Maratha Vidya Prasarak Samaj's

Karmaveer Adv. Baburao Ganpatrao Thakare College of Engineering

An Autonomous Institute affiliated to Savitribai Phule Pune University, Pune

Udoji Maratha Boarding Campus, Gangapur Road, Nashik - 422 013,

Maharashtra, India

Syllabus of Under-Graduate Program

Third Year B.Tech. Instrumentation and Control Engineering – Honors in Internet of Things (2024 Pattern)

(As per NEP 2020)

Academic Year 2026-27

(Copy for Student Circulation Only)

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Third Year B.Tech. Instrumentation and Control Engineering – Honors in Internet of Things
Curriculum Structure (2024 Pattern) Semester – V

Course Code	Course Type	Course Name	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks					Credits			
			TH	PR	TU	CCE	ESE	TW	PR + OR	TOT	TH	PR	TU	TOT
104507	HON-1	Embedded Systems in IoT	3	2	-	40	60	25	25	150	3	1	-	4
Total			3	2	0	40	60	25	25	150	3	1	0	4

Third Year B.Tech. Instrumentation and Control Engineering – Honors in Internet of Things
Curriculum Structure (2024 Pattern) Semester – VI

Course Code	Course Type	Course Name	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks					Credits			
			TH	PR	TU	CCE	ESE	TW	PR + OR	TOT	TH	PR	TU	TOT
104607	HON-2	IoT Architecture and Protocols	3	2	-	40	60	25	25	150	3	1	-	4
Total			3	2	0	40	60	25	25	150	3	1	0	4

Semester - V

Course Code: 104507	Course Name: Embedded Systems in IoT	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Basic Electronic components, Basics of Digital Electronics, Basics of Microprocessors/Microcontrollers.

Course Objectives:

- To learn and understand the basics of Embedded systems.
- To be acquainted with interfacing of sensors and actuators with microprocessor.
- To design embedded systems applications.
- To understand the Internet of Things and its usefulness for society.

Course Outcomes:

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

CO1: Identify and understand the unique characteristics and components of embedded systems.

CO2: Implement interfacing of various sensors, actuators to the development boards.

CO3: Design, implement and test an embedded system application.

CO4: Configure U-Boot, Understand IoT building blocks.

CO5: Design various IoT applications.

Course Contents:

Unit-I: Overview of Embedded System **08 Hours**

Architecture and characteristics of embedded system. Types of embedded systems, examples of embedded systems.

Embedded System on Chip (SOC). Discuss in detail hardware and software components in detail. Hardware: Power supply: Types, characteristics, selection criteria, processing unit, input devices, output devices.

Unit-II: Sensors, Actuators and Interfacing **08 Hours**

Sensors: Roles of Sensors & Actuators, Types of sensors, Active and passive, analog and digital, Contact and no-contact, Absolute and relative

Working of Sensors: Position, occupancy and motion, velocity and acceleration, force, pressure, flow, Acoustic, Humidity, light, radiation, temperature, chemical, biosensor.

Development boards: Types of boards - Arduino, Raspberry pi, Beagle bone, ESP32, selection criteria. Interfacing of sensors with development boards.

Unit-III: Embedded System - Application Development 08 Hours

Integrated Development Platforms for Application Development in ES environment, SDLC Requirements, Architecture, Design, Components, Coding, Testing and Deployment.
Study of any two Open-source IDE for ES application development with respect to any of the two indicated Case studies.

Case Study: Design and development of ES Applications: Object detection, Traffic signal, digital clock, robotics arm movement, fire alarm, automated disinfection tent, Bus ticketing system, Tyre pressure monitoring system, smart metering, etc.

Unit-IV: Internet of Things 08 Hours

Introduction of IoT: Definition and characteristics of IoT, Technical Building blocks of IoT, Device, Communication Technologies, Data, Physical design of IoT, IoT enabling technologies, IoT Issues and Challenges- Planning, Costs and Quality, Security and Privacy, Risks.

Case Study: Smart Home: Characteristics of Smart Home - Smart Home Energy Management, Smart Appliances, Communication Technologies for Smart Homes, maintenance, security, challenges.

Smart Agriculture: Characteristics and applications -Scarecrow, Smart Irrigation System, Crop Water Management, Integrated Pest Management, Sensor-based field and resource mapping, Remote equipment monitoring.

Unit-V: Advanced IoT Applications 08 Hours

Embedded System Design Methodology: Requirement analysis, Hardware–software co-design, Testing and debugging.

Real-Time Embedded Systems Concepts, Interrupt-driven systems.

Applications of Smart City, Smart Home, Industrial IoT (IIoT), Wearable technology, Edge Computing, Mini project integration.

Learning Resources:

Text Books:

1. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press.

2. Lyla B. Das, Embedded Systems: An Integrated Approach, Pearson.

Reference Books:

1. Sriram V. Iyer, Pankaj Gupta, "Embedded Real-time Systems Programming", Tata McGraw-Hill.
2. David Hanes, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press.
3. Raj Kamal, "Embedded Systems: Architecture, programming and Design", 2nd Edition, McGraw-Hill.
4. Olivier Hersent, Omar Elloumi and David Boswarthick, "The Internet of Things: Applications to the Smart Grid and Building Automation", Wiley, 2012.
5. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.nptel.ac.in/noc20_ee98/preview
2. https://onlinecourses.nptel.ac.in/noc21_ee85/preview

List of Practicals: (Any 8)

1. Introduction to Arduino IDE and flashing LED using embedded C/Arduino code.
2. Interfacing Sensors (DHT11 Humidity/Temperature, LDR) with ESP32.
3. Interfacing Actuators (Servo motor, Relay module) with ESP32.
4. Implementation of Serial Communication (UART) to send data to PC.
5. Interfacing LCD Display and Real Time Clock (RTC) with Arduino.
6. Use a PIR sensor to detect motion and trigger a buzzer with ESP32.
7. Measure and display soil moisture percentage using a sensor. With ESP32.
8. Demonstrate an IoT-based traffic light controller with ESP32
9. Use RFID to track car parking slots and update occupancy via IoT with ESP32
10. Introduction to Raspberry Pi and flashing LEDs using Raspberry Pi.
11. Implement DC Motor or Stepper Motor control through a Raspberry Pi interface.
12. Use ESP32 to control household appliances (relays) via a smartphone interface.

Semester - VI

Course Code: 104607	Course Name: IoT Architecture and Protocols	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Basic knowledge of Computer Networks, Fundamentals of Sensors & Instrumentation, Basic programming knowledge (C/Python), Understanding of Embedded Systems.

Course Objectives:

- To understand the fundamentals of IoT architecture and its layers.
- To study various IoT communication protocols and standards.
- To analyze data handling, cloud integration, and security in IoT.
- To design IoT-based solutions using modern tools and platforms.
- To explore real-world IoT applications and case studies.

Course Outcomes:

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

CO1: Understand IoT architecture and enabling technologies.

CO2: Analyze networking and communication techniques in IoT.

CO3: Compare and implement IoT protocols.

CO4: Apply data management and security concepts in IoT systems.

CO5: Design and develop IoT-based applications for real-world problems.

Course Contents:

Unit-I: Introduction to IoT and Architecture **08 Hours**

Definition and characteristics of IoT, IoT ecosystem and enabling technologies, IoT reference models (3-layer, 5-layer architecture), physical and logical design of IoT, IoT vs M2M communication, Sensors, actuators, and embedded platforms.

Unit-II: IoT Networking and Communication **08 Hours**

Basics of networking for IoT, IPv6 and 6LoWPAN, Wireless technologies: Wi-Fi, Bluetooth, Zigbee, LoRaWAN, Network topologies in IoT, Edge, Fog, and Cloud computing concepts.

Unit-III: IoT Protocols **08 Hours**

Application layer protocols: MQTT (Message Queuing Telemetry Transport), CoAP (Constrained Application Protocol), HTTP/HTTPS. Transport protocols: TCP vs UDP. Data formats: JSON, XML. Protocol comparison and selection criteria.

Unit-IV: IoT Data Management and Security **08 Hours**

Data acquisition and processing, Cloud platforms (AWS IoT, Azure IoT basics) , Data analytics in IoT, Security challenges in IoT, Encryption, authentication, and privacy issues.

Unit-V: IoT Applications and Case Studies **08 Hours**

Applications: Smart homes and smart cities, Industrial IoT (IIoT), Healthcare IoT systems, Agriculture and environmental monitoring, IoT project design methodology, Case studies, and mini project discussion.

Learning Resources:

Text Books:

1. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on Approach)”, University Press 1st Edition, 2014
2. Jeeva Jose, “Internet of Things”, ISBN-10: 938617359X, Khanna Book Publishing, 2018
3. Raj Kamal, Internet of Things: Architecture and Design Principles”, ISBN-13: 978-93-5260-522- McGraw-Hill Education (India), 2017.

Reference Books:

1. The Internet of Things: From RFID to the Next-Generation Pervasive Networked Lu Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning
2. Designing the Internet of Things, Adrian McEwen (Author), Hakim Cassimally.
3. Hakima Chouchi, “The Internet of Things Connecting Objects to the Web”, ISBN 078 -1-84821-140-7, Wiley Publications. Asoke K Talukder and Roopa R Yavagal, “Mobile Computing,” Tata McGraw-Hill, 2010.
4. Computer Networks; By: Tanenbaum, Andrew S; Pearson Education Pte. Ltd., Delhi, 4th Edition
5. Data and Computer Communications; By: Stallings, William; Pearson Education Pte. Ltd., Delhi, 6th Edition.

Web link for MOOC / NPTEL Links:

1. Design for Internet of Things
   https://nptel.ac.in/courses/108108098
2. INTERNET Components and Applications of Internet of Things
   https://onlinecourses.swayam2.ac.in/e-learning/preview/arp19_ap52
3. Introduction to Internet of Things
   https://onlinecourses.nptel.ac.in/noc21_cs17/preview

List of Practicals:

1. Introduction to IoT Hardware: Study of Arduino / Raspberry Pi, Interfacing basic components (LED, sensors).
2. Sensor Interfacing: Temperature & Humidity sensor (DHT11/DHT22), Data acquisition and display.
3. Actuator Control: Control of relay, motor, or buzzer using a microcontroller
4. IoT Communication using Wi-Fi: Interfacing ESP8266/Node MCU, Sending sensor data to the cloud.
5. MQTT Protocol Implementation: Publish/Subscribe model using MQTT broker (e.g., Mosquito), sending and receiving sensor data.
6. HTTP Protocol in IoT: Sending data to a web server using HTTP GET/POST, Display data on a web dashboard.
7. CoAP Protocol Demonstration: Basic CoAP client-server communication, Comparison with HTTP/MQTT.
8. Cloud Integration: Data logging using ThingSpeak / Blynk, Visualization of sensor data.
9. IoT Data Analytics: Basic data analysis and visualization using a cloud platform.
10. IoT Security Basics: Secure communication using HTTPS / SSL, Authentication techniques.
11. Edge/Fog Computing Concept: Local data processing using Raspberry Pi.
12. Mini Project: Design and implementation of IoT applications such as Smart Home Automation, Smart Irrigation System and Industrial Monitoring System.