# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Engineering**
**Subject Code: 3171108**
**Semester – VII**
**Subject Name: Internet of Things**

**Type of course:** Professional Elective Course (PEC-VI)

**Prerequisite:** Computer networking, Embedded systems

**Rationale:** IoT market is growing rapidly from installed base of about 30 billion devices in the year 2020 and expected to grow up to 75 billion devices by 2025. IoT is useful in many sectors like consumer, commercial, infrastructure, health, industry and military. Industry 4.0 is based on IoT. This course will provide opportunity to the students for contribution in IoT applications.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| L | T | P | C | Theory Marks | | Practical Marks | | |
| | | | | ESE (E) | PA (M) | ESE (V) | PA (I) | |
| 2 | 0 | 2 | 3 | 70 | 30 | 30 | 20 | 150 |

**Content:**

| Sr. No. | Content | Total Hrs |
|---|---|---|
| 1 | **Introduction to Internet of Things:** IoT Definition, IoT characteristics, M2M and IoT, End to End IoT Architecture, Physical design of IoT, Logical Design of IoT, Overview of IoT protocols, IoT levels and deployment templates, Challenges for IoT, Interdependencies of IoT and cloud computing, Web of things | 6 |
| 2 | **Embedded IoT devices:** Sensors and actuators for IoT applications, IoT components and implementation, Programming of NodeMCU and Raspberry PI, Implementation of IoT with Edge devices, Reading sensor data and transmit to cloud, Controlling devices through cloud using mobile application and web application, Types and configurations of gatways, Specifications of IoT gateways (Practical aspects of this chapter should be covered during lab sessions) | 8 |
| 3 | **IoT Protocols:** Link layer protocols, Network/internet layer protocols, Transport layer protocols, Application layer protocols: Hypertext transfer protocol (HTTP), Systematic HTTP access methodology, Web Socket, Constrained application protocol CoAP), Message Queue Telemetry Transport Protocol (MQTT), XMPP, DDS, AMQP | 8 |
| 4 | **IoT Security and challenges :** IOT Security, Dangers, Assigning values to Information, Security Components, Key Management, Update Management, Challenges in IoT security. | 4 |
| 5 | **IoT Applications and case study** Broad categories of IoT applications: Consumer IoT, Commercial IoT, Industrial IoT, Infrastructure IoT, Military Things (IoMT) | 4 |

| | |
|---|---|
| IoT Case studies:<br>Home automation with IoT, River water pollution monitoring, Smart city street light control and monitoring, Health care monitoring, Voice Apps on IoT device | |

**Suggested Specification table with Marks (Theory):**

| Distribution of Theory Marks | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **10** | **30** | **20** | **5** | **5** | **10** |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Reference Books:**

[1] Rahul Dubey, "An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications", Cengage India Publication
[2] Raj Kamal, "Internet of Things: Architecture and Design Principles, Mc Graw Hill Education

[3] Hanes et al "IoT Fundamentals", Cisco Press

[4] Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", , Paperback, 2015.

[5] A. McEwen, H. Cassimally, "Designing the Internet of Things", Wiley, 2013.

[6] Yashwant Kanetkar, "21 Internet of Things Experiments", Kindle edition

[7] Adeel Javed, "Building Arduino projects for Internet of Things", Apress publication

[8] Donald Noris, "The Internet of Things: Do it yourself Projects with Arduino, Raspberry PI and BeagleBone Black" Mc Graw Hill Publication

[9] Adrian McEwen & Hakim Cassimally, "Designing the Internet of things", Willey publication

**Course Outcomes:**

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | Understand IoT architecture | 20% |

| CO-2 | Program Embedded IoT devices | 30% |
|------|------------------------------|-----|
| CO-3 | Use IoT protocol to upload sensor data and to control devices | 30% |
| CO-4 | Design IoT application | 20% |

**Suggested List of Laboratory Experiments:**

1. Getting started with NodeMCU, Arduino with ESP8266 and ESP32 in the Arduino IDE.
2. GPIO Interfacing and programming
3. Digital on/off sensor (PIR and IR) Interfacing programming
4. Analog sensor programming and uploading sensor data on cloud
5. Controlling devices remotely using Bluetooth link, WiFi link
6. Interfacing and programming of actuators, Controlling devices remotely using cloud
7. Web based device control
8. Development of Android applications suitable for IoT
9. Experiments on Agriculture IoT (Soil moisture, PH monitor)
10. IoT based home automation
11. Smart energy experiments
12. Smart city IoT applications
13. IoT based mini project
14. Developing Voice App for IoT device

**List of Open Source Software/learning website:**

1. NPTEL online course on IoT: https://onlinecourses.nptel.ac.in/noc18_cs08
2. IoT Tutorial point www.tutorialspoint.com
3. https://www.microsoft.com/en-us/internet-of-things/
4. https://www.scnsoft.com/blog/iot-architecture-in-a-nutshell-and-how-it-works
5. https://wso2.com/whitepapers/a-reference-architecture-for-the-internet-of-things/