Annexure I: Course Curriculum

TABLE 1: MODULE WISE COURSE CONTENT AND OUTCOME				
Sl. No	**Module Name**	**Module Content**	**Module Learning Outcome**	**Duration (Hrs)**
1	Introduction to IoT & Embedded Systems	Overview of IoT, its applications, and the role of embedded systems in IoT. Basics of microcontrollers, sensors, and actuators.	Understand the role of IoT in industry and the components involved in IoT-based embedded systems.	4
2	Embedded System Basics	Introduction to microcontrollers (e.g., ESP32), programming basics, and I/O operations	Gain knowledge in working with microcontrollers and performing basic embedded system tasks.	6
3	Communication Protocols	Study of communication protocols like I2C, SPI, UART for connecting sensors and actuators to the system.	Learn to interface sensors and devices with the microcontroller using communication protocols.	7

4	Sensor Interfacing and Data Collection	Connecting sensors (e.g., DHT11, ultrasonic) to ESP32 for collecting real-time data	Develop skills to interface sensors and collect data for IoT applications.	5
5	Cloud Integration for IoT	Introduction to cloud platforms (ThingSpeak, Blynk) and data visualization techniques.	Learn how to upload sensor data to the cloud and visualize it in real-time on cloud platforms.	4
6	Power Management in IoT Devices	Power-saving techniques for embedded IoT systems, using sleep modes and low-power operation.	Understand energy-efficient methods for battery-powered IoT systems.	3
7	Security in IoT Systems	Overview of security challenges in IoT and methods like encryption, authentication for secure data transmission.	Learn the best practices for securing IoT systems and protecting data.	6

8	Data Logging and Real-Time Monitoring	Techniques for storing sensor data locally or in the cloud, and developing real-time monitoring systems.	Learn to implement systems for continuous data logging and monitoring in IoT applications.	4
9	Final Project Development	Integration of multiple sensors, cloud communication, and data logging into a complete IoT system.	Develop a complete IoT system using all learned concepts, including sensors, microcontrollers, and cloud integration.	6

Annexure II: Use Cases and Test Projects

Use cases:

IoT-based environmental monitoring system
Interfacing ESP32 with sensors like DHT11 or ultrasonic sensor
Smart home temperature control
I2C communication for connecting multiple sensors
Weather monitoring system with live updates on a cloud dashboard
Battery-powered IoT sensor nodes
Encrypted communication for sensitive IoT healthcare data
Smart energy meter with alerts for abnormal power consumption
IoT-enabled smart irrigation system

LIST OF TEST PROJECTS (20 PROJECTS THAT COMPREHENSIVELY COVER ALL THE LEARNING OUTCOMES)	
S.NO	**Final Projects**
1	Smart Home Automation System • Task 1: Interface sensors (e.g., motion, temperature) and actuators for automation. • Task 2: Program the microcontroller to control devices like lights and fans. • Task 3: Enable remote control and monitoring using Wi-Fi communication. • Task 4: Integrate cloud platforms for real-time data visualization and device control. • Task 5: Implement security measures for safe and encrypted IoT operations.
2	IoT-based Weather Monitoring Station • Task 1: Interface environmental sensors like temperature, humidity, and pressure sensors. • Task 2: Program the microcontroller to collect and

	process sensor data. • Task 3: Establish communication to transmit data to a cloud platform. • Task 4: Visualize real-time weather data on a cloud dashboard or mobile app. • Task 5: Implement data logging and alerts for weather condition changes.
3	Smart Energy Meter with Cloud Monitoring • Task 1: Interface energy sensors to measure electricity usage. • Task 2: Program the micro-controller to process energy data. • Task 3: Establish communication to send data to the cloud. • Task 4: Visualize energy consumption on a cloud dashboard or app. Task 5: Implement alerts for abnormal energy usage.
4	Automated Irrigation System with Soil Moisture Sensors • Task 1: Connect soil moisture sensors to monitor water levels. • Task 2: Program the system to automate irrigation based on sensor data. • Task 3: Enable remote control of the system using IoT. • Task 4: Log irrigation patterns on a cloud platform. Task 5: Set alerts for low soil moisture levels.
5	Industrial Safety System with Emergency Shutdown • Task 1: Interface sensors for monitoring critical parameters. • Task 2: Program the micro-controller to detect unsafe conditions. • Task 3: Develop logic to trigger emergency shutdown. • Task 4: Transmit alerts to operators via cloud integration. Task 5: Log safety events for further analysis.

6	Smart Traffic Light Control System • Task 1: Connect sensors to detect vehicle flow and density. • Task 2: Program the system to control traffic lights dynamically. • Task 3: Enable remote monitoring and control of the system. • Task 4: Log traffic patterns for optimization. Task 5: Set alerts for unusual traffic conditions.
7	IoT-enabled Healthcare Monitoring System • Task 1: Interface biomedical sensors to measure health parameters. • Task 2: Program the microcontroller for data collection and processing. • Task 3: Transmit data to a cloud platform securely. • Task 4: Visualize patient data on a dashboard for real-time monitoring. Task 5: Set alerts for abnormal health readings.
8	Smart Door Lock System with Biometric Authentication • Task 1: Interface a fingerprint sensor for biometric authentication. • Task 2: Program the microcontroller to process biometric data. • Task 3: Enable remote locking/unlocking using IoT. • Task 4: Log access events for security purposes. Task 5: Implement encryption for secure communication.
9	IoT-based Air Quality Monitoring System • Task 1: Connect sensors for air quality parameters like PM2.5, CO2, and humidity. • Task 2: Program the microcontroller to collect and analyze sensor data. • Task 3: Transmit air quality data to a cloud platform. • Task 4: Visualize air quality trends on a dashboard. • Task 5: Send alerts for poor air quality levels.

10	Real-time Inventory Tracking System with Load Sensors • Task 1: Interface load sensors to monitor inventory weight. • Task 2: Program the system to calculate and update inventory levels. • Task 3: Enable real-time tracking using IoT communication. • Task 4: Visualize inventory data on a cloud platform. • Task 5: Set alerts for low stock levels.
11	IoT-enabled Vehicle Tracking System • Task 1: Integrate GPS and GSM modules for location tracking. • Task 2: Program the microcontroller for real-time location updates. • Task 3: Transmit vehicle data to a cloud platform. • Task 4: Visualize vehicle routes and status on a dashboard. • Task 5: Implement alerts for route deviations or unexpected stops.
12	Automated Street Lighting System with Energy Efficiency • Task 1: Interface light and motion sensors to detect ambient conditions. • Task 2: Program the microcontroller to control lights dynamically. • Task 3: Enable remote monitoring and control via IoT. • Task 4: Log energy usage patterns on a cloud platform. • Task 5: Set alerts for abnormal energy consumption.
13	IoT-based Smart Waste Management System • Task 1: Connect ultrasonic sensors to measure waste bin levels. • Task 2: Program the system to update bin status in real-time. • Task 3: Transmit data to a cloud platform for remote monitoring. • Task 4: Optimize waste collection routes using IoT

	insights. • Task 5: Send alerts for bins reaching capacity.
14	Smart Plant Monitoring System with Humidity and Temperature Sensors • Task 1: Interface temperature and humidity sensors for environmental monitoring. • Task 2: Program the microcontroller to analyze plant care requirements. • Task 3: Transmit data to a cloud platform for remote tracking. • Task 4: Log plant conditions on a dashboard for trend analysis. • Task 5: Automate watering based on real-time data.
15	Home Security System with Motion Detection and Alarm • Task 1: Connect PIR motion sensors for intrusion detection. • Task 2: Program the microcontroller to trigger alarms upon motion. • Task 3: Transmit alerts to the user via IoT. • Task 4: Log security events on a cloud platform. • Task 5: Implement remote arming/disarming of the system.
16	IoT-enabled Industrial Machine Monitoring System • Task 1: Interface sensors to monitor machine parameters like vibration and temperature. • Task 2: Program the system to detect anomalies. • Task 3: Transmit data to a cloud platform for remote monitoring. • Task 4: Log operational data for trend analysis. Task 5: Send alerts for potential machine failures.
17	IoT-based Water Quality Monitoring System • Task 1: Connect sensors to measure parameters like pH, turbidity, and conductivity.

	• Task 2: Program the microcontroller to analyse water quality data. • Task 3: Transmit water quality data to a cloud platform. • Task 4: Visualize water quality trends on a dashboard. Task 5: Set alerts for unsafe water quality levels.
18	IoT-enabled Smart Parking Management System • Task 1: Interface sensors to detect parking slot availability. • Task 2: Program the microcontroller to manage parking data. • Task 3: Transmit parking status updates to a cloud platform. • Task 4: Enable remote booking and monitoring of parking slots. Task 5: Log parking usage for optimization.
19	Smart Building Energy Management System • Task 1: Connect energy meters and sensors to monitor device consumption. • Task 2: Program the system to analyze energy usage patterns. • Task 3: Transmit data to a cloud platform for visualization. • Task 4: Implement strategies for energy-saving measures. • Task 5: Set alerts for excessive energy usage.
20	IoT-based Smart Supply Chain Management System • Task 1: Track shipments using GPS and RFID technology. • Task 2: Program the system to update inventory data in real-time. • Task 3: Transmit supply chain data to a cloud platform. • Task 4: Visualize logistics data for efficient

	management. • Task 5: Send alerts for delays or discrepancies.

Annexure III: Assessment Rubrics

TABLE 4: COURSE ASSESSMENT RUBRICS (TOTAL MARKS: 70)				
ASSESSMENT CRITERIA	FAIR (50%-64%)	GOOD (65%-79%)	EXCELLENT (80%-100%)	WEIGHTAGE (MARKS)
1.Practical Skills Proficiency	Minimal skill application, requires significant improvement.	Competent execution, minor gaps in skill or understanding.	Exceptional execution with high accuracy and efficiency.	20
2.Technical Knowledge Application	Limited application of knowledge, lacks connection to real-world usage.	Applies concepts with minor gaps or errors.	Accurate and relevant application of all concepts, ready for industry use.	15
3.Project Execution	Incomplete or flawed execution; requires guidance for improvement.	Demonstrates thoroughness with minor issues; executes independently with occasional help.	Innovative, thorough execution of projects; exceeds industry standards.	25
4.Communication and Reporting	Communication lacks clarity, with minimal professional standards	Clear communication but could improve in professionalism and depth.	Professional, clear, and well-organized communication with in-depth technical explanation.	10

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