Government Degree College, (Autonomous), Baramulla

Semester 8TH | Major Course

INFORMATION TECHNOLOGY

Title: Internet of Things | Course code: BITC2822M

Credits (4+2): Theory 04, Lab -02) | Contact hours: 60 (T) + 30 (T)

VIII SEMESTER

(For Honours courses)

Course Objectives:

This course aims to introduce the fundamental concepts, technologies, and applications of the Internet of Things (IoT). It focuses on enabling students to understand IoT architectures, communication models, and device-level implementation using sensors and embedded platforms. The course also provides insights into machine-to-machine (M2M) communication, data processing, cloud integration, and the development of web-based IoT services, along with addressing security and privacy challenges in IoT systems.

Learning Outcomes

By the end of this course, students will be able to:

- *Understand IoT architecture, value chain, and key enabling technologies*
- *Analyze IoT communication models, protocols, and networking concepts*
- *Work with IoT hardware components such as sensors, actuators, and microcontrollers*
- *Design and implement basic IoT applications using platforms like Arduino and Raspberry Pi*
- *Process, store, and analyze IoT data using cloud and big data technologies*
- *Evaluate IoT security challenges and apply appropriate security mechanisms*
- *Explore real-world IoT applications across domains such as smart homes, healthcare, and agriculture*
- *Gain practical exposure to IoT systems through projects and industrial interactions*

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Unit I*:*

Definition and Characteristics of IoT, Evolution of IoT, IoT Architecture (3-Layer and 5-Layer Models), IoT Reference Models (ITU-T), IoT Components (Devices, Gateways, Cloud), Communication Protocols (TCP/IP, UDP, HTTP), IoT-Specific Protocols (MQTT, CoAP, AMQP), IoT Applications (Smart Homes, Agriculture, Healthcare, Industry, Smart Cities), Use Cases and Challenges, Basic IoT System Design Concepts.

Unit II:

IOT Hardware: Microcontrollers (Arduino, Raspberry Pi), IOT hardware modules (ESP8266 Wifi Module, Bluetooth module), Sensors (types, characteristics, interfaces, and data formats), Implementation of Basic Sensors (Temperature, Humidity, Proximity, Gas, air Quality, Ultrasonic Sensors), Actuators. IOT communication models (M2M, API, NFC), RESTful Architecture (REST APIs, Methods: GET, POST, PUT, DELETE, Client-Server Model), MQTT vs REST. Wireless Communication basics: RF fundamentals (RF Spectrum), Channel access methods (CSMA/CD, CSMA/CA), IoT Networks: Wireless sensor networks (WSN), Bluetooth, Zigbee, LoRA, Network Protocols: Addressing, routing, security mechanisms in IoT networks.

Unit III:

Data Generation: Data models, data formats (JSON, XML), data collection methods, Data Processing: Data preprocessing, cleaning, integration, and transformation, Data Storage: IoT on Cloud (AWS, Azure, GCP). Overview of data warehousing, data lakes and Data Analytics: IoT data analytics techniques (descriptive, predictive, and prescriptive), big data technologies (Hadoop, Spark), Edge computing paradigm.

Unit IV:

IoT Security Challenges: Threats and vulnerabilities in IoT systems, Security Mechanisms: Authentication, Authorization, Encryption, Access Control. Device-Level and Network-Level Security, Privacy Issues (Data Privacy, User Privacy, Ethics), IoT Cloud Integration (ThingSpeak), Data Visualization and Remote Monitoring.

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LIST OF PRACTICALS:

1. Install the Arduino IDE and write a basic program to blink an LED in order to understand digital output operations.
2. Interface a push button with Arduino to control an LED, demonstrating how digital input signals are read and processed.
3. Connect a temperature and humidity sensor (DHT11/DHT22) and display real-time readings on the serial monitor.
4. Use an ultrasonic sensor to measure distance and continuously display the measured values.
5. Interface a gas or air quality sensor to detect environmental changes and monitor variations in readings.
6. Control a servo motor using Arduino to understand actuator behavior and position control.
7. Integrate the ESP8266 WiFi module with Arduino to establish internet connectivity and transmit data.
8. Send sensor data to a cloud platform such as ThingSpeak and visualize it using graphical dashboards.
9. Implement MQTT protocol to publish and subscribe sensor data between devices efficiently.
10. Develop a simple IoT-based system, such as smart irrigation, to monitor environmental parameters and automate control actions.

TEXT BOOKS:

1. Internet of Things: A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547

2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759 3. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895