| **Devi Ahilya University, Indore, India Institute of Engineering & Technology** | | | | **III Year B.E. (Electronics and Telecommunication Engg.)** | | | |
|---|---|---|---|---|---|---|---|
| **Subject Code & Name** | **Instructions Hours per Week** | | | **Credits** | | | |
| **6ETRC2 INTERNET OF THINGS** | **L** | **T** | **P** | **L** | **T** | **P** | **Total** |
| | **3** | **1** | **2** | **3** | **1** | **1** | **5** |
| **Duration of Theory Paper: 3 Hours** | | | | | | | |

## Course Learning Objective:

The course is designed

- To familiarize students with different enabling technologies used in IoT.
- To understand different constituents of IoT physically and conceptually.
- To learn programming skills of different microcontroller boards such Arduino Uno, Node MCU, Rasberry Pi etc.
- To hands-on experience/ practice on cloud platforms such as Thingspeak, Adafruit etc.
- To apply IoT principles in different application areas.

## Prerequisites:

Knowledge of layered approach of OSI model, working experience on microcontrollers, basic concepts of communication networks, C/C++/Python language.

## COURSE CONTENTS

**Unit –I**

**Fundamental of IoT-** Fundamentals of IoT-IoT definition, IoT growth, Characteristics of IoT, Things in IoT, Enabling technologies of IoT, IoT challenges and solutions, IoT network architectures, IoT levels, Concept of Fog, Egde and Cloud in IoT, Functional blocks of IoT ecosystem.

**Unit-II**

**Introduction to Sensors, Actuators, Microcontrollers and their interfacing:** Sensors and actuators: types, Characteristics, working

**IoT supported hardware platforms:** Introduction to Arduino and Node MCU, Arduino board details, Node MCU details, Architecture, programming concepts of Arduino board and Node MCU, Introduction to RasberryPi, Architecture, hardware and programming concepts.

**Interfacing of sensors and actuators with Arduino//Node MCU/RasberryPi:** Hardware connections and programming.

**Unit-III**

**Communication Technologies and IoT Protocols:**

Long range and short range communication technologies used in IoT- Cellular Network, LoRaWAN, SigFox, Wi-Fi, LiFi, WSN, Zigbee, LoRa, Bluetooth, BLE,Near-Field Communication, RFID, Z-Wave etc.

**Messaging and addressing protocols:** MQ Telemetry transport (MQTT), Constrained application protocol (CoAP), IPv4, IPv6, Uniform resource Identifier (URI) etc

**Unit-IV**

**Cloud for IoT:** Introduction, IoT with Cloud-Challenges, Selection of cloud service provider, Introduction to fog computing, Cloud computing security aspects

**Introduction to thingspeak cloud/Adafruit cloud:** How to use, Collection and share of data in public/private channels, data analysis and visualization

**An introduction to data handling and analytics for IoT:** Data Analytics, Structured versus unstructured data, Data analytics challenges Machine learning, Big data platform, big data pipeline

**Unit-V**

**Application Buildings with IoT:**

Smart home, Smart cities, Smart healthcare, IoT based application to monitor air quality/ water quality, Activity monitoring, Industrial IoT etc., IoT case studies and future trends.

## Course Outcome:

Students earned credits will develop ability to

| CO .No. | CO | PO |
|---|---|---|
| CO1 | Compare different IoT layered architectures & comparison of IoT architectures with other networks architectures. | PO-2 |
| CO2 | Outline/ Identify the communication technologies suitable for IoT with proper reasoning, out of all available technologies. | PO-1, PO-2 |
| CO3 | Customize/apply the usage of existing hardware such as sensors, microcontroller boards specific to IoT applications. | PO-2, PO-3, PO-1 |
| CO4 | Learn and apply the available cloud platforms for IoT usage. | PO-1, PO-5, PO-7 |
| CO5 | Apply knowledge to design projects which male lives of common people easier and comfortable. | PO-5, PO-6, PO-9, PO-12 |

## CO-PO Relationship

| CO | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | 3 | | | | | | | | | | |
| CO2 | 3 | 3 | | | | | | | | | | |
| CO3 | 3 | 2 | 3 | | | | | | | | | |
| CO4 | 2 | | | | 3 | | 2 | | | | | |
| CO5 | | | | | 2 | 2 | | | 2 | | | 2 |

## BOOKS RECOMMENDED:

[1]. Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sunaram, “Internet of Things”, Willey, 2019.
[2]. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, Pearson Education, 2017.
[3]. Srinivasa K G, “Internet of Things”, CENGAGE Leaning India, 2017.
[4]. Nptel Swayam Course on Introduction To Internet Of Things By Prof. Sudip Misra, IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc23_cs83/preview .
[5]. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1 st Edition, VPT, 2014.
[6]. Raj Kamal, “Internet of Things: Architecture and Design Principles”, McGraw Hill Education, 2022.

## List of Practical Assignments:

Each assignment consists of multiple tasks. In Assignment 1 –Assignment 3, all tasks are compulsory. In Assignment 4, implement any one project listed/ given by teacher/course instructor.

**Assignment1:**

**Basic Programming using (i)Arduino IDE and Arduino boards/Node MCU and (ii) Rasberry Pi:** Blinking LEDs, Servo Motor, Ultra sonic Sensors, IR Sensors, Temperature Sensors etc.

**Assignment2:**

**Programming using MATLAB and Arduino boards/Node MCU/Rasberry Pi:** Blinking LEDs, Servo Motor, Ultra sonic Sensors, IR Sensors, Temperature Sensors etc.

**Assignment3:**

**Hands-on experience/ practice on cloud platforms**: Thingspeak, Adafruit etc.

**Assignment4:**

**IoT based project development using Arduino/Node MCU/Rasberry Pi:** Home automation, Health care, Irrigation system, Air/Water quality monitoring system, heartbeat monitoring system, human activity system, LoRa based GPS Tracker, Colour sorting machine, Motion detector, Accident alert system, Water flow meter, smart energy meter, Flood monitoring system etc.