Optical Transmitter: Introduction, LED's, LASER diodes, Photo detectors, Photo detector noise, Response time, double hetero junction structure, Photo diodes, comparison of photo detectors**.** drive circuits. **Optical Receivers:**	

	Photo detector types and performance characteristics, PiN photodiodes, Direct detection receivers, Coherent receivers, Advanced measurement techniques for optical fiber links.	
UNIT –III	**Analog and Digital Links**	**(06 Hours)**
	Analog links – Introduction, overview of analog links, CNR, multichannel transmission techniques, RF over fiber. **Digital links** – Introduction, point–to–point links, System considerations, link power budget, Transmission distance for single mode fibers, nodal noise and chirping.	
UNIT – IV	**Optical Components and Networks:**	**(06 Hours)**
	WDM concepts, overview of WDM operation principles, WDM standards, Types of Optical Amplifier and its applications, Amplifier Noise, Optical SNR, Raman Amplifier, Fiber optic splices, connectors ,couplers & Coupling losses. Optical couplers, Isolators and Circulators. Network Concepts, network Topology,	
UNIT – V	**Advanced Optical Systems and Networks**	**(06 Hours)**
	Introduction to Free Space optical Communication, Introduction to Photonic crystal technology, Photonic crystal fibers, Introduction to Optical Networks, Local area network, Metropolitan-Area N/W,SONET/SDH	
UNIT –VI	**Optical Fiber Measurements and Application**	**(06 Hours)**
	Test Equipment's, Inter-symbol interference OTDR , Set ups for Measurement of Attenuation, Dispersion, NA and EYE pattern. Application in military, industrial applications and applications in local area network	

Text Book:

1. Gerd Keiser, “Optical Fiber Communications”, Tata McGraw Hill, Fourth Edition.2011

2. John M. Senior, Optical Fiber Communications-Principles and Practice, Prentice Hall of India, second Edition 1992

Reference Books

1. Jasprit Singh, “Opto Electronics – As Introduction to materials and devices”, Tata McGraw-Hill International Edition, 1998.

2.Djafar K.Mynbaev and Lowell L.Scheiner “ Fiber optic communication Technology”,2001

3. J.H. Franz and V. K. Jain, “ Optical Communication - Components and systems”, Narosa Publishing house,2000

4. Bhattacharya “Semiconductor Opto Electronic Devices”, PHI Learning, New Delhi, 1995
Project Based Learning:
Students are expected to perform a project (in a group) based on the course and prepare a report for the same. The report should be as per the standard guidelines.

Programme:B.Tech. (Common for All) Sem –VI(2023 course)

PROFESSIONAL SKILLS		
Teaching Scheme:	**Examination Scheme:**	**Credits Allotted:**
Practical:- 2 Hrs/week	Semester End Examination (ESE): Nil Internal Assessment (IA): Nil Term work: 25 Marks	Credits:01
	Total Marks: 25 Marks	Total Credit:01

Course Pre-requisites: The students should have knowledge of	
1	Basic mathematical concepts, reasoning skills, and comprehension abilities.
2	Fundamentals of communication processes and soft skills.
3	Basic understanding of leadership qualities, ethics, etiquettes, and values.
Course Objective:	
	This course is structured to provide students with a well-rounded foundation in quantitative aptitude, logical and verbal reasoning, professional communication, employment skills, leadership development, and business ethics. By integrating these components, students will be better equipped to excel in recruitment processes and succeed in their professional careers.
Course Outcomes: The student will be able to	
1	Apply shortcut techniques to solve quantitative aptitude questions efficiently in recruitment and competitive exams.
2	Utilize logical reasoning methods and mnemonics to enhance problem-solving skills in placement tests.
3	Improve verbal communication skills, including vocabulary, sentence patterns, and reading comprehension, for effective professional interactions.
4	Develop proficiency in job application writing, resume building, and interview skills to enhance employability.
5	Understand and apply soft skills, leadership qualities, and professional ethics in the workplace.
6	Demonstrate appropriate corporate etiquette, business ethics, and values in professional settings.

Course Content:

Unit-I	**Quantitative Aptitude** :	**(4 Hours)**
	Number System, Percentage, Profit and Loss, Simple & Compound Inte,Ratio, Proportion, and Average, Mixture and Allegation, Time, Speed & Distance, Time & Work, Permutation & Combination, Probability, Pipes and Cisterns	
Unit-II	**Logical Reasoning :**	**(4 Hours)**

	Coding-Decoding, Number Series, Blood Relation, Directions, Cubes & Dices, Data Interpretation, Data Sufficiency, Set Theory & Syllogisms, Matching, Selection & Arrangement, Clocks & Calendars, Visual Reasoning, Input-Output & Flow Charts	
Unit-III	**Verbal Reasoning:**	**(4 Hours)**
	Sentence Patterns, Sentence Correction, Spotting Errors, Vocabulary, Antonyms & Synonyms, Analogy, Phrasal Verbs, Idiomatic Expressions, Reading Comprehension, Cloze Test, Sentence Rearrangement and Theme Detection	
Unit-IV	**Honing Employability and Presentation Skills:**	**(4 Hours)**
	Job Application Letters: Layout, Structure, Covering Letter, Resume & CV Building: Structure, Effective Writing Tips, Group Discussion: Skills, Strategies, and Evaluation, Interview Skills: Telephonic & Face-to-Face Interviews, Body Language, Grooming & Etiquette for GD & PI,Extempore Speaking Techniques, Presentation Skills: Structure, Layout, Flow, and PPT Creation	
Unit-V	**Soft Skills and Leadership Development:**	**(4 Hours)**
	Soft Skills: Definition, Importance, and Differences from Hard Skills,Life Skills & Personal Development, Team Building & Conflict Resolution, Problem-Solving, Time & Stress Management, Pareto Principle (80/20 Rule), Time Management Matrix, Leadership Skills: Importance, Types, Attributes of a Good Leader, Motivational Theories and Emotional Intelligence in Professional Life	
Unit-VI	**Business Ethics, Etiquettes and Values:**	**(4 Hours)**
	Ethics & Values in the Business World, Respect for Individuality and Workplace Diversity, Key Features of Corporate Etiquette, Corporate Grooming & Dressing, Social & Office Etiquette, Importance of Professional Behavior in the Workplace, Corporate Social Responsibility (CSR): Need and Importance .	

Reference Books:

1.Quantitative Aptitude by R. S. Agarwal published by S. Chand

2.The Book of Numbers by Shakuntala Devi

3.A Modern Approach To Logical Reasoning by R. S. Agarwal published by S. Chand

4.A New Approach to Reasoning Verbal & Non-Verbal by Indu Sijwali

5.Business Communication by Meenakshi Raman, Prakash Singh published by Oxford University press, second edition
6.Communication Skills by Sanjay Kumar, Pushp Lata, published by Oxford University press, second edition
7.Technical Communication by Meenakshi Raman, Sangeeta Sharma published by Oxford University press
8.Developing Communication Skills by Krishna Mohan, Meera Banerji published by Macmillan India Pvt Ltd
9.Soft Skills by Meenkashi Raman, published by Cengage publishers
10.Soft Skills by Dr. K Alex published by Oxford University press
11.Soft skills for Managers by Dr. T. Kalyana Chakravarthi and Dr. T. Latha Chakravarthi published by biztantra

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B.Tech(Electronics & Communication) Sem: VI
SBC-VI - R PROGRAMMING

Teaching Scheme:	**Examination Scheme:**	**Credits Allotted:**
Practical:02hrs./week	TW: 25 Marks	Credits: 01
	OR: 25 Marks	
	Total:50 Marks	Total Credits: 01

Course Pre-requisite: The students should have knowledge of

1. Computer Programming -II
2. Information Theory and Coding

Course Outcomes: After learning this course students will be able to

1	Understand the fundamentals of R and its programming environment.
2	Perform data import/export, transformation, and visualization.
3	Implement control structures, functions, and debugging techniques.
4	Conduct statistical analysis and data modeling using R.
5	Utilize R for machine learning and real-world problem-solving.

UNIT – I	**Introduction to R**	**(04 Hours)**
	Overview of R: History, Features, and Installation, RStudio and R Console: Basic Operations, R Packages and Libraries, Variables, Data Types, and Operators in R, Basic Input/Output in R, Writing and Executing R Scripts. Introduction to RMarkdown for Report Generation	
UNIT– II	**Data Structures and Manipulation**	**(04 Hours)**
	Vectors, Lists, Matrices, Arrays, Factors and Data Frames Data Import and Export (CSV, Excel, JSON, Database) Data Cleaning and Pre-processing, String Manipulation and Regular Expressions, Handling Missing Values. Introduction to dplyr, tidyr, and stringr for Data Manipulation.	
UNIT – III	**Control Structures and Functions**	**(04 Hours)**
	Conditional Statements: if, else, switch Loops: for, while, repeat,Functions in R: Built-in and User-defined Functions,Function Scope, Arguments, and Recursion Exception Handling and Debugging Techniques	
UNIT – IV	**EDA and Visualization**	**(04 Hours)**
	Introduction to ggplot2 and Base R Graphics	

	Plotting Techniques: Line Charts, Bar Charts, Histograms, Pie Charts, Scatter Plots and Box Plots, Customizing Plots (Themes, Labels, Colors), Heatmaps, Correlation Plots, and Interactive Visualization with Plotly and Shiny	
UNIT – V	**Hypothesis Testing**	**(04 Hours)**
	Descriptive Statistics: Mean, Median, Mode, Variance, Standard Deviation. Probability Distributions and Hypothesis Testing. Correlation and Regression Analysis, Cross-validation, Model Evaluation Metrics, and Feature Engineering for machine learning models	
UNIT – VI	**Big data deployment**	**(04 Hours)**
	Time Series Analysis and Forecasting. Sentiment Analysis using Text Mining. Web Scraping with rvest Working with APIs in R. Introduction to SparkR. Shiny Dashboard Creation for Interactive Data Applications and Hands-on Project: Solving a Real-World Problem Using R	

List of Practical:

The term work shall consist of a record of a minimum of Twelve experiments.

1. Implementing vectors, lists, matrices, arrays, factors, and data frames in R.
2. Reading and writing CSV, Excel, and JSON files in R.
3. Subsetting, adding/removing columns, and merging data frames.
4. Identifying and replacing missing values using different strategies.
5. Using if-else, for loops, while loops, and switch-case in R programs.
6. Implementing try-catch blocks for error handling.
7. Creating and executing functions, passing arguments, and returning values.
8. Creating line charts, bar charts, and histograms using base R functions.
9. Generating scatter plots, box plots, and custom plots using ggplot2.
10. Computing mean, median, standard deviation, and visualizing distributions.
11. Implementing linear regression and plotting regression lines.
12. Implementing Logistic Regression, Decision Trees, and K-Means Clustering.
13. Performing time series decomposition and forecasting using ARIMA.
14. Developing a real-world application using R (e.g., stock market analysis, sales forecasting, or customer segmentation).
15. Extracting data from websites using rvest.
16. Analysing text data and performing sentiment classification.

Text Book/ Reference Books:

1. Matloff, Norman. The art of R programming: A tour of statistical software design. No Starch Press, 2011.
2. Grolemund, Garrett. Hands-on programming with R: Write your own functions and simulations. " O'Reilly Media, Inc.", 2014.
3. Lantz, Brett. Machine learning with R: expert techniques for predictive modeling. Packt publishing ltd, 2019.

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B.Tech (Electronics & Communication) Sem: VI
VALUE ADDED COURSE II: AUTOMOTIVE EMBEDDED SYSTEM

Teaching Scheme:	**Examination Scheme:**	**Credits Allotted:**
Theory: 02 Hrs./week	Semester End Examination (ESE): Nil Internal Assessment (IA):50 Marks	Credits: 02
	Total:50 Marks	Total Credits: 02

Course Pre-requisite:

1. Computer Programming
2. Basics of Controller

Course Outcomes: After learning this course students will be able to

1.	Profound understanding of automotive embedded systems and their components.
2.	Implement and analyze embedded communication protocols
3.	Understand Embedded System Architecture
4.	Understand Integrated Development Environments
5.	Examine various programming tools and microcontrollers relevant to the automotive industry.
6.	Ability to design, program, and troubleshoot embedded systems for automotive applications.

UNIT – I	**Introduction to Automotive Embedded Systems**	**(04 Hours)**
	Definition and Distinctions of Embedded Systems, Overview of Embedded Architectures and System Categories Processor Architectures and Attributes: RISC vs. CISC	
UNIT– II	**Embedded Communication Protocols**	**(04 Hours)**
	Communication Modes: Serial, Parallel, Synchronous, Asynchronous, Serial Protocols: I2C, CAN, USB Automotive Networking: CAN Protocol and Flex Ray	
UNIT – III	**Microcontroller Fundamentals**	**(04 Hours)**
	Introduction to MC51, MSP430, ARM, Block Diagrams, Features, and Programming Models, Assignment: Microcontroller Programming Exercises	
UNIT – IV	**Software Development in Embedded Systems**	
	Introduction to Integrated Development Environments (IDE)	

	Using Code Warrior IDE for Editing, Debugging, and Flashing Code, Software-Hardware Integration: Practical Examples and Tests	
UNIT – V	**Interfacing and Integration**	**(04 Hours)**
	Interfacing Techniques for Relays, Sensors, and Actuators with Embedded Cores, Hands-on Projects: Ultrasonic, Humidity Sensors, and DC Motor Control I2C Communication Implementation	
UNIT – VI	**Practical Applications and Troubleshooting**	**(04 Hours)**
	Building Circuits on Breadboards and Schematic Development, Programming for Different Applications in the Automotive Sector Troubleshooting Techniques for Common Issues in Embedded Systems	

Text Book/ Reference Books:

1. Handbook On ARM/STM32/MSP430
2. Integrated Development Environments (IDEs) by Chad Heaton Alice Park Charles Zedlewski
3. Mechatronics Systems, Sensors and actuators Mechatronics Handbook, 2nd Edition