FIFTH SEMESTER

Sr No	Course Category	Course Code	Course Title	Hours per Week			Credits	Maximum Marks		
				L	T	P		Continual Assessment	End Sem Examination	Total
1	PCC	23ET501T	Analog & Digital Communication	3	-	-	3	30	70	100
2	PCC	23ET501P	Analog & Digital Communication Lab	-	-	2	1	25	25	50
3	PCC	23ET502T	Internet Of Things	3	-	-	3	30	70	100
4	PCC	23ET502P	Internet Of Things Lab	-	-	2	1	25	25	50
5	PCC	23ET503T	Antenna and Wave Propagation	3	-	-	3	30	70	100
6	PCC	23ET504P	Circuit Simulation & Coding Lab	-	-	2	1	25	25	50
7	PEC	23ET505T	Professional Elective Course -I	3	-	-	3	30	70	100
8	OE	23ET561O	Open Elective - II	3	-	-	3	30	70	100
9	VSC	23ET506T	Technical Skill Development - II	2	-	-	2	50	-	50
10	SEC	23ET507P	Career Development - V	-	-	2	1	50	-	50
11	MDM	23ET531M	Multidisciplinary Minor -III	3	-	-	3	30	70	100
Total				**20**	**-**	**8**	**24**	**355**	**495**	**850**

23ET506T	Professional Elective course -I
23ET505T(i)	Computer Communication Network
23ET505T(ii)	Wireless Sensor Network
MDM	
23ET531M	Industrial Applications of Microcontrollers

Open Elective - II	
23ET561O	Sensors and Actuators

FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
23ET501T	Analog & Digital Communication	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
1. To study basic components of digital communication systems. 2. To understand the designing aspects of optimum receivers for digital modulation techniques. 3. To study the analysis of error performance of digital modulation techniques. 4. To study the designing of digital communication systems under given power, spectral and error performance constraint.	After completion of the course students are able to, 1. Explain the working principles of basic building blocks of analog communication system. 2. Explain the working principles of basic building blocks of a digital communication system. 3. Demonstrate and elaborate the concept of source and waveform coding techniques 4. Illustrate digital modulation techniques 5. Demonstrate and elaborate the concept of channel coding and decoding techniques, and describe spread spectrum analysis.

UNIT- I: **[10 Hrs]**

Base band & Carrier communication, Introduction of modulation, Equation of modulation, Generation of AM (DSBFC) and its spectrum, Modulation Index, Power relations applied to sinusoidal signals, Comparison of AM, FM and PM, Pulse Analog modulation: PAM PWM & PPM.

Unit –II:- **[10 Hrs]**

Model of digital communication system, Gram Schmitt Orthogonalization procedure, signal space concept, Geometric interpretation of signals. PCM – Generation & reconstruction, Bandwidth requirement of PCM, Differential PCM, Delta Modulation & Adaptive DM. (Only Block diagram treatment).

Unit –III:- **[7 Hrs]**

Source coding Theorem, Shannon Fano Coding, Huffman coding-Z encoding algorithm, Rate distortion theory for optimum quantization, scalar & vector quantization. Waveform coding methods: ADPCM, Adaptive Sub-Band & Transform coding, LP & CELP coding.

UNIT- IV: **[10 Hrs]**

Coherent Binary: QPSK, MSK, Gaussian MSK, DPSK, Memory less modulation methods, linear modulation with Memory, nonlinear modulation methods with memory: CPFSK, CPM.Binary: QPSK, MSK, Gaussian MSK, DPSK, CPFSK, CPM.

Unit -V: **[8 Hrs]**

Introduction to Galois field, Construction of Galois field GF (2 m) & its basic properties. Types of error control: Forward error correction (FEC), Automatic repeat request system (ARQ). Convolution encoding and decoding distance properties, Viterbi algorithm and Fano algorithm. Spread - Spectrum methods: - Study of PN sequences, direct sequence methods, Frequency hop methods, slow and fast frequency hop.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Digital communication	Simon Haykin	3	WEP
2	Error Control Coding	Shu Lin & Daniel	2	TMH
3	Digital Communication	J.S.Chitode	3	TMH

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Communication Systems	Simon Haykin	4	John Wiley & Sons
2	Principles of Communication Systems	Taub & Schilling	3	Tata McGraw-Hill

FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
23ET501P	Analog & Digital Communication Lab	-	-	2	1	25	25	50

Course Objectives	Course Outcomes
1. To study the concept of communication based on RF-AF in digital domain. 2. To study the role of sampling factor for analyzes the digital communication systems 3. To study & Design the digital communication systems. 4. To study line coding and its application.	After completion of the course students are able to, 1. Test the concept of the analog communication-based systems and techniques 2. Examine and analyze the digital communication-based circuit design 3. Design and conduct experiments for testing digital communication circuits and systems. 4. Analyze the different coding technique for design and modeling of digital communication. 5. Formulate and solve digital communication circuits and systems problems

Minimum 8 practical based on the syllabus.

Sr.No.	List of the experiment
1	To generate Amplitude Modulated wave using different techniques and plot its waveform.
2	To generate Frequency Modulated wave using different techniques and plot its waveform.
3	To study generation of SSB-SC using balanced modulator
4	To study generation of DSB-SC signal.
5	To Study and perform Error Detection and Correction codes.
6	To study the performance of adaptive Delta modulator/Demodulator circuits.
7	To study and observe the effect of signal Distortion using EYE-Diagram.
8	To Study and perform generation & reception of BPSK & perform its spectral analysis.
9	To Study and perform generation & reception of FSK & perform its spectral analysis.
10	To Study and perform generation & reception of QPSK & perform its spectral analysis.
11	To Study and perform generation & reception of MSK & perform its spectral analysis.
12	To Study and perform generation & reception of DPSK & perform its spectral analysis.
13	Write and execute Scilab/Matlab code for generation of BPSK / Prepare Simulink Model for BPSK.

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Digital communication	Simon Haykin	3	WEP
2.	Error Control Coding	Shu Lin & Daniel	2	TMH
3	Digital Communication	J.S.Chitode	3	TMH

Reference Book: Lab Manual

FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
23ET502T	Internet of Things	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
1. To acquaint students with basic concepts and architecture of IoT. 2. To enable students to design and develop Arduino and ESP32 based systems for IoT applications. 3. To introduce students to modern networking protocols and interoperability issues in IoT. 4. To explore cloud and edge analytics strategies for IoT data. 5. To expose students to advanced industrial IoT case studies.	After successful completion of the course, students will be able to: 1. Explain fundamental concepts, trends, and components of IoT. 2. Analyze communication protocols, IPv6 addressing, and machine-to-machine communications. 3. Design and implement IoT systems using Arduino and ESP32 platforms. 4. Apply analytics methods including cloud and edge-based data processing. 5. Evaluate industrial IoT use cases including smart manufacturing and smart cities.

UNIT- I: Introduction to IoT	**[10 Hrs]**
Introduction to IoT: Definition & Characteristics, IoT Functional Blocks: Sensing, Actuation, Control, Physical Design and Logical Design of IoT,Constraints affecting Design in IoT,Emerging Trends in IoT: AI Integration and Edge Computing	
Unit –II:- Basics of Networks:	**[9Hrs]**
Basics of Networks/IP Model, IP Addresses, Application Layer Protocols: HTTP, MQTT, CoAP,Introduction to IPv6 Addressing for IoT,Stack Architectures for IoT Communication.	
Unit –III: - Introduction to IoT tools	**[10 Hrs]**
Interoperability in IoT,Machine-to-Machine (M2M) Communications, Overview of IoT supported Hardware Platforms: Arduino Board, Introduction to Arduino Programming, Integration of Sensors and Actuators, Introduction to ESP32 WiFi-Bluetooth MCU Module,MQTT Protocol Implementation.	
UNIT- IV: Data analytics and Cloud Computing	**[8Hrs]**
Data Analytics: Introduction, Structured Versus Unstructured Data,IoT Data Analytics Challenges, Data Acquisition and Organization in IoT/M2M,Introduction to Edge Analytics: Local Data Processing.	
Unit -V: Industrial IoT & Case Study	**[8Hrs]**
IoT Application Case Studies: Smart Cities, Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Agriculture, Healthcare,Case Study: Smart Manufacturing (Industry 4.0),IoT in India: Smart India Projects, Challenges in IoT Implementation.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	The Internet of Things: Enabling Technologies, Platforms, and Use Cases	Pethuru Raj and Anupama C. Raman	1	CRC Press
2	Internet of Things: A Hands-on Approach	Arshdeep Bahga and Vijay Madisetti	1	Universities Press)

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Introductions to Internet of Things	Prof. Sudip Misra,| IIT Kharagpur	-	https://swayam.gov.in/nd1_noc19_cs65/previe

FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
23ET502TP	Internet of Things Lab	-	-	2	1	25	25	50

Course Objectives	Course Outcomes
1. To provide hands-on experience with Arduino and ESP32 platforms for IoT applications. 2. To implement basic IoT communication protocols and data visualization techniques. 3. To introduce data acquisition and local (Edge) processing techniques.	After completion of the course students are able to, 1. Design, implement, and test basic IoT applications using Arduino/ESP32 platforms. 2. Demonstrate data communication between sensors, controllers, and cloud platforms. 3. Implement basic data analytics and device control through cloud services. 4. Build real-time small scale IoT prototypes integrating edge computing concepts.

Minimum 8 practical based on the syllabus.

Sr.No.	List of the experiment
1	Comparative Survey of IoT Boards: Arduino, Node MCU, Raspberry Pi, Jetson Nano
2	To analyze the operation and data acquisition of the DHT11 digital temperature and humidity sensor when interfaced with Arduino Uno and to evaluate serial data output for real-time monitoring.
3	To analyze the operation and data acquisition of the DHT11 digital temperature and humidity sensor when interfaced with Arduino Uno and to evaluate serial data output for real-time monitoring.
4	To analyze the process of acquiring environmental data using a DHT11 sensor and uploading it to the ThingSpeak Cloud via WiFi using the ESP32 microcontroller.
5	To implement MQTT communication between ESP32 and PC using the Mosquitto broker for real-time IoT messaging and data exchange.
6	To control an LED using a mobile app via Bluetooth communication using HC-05 and Arduino.
7	To collect and analyze humidity data locally using edge analytics on ESP32.
8	To create a smart light system that automatically turns the streetlight ON/OFF using LDR and Arduino.
9	Mini Project: Create a Home Automation Prototype (Fan/Light ON-OFF with Blynk App using ESP32)
10	Control a DC Motor Speed using PWM with ESP32 and Monitor via Serial Monitor

Text Books

S.N	Title	Authors	Edition	Publisher
1	Internet of Things: A Hands-on Approach	Arshdeep Bahga, Vijay Madisetti	1st	Universities Press
2	The Internet of Things: Enabling Technologies, Platforms, and Use Cases	Pethuru Raj, Anupama C. Raman	1st	CRC Press
3	Getting Started with ESP32 Development	Neil Kolban	1st	Kolban's Book

Reference Book: Lab Manual

FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
23ET503T	Antenna and Wave Propagation	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
1. To acquaint students with various basics of waveguides, transmission line characteristics, radiating elements, antennas, their principle of operation, analysis and their applications. 2. The student will able to understand the features of Antenna array, Micro-strip antenna and reflector antenna.	After completion of the course students are able to, 1. Examine transmission line characteristics. 2. Design & analyze the wired antenna parameters. 3. Design and characterize antenna arrays. 4. Analyze and design Micro-strip Antennae. 5. Illustrate the operation of aperture and reflector antennae

UNIT- I: Transmission lines	**[10 Hrs]**
Transmission line equations and their solution. Transmission line parameters, characteristic impedance, propagation constant, attenuation constant and phase constant, waveform distortion, distortion less transmission lines, reflection coefficient and VSWR. Equivalent circuits of transmission lines, open and short circuited lines, smith chart, stub matching.	
Unit –II:- Linear wire antennas	**[9 Hrs]**
Retarted Potential, Infinitesimal dipole, its radiation field, radiation resistance, near field, far field directivity, finite length dipole, half wave length dipole, Monopole and their application, folded dipole. Introduction to loop Antenna & its applications.	
Unit –III:- Antenna Array	**[9 Hrs]**
Array of two isotropic point sources, non – isotropic sources, principle of pattern multiplication, linear arrays of n elements, broadside, End fire, radiation Pattern, directivity, Beam width and null directions, array factor, Antenna analysis using **Binomial Array** & Dolph-Tschebyscheff. Log-periodic and Yagi-Uda antennas.	
UNIT- IV: Microstrip antennas	**[9 Hrs]**
Radiation Mechanism of Microstrip antenna, feeding methods, methods of analysis, Circularly Polarized Patch antenna, Rectangular & circular patch, Circular polarization and feed network.	
Unit -V: Reflector antennas	**[8 Hrs]**
Simple reflectors, the design of a shaped Cylindrical reflector, Radiation patterns of Reflector Antennas, Dual shaped Reflector Systems, Plane reflector, Corner reflector, parabolic reflector, horn antenna, aperture antenna.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Antenna Theory analysis and design	Costantine A. Balanis	2	John Wiley Publication
2	Antenna and Wave propagation	K.D. Prasad	1	Satya Prakashan
3	Electromagnetic	Jordan Balmann,	1	Prentice Hall of India publication

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Antenna & Wave Propagation	Sisir K Das	1	Mc Graw Hill
2	Antennas and Radio Propagation	R.E. Collins	1	Mc Graw Hill

FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
23ET504P	Circuit Simulation & Coding Lab	-	-	2	1	25	25	50

Course Objectives	Course Outcomes
1. To use MATLAB, Python, and Multisim for circuit simulation and audio signal processing. 2. To understand analog circuits and their simulation (amplifiers, diodes, etc.). 3. To develop coding and hardware interfacing skills using Arduino and LoRa boards.	After the complication of the course, students will have, 1. Ability to simulate and analyze electronic circuits using Multisim. 2. Skills in processing audio signals using MATLAB and Python. 3. Hands-on experience in hardware interfacing with Arduino and LoRa.

Minimum 8 practical based on the syllabus.

Sr.No.	List of the experiment
1	To Study MATLAB conditional structures
2	To Generate Elementary Signals using MATLAB
3	To interface Mike & Speaker with Matlab
4	Audio Signal Processing Using Python
5	Interfacing function generator with pc using matlab
6	Interfacing cro with pc using matlab
7	Multirate demo with audio signal
8	To determine the fundamental frequency of an audio signal using autocorrelation
9	To determine the fundamental frequency of an instrumental sound using fft
10	Experiment with Arduino using Analog Input terminal
11	Experiment on LED blinking using Arduino
12	To implement device-to-device communication using LoRA Duino Development Boards
13	Simulation of Schmitt Trigger and Comparator Circuits
14	Simulation of Class A, B, AB and C Power Amplifiers using Multisim
15	Design and Simulation of BJT Biasing Circuits using Multisim
16	VI Characteristics of PN Junction Diode Simulation with Multisim

Reference Book: Lab Manual

FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
23ET505T(i)	PE-I Computer Communication Network	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
1. To understand the basic concept of computer communication network 2. To recognize the computer network layer 3. To describe IP addressing scheme & Hardware aspect of network communication. 4. To clarify network security & administration	Upon successful completion of the course, students will be able to: 1. Illustrate the requirement of theoretical & practical aspect of computer network. 2. Explain the different wired & wireless LAN standards. 3. Classify various protocols used in network layer, application layer for routing, streaming and transport layer for reliable and unreliable data communication. 4. Explain and analyze the concept of computer network security using different tools 5. Explain and analyze the concept of computer network security using different tools

Unit I: Introduction to Computer Networks	**[10 Hrs]**
Uses of computer Network, Network Software-design Issues for layers, Service primitives and relationship of services to Protocols, Reference models-OSI &TCP/IP, Network architectures introduction. ADDRESSING: Physical Addresses, Logical Addresses, Port Addresses, Specific Addresses.	
Unit II: Physical and Data Link layer	**[10 Hrs]**
Physical layer-Data rate limits, Transmission media, Switching systems, Datagram Switching & Virtual circuit switching, Structure of circuit and packet switch, cable modem, SONET basics, Selection of IEEE std 802.1. DIGITAL-TO-ANALOG CONVERSION: Aspects of Digital-to-Analog Conversion, Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, Quadrature Amplitude Modulation. Data link layer: Framing, Flow & Error control Protocols, Multiple access techniques random access, and controlled access. Block coding: Error Detection, Error Correction.	
Unit III: Transport Layer and Network Layer	**[10 Hrs]**
Transport layer: Process to process delivery, Connection oriented & Connectionless Transport, UDP, TCP, congestion control and Quality of Service. Network Layer: IPv4ADDRESSES: Address Space, Notations, Classful Addressing, Classless Addressing, Network Address Translation (NAT), IPv6 ADDRESSES: Structure, Address Space, Address mapping-ARP, RARP & DHCP, IPv4: Datagram, Fragmentation, Checksum, Options. IPv6: Advantages, Packet Format, Extension Headers	
Unit IV: Application Layer	**[7 Hrs]**
Application layer : Application layer protocols and applications like Ping, FTP, telnet, http (www), SMTP, SNMP, Trace route, TFTP, BOOTP, DNS, NFS, RPC, X-server, E-mail, Introduction to streaming Audio/Video,P2P file sharing	
UNIT- V: Basics of Network Security and Network administration	**[8 Hrs]**
Network security: Introduction to Cryptography, Secret key algorithm, public key algorithm, Secret key algorithm, public key algorithm, Basics of Security Requirements/Services/Dimensions. IPSecurity (lPSec): Two Modes, Two Security Protocols, Security Association, Internet Key Exchange (IKE), Virtual Private Network. Network Administration: UTP Cabling for PC to PC communication, Network tester, network monitoring, Protocol Analyzer	

Text Books

S.N	Title	Authors	Edition	Publisher
1	*Computer Networks*	Andrew S. Tanenbaum	4	Pearson Education
2	Data Communications and Networking	Behrouz A. Forouzan	5	TMH, 2013

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Data and Computer Communications	William Stallings	6	Pearson

FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
23ET505T(ii)	PE-I Wireless Sensor Networks	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
1. Understand the basic architecture and applications of wireless sensor networks. 2. Learn communication protocols and routing techniques for efficient WSN operation. 3. Explore advanced WSN concepts like localization, mobility, and IoT integration.	Upon successful completion of the course, students will be able to: 1. Describe the architecture, components, and applications of wireless sensor networks. 2. Explain the functioning of sensor node hardware and operating systems. 3. Analyze various MAC and routing protocols used in WSNs. 4. Evaluate performance metrics and energy efficiency in sensor network communication. 5. Apply WSN concepts in designing basic real-world applications and integrating with IoT.

Unit I : Unit 1: Introduction to Wireless Sensor Networks	**[10Hrs]**
Overview of wireless communication, Evolution from traditional networks to sensor networks, Architecture and components of WSNs, Types of wireless sensor networks: static vs mobile, proactive vs reactive, Applications of WSNs: industrial, environmental, military, healthcare, smart cities.	
Unit 2: Sensor Node Architecture and Hardware	**[10 Hrs]**
Hardware architecture of sensor nodes, Microcontroller, transceiver, power unit, and sensing unit, Operating systems for sensor nodes (TinyOS, Contiki), Challenges in sensor node design: energy, memory, and computation constraints, Sensor deployment strategies and coverage models.	
Unit 3: Communication and MAC Protocols	**[9 Hrs]**
Wireless channel characteristics and communication fundamentals, Medium Access Control (MAC) issues in WSNs, Contention-based MAC protocols: CSMA, S-MAC, T-MAC, Schedule-based MAC: TDMA, IEEE 802.15.4, Energy-efficient communication techniques	
Unit 4: Routing and Data Dissemination Protocols	**[8 Hrs]**
Routing challenges in WSNs, Classification of routing protocols: data-centric, hierarchical, location-based, LEACH (Low-Energy Adaptive Clustering Hierarchy), Directed Diffusion, Rumor Routing, SPIN, GAF, Data aggregation and fusion techniques	
Unit 5: Advanced Topics and Applications	**[8 Hrs]**
Localization techniques and synchronization in WSNs, Mobility management in WSNs, Security issues and countermeasures in WSNs, Introduction to IoT and integration with WSNs, Case studies and applications in smart environments, healthcare, and industrial monitoring	

Text Books

S.N	Title	Authors	Edition	Publisher
1	AdHoc Wireless networks	C. Siva Ram Murthy, and B. S. Manoj	2008	Pearson Education
2	Wireless sensor networks	Feng Zhao and Leonides Guibas	2004	Elsevier publication
3	Mobile Communications	Jochen Schiller	2	Pearson Education

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Wireless Communications and Networks	William Stallings	2004	Pearson Education

FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
23ET561O	OE II Sensors and Actuators	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
1. Introduce the fundamental principles of sensors, actuators, and their transduction mechanisms used across various engineering domains. 2. Familiarize students with sensor materials, fabrication techniques, and signal interfacing strategies with embedded systems. 3. Explore real-world applications of sensors and emerging trends like IoT-based smart sensors and energy harvesting systems.	Upon successful completion of the course, students will be able to: 1. Classify different types of sensors and actuators based on their principles and applications 2. Explain the microfabrication processes and materials used in sensor technology. 3. Apply signal conditioning and interfacing techniques to connect sensors with microcontrollers and data acquisition systems. 4. Analyze the role of sensors in industrial, biomedical, environmental, and automotive domains. 5. Evaluate advanced technologies such as smart sensors, WSNs, and energy harvesting methods for modern applications.

Unit I: Fundamentals of Sensors and Actuators	**[10 Hrs]**
Introduction to sensors: definitions, classifications, and characteristics, Operating principles of various sensors (thermal, mechanical, optical, chemical), Introduction to actuators: types and working principles, Transduction mechanisms: resistive, capacitive, piezoelectric, etc.	
Unit II: Sensor Materials and Fabrication Techniques	**[10 Hrs]**
Overview of sensor materials: silicon, polymers, ceramics, and composites, Microfabrication techniques: photolithography, etching, deposition processes, MEMS technology: design and fabrication of micro-scale sensors, Cleanroom practices and safety protocols in sensor fabrication	
Unit III: Signal Conditioning and Interfacing	**[9Hrs]**
Signal conditioning circuits: amplification, filtering, and analog-to-digital conversion, Interfacing sensors with microcontrollers and data acquisition systems, Communication protocols: I2C, SPI, UART for sensor data transmission, Calibration techniques and error analysis in sensor systems	
Unit IV: Sensor Applications in Various Domains	**[8Hrs]**
Industrial automation: tempeature, pressure, and proximity sensors, Biomedical applications: biosensors, wearable sensors, and implantable devices, Environmental monitoring: gas sensors, humidity sensors, and pollution detectors, Automotive applications: accelerometers, gyroscopes, and tire pressure sensors.	
Unit V: Advanced Sensor Technologies and Future Trends	**[8Hrs]**
Smart sensors and IoT integration, Wireless sensor networks: architecture and applications, Energy harvesting for self-powered sensors, Emerging trends: nanotechnology in sensors, flexible and wearable sensors.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Sensors and Transducers	D. Patranabis	2	PHI Learning Pvt. Ltd.
2	*Introduction to Sensors*	John Vetelino and Aravind Reghu	2	CRC Press

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Sensor Technology Handbook	Jon S. Wilson	1	Elsevier/Newnes

FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
23ET531M	MDM-III Industrial Applications of Microcontrollers	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
The student can creatively use the capabilities of modern microcontrollers & latest technical advancements.	1. Explain the architecture of modern microcontrollers 2. Develop a circuit consisting of external elements connected to microcontroller I/O ports 3. Design the application by using embedded peripherals 4. Compare and choose the proper communication interface for the application to be designed 5. Outline the automation system for an application consisting of external elements

Unit I : Architecture and Basic Characteristics of Microcontrollers	**[9Hrs]**
Selection of Microcontrollers, Architecture & Characteristics of Arduino, Introduction to ESP 32 & ARM-based Microcontrollers. Setting up the Arduino board, creating sketches, Libraries, Example codes, and Debugging Using the Serial Monitor & ICE (In-Circuit Emulator)	
Unit II : Input-output ports & Interface	**[9 Hrs]**
Microcontroller I/O ports and interconnection with external devices like Keyboards, displays etc. Analog Inputs- Thermocouple, Potentiometer, A/D converter (ADC) in microcontrollers. Sensors: Temperature sensors, Soil Moisture Sensor, Proximity sensors, Ultrasonic sensor, Accelerometer, and gyro sensor	
nit III Memory System, Clock generator and timers/counters:	**9 Hrs]**
Flash memory subsystem, EEPROM. Interrupts system, Architecture of timers/counters subsystem (TC) used in microcontrollers, Use of the TC subsystem to generate square waveforms of given parameters and measure frequency, duty factor, and time shift of waveforms. Pulse width Modulation (PWM).Case study of one Industrial Application	
Unit IV: Communication Interfaces:	**[9 Hrs]**
USART, I2C (TWI), and SPI standards, Architecture of USART, TWI, and SPI controllers used in microcontrollers, Registers, and software handling of above interfaces for Arduino, USB to TTL converter module. Examples on I2C(Interfacing RTC), SPI(Serial Eprom). Introduction to LoRaWAN Communication Technology. Case study of one Industrial Application	
Unit V Industrial Automation:	**[9 Hrs]**
Basic block diagram, PLC & SCADA, Concepts of DCS, Process Boiler Automation, Machine control Automation, PLC and Microcontroller based instrumentation Systems, HMI display with touch screen, Modbus, PROFINET. Arduino Libraries for implementing MQTT & REST protocols for IoT.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Arduino Cookbook	Michael Margolis, O'Reilly Media	1	Inc.
2	Microcontrollers, Architecture, Programming, Interfacing and System Design	Rajkamal	2	Peaeson Publucations

Reference Books

1. https://www.ti.com/microcontrollers-mcus-processors/processors/digital-signal-processors/overview.html
2. Microcontrollers datasheets and user's manual(https://www.farnell.com/datasheets/1682209.pdf)