GUJARAT TECHNOLOGICAL UNIVERSITY
Syllabus for Integrated MSc, 9th Semester
Branch: Computer Science
Subject Name: Industrial IOT
Subject Code: 1390305

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE(E)	PA (M)	PA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

CONTENT:

Sr. No.	Content	Teaching Hours	Module Weightage (%)
1	**INTRODUCTION:** Overview of IoT and Industrial IoT; Evolution from traditional industrial systems to IIoT; IIoT architecture and key components; Applications of IIoT in various industries (manufacturing, healthcare, energy, etc.).	05	10
2	**SENSORS, ACTUATORS, AND EDGE DEVICES:** Role of sensors and actuators in IIoT systems; Types of sensors and actuators used in industrial applications; Microcontrollers and edge devices for IIoT (e.g., Arduino, Raspberry Pi, ESP32); Interfacing sensors and actuators with edge devices.	08	15
3	**COMMUNICATION PROTOCOLS IN IIOT:** Overview of communication protocols (wired and wireless); Ethernet, Modbus, and CAN for industrial communication; Wireless protocols: Wi-Fi, ZigBee, LoRa, Bluetooth, and NB-IoT; MQTT, CoAP, and OPC-UA for data transfer.	07	15
4	**CLOUD AND EDGE COMPUTING IN IIOT:** Cloud computing vs. edge computing; IIoT platforms and cloud services (AWS IoT, Azure IoT, Google Cloud IoT); Data collection, storage, and analysis on the cloud; Role of edge computing in real-time processing.	08	20
5	**DATA ANALYTICS AND MACHINE LEARNING:** Importance of data analytics in IIoT; Data preprocessing and visualization techniques; Introduction to machine learning models for predictive maintenance; Tools for data analytics (Python, MATLAB, etc.).	07	15

6	**SECURITY, PRIVACY, AND STANDARDS IN IIOT:** Security challenges in IIoT systems; Encryption, authentication, and access control mechanisms; Privacy issues and regulatory standards (ISO, NIST, GDPR); Best practices for securing IIoT systems.	06	15
7	**IIOT CASE STUDIES AND APPLICATIONS:** Case studies in smart manufacturing, energy management, healthcare, and agriculture; Future trends and opportunities in Industrial IoT.	04	10

Reference Books:

1. Industrial Internet of Things: Principles and Practice by Alasdair Gilchrist
2. Building the Internet of Things with MQTT by Arlen Nipper and Gaston C. Hillar
3. Internet of Things: A Hands-On Approach by Arshdeep Bahga and Vijay Madisetti
4. Designing the Internet of Things by Adrian McEwen and Hakim Cassimally
5. IoT and Edge Computing for Architects by Perry Lea

Course Outcome:

1. Develop a deep understanding of the components and architecture of Industrial IoT systems.
2. Select appropriate sensors, actuators, and communication protocols for IIoT applications.
3. Integrate IIoT devices with cloud and edge platforms.
4. Apply data analytics and machine learning techniques for industrial use cases.
5. Implement secure and scalable IIoT solutions in real-world scenarios.

List of Experiments:

1) **Introduction to IoT Development Boards:** Setup and configure Arduino/Raspberry Pi for IIoT applications.
2) **Sensor Interfacing:** Interface temperature, humidity, and pressure sensors with edge devices.
3) **Actuator Control:** Control motors, relays, and other actuators via IoT platforms.
4) **Data Communication using MQTT:** Establish communication between devices using MQTT protocol.
5) **Data Logging and Visualization:** Log sensor data to the cloud and visualize it using dashboards.
6) **Edge Computing Setup:** Configure an edge device to process sensor data locally.
7) **Predictive Maintenance:** Implement a simple machine learning model for predictive maintenance.
8) **Security Implementation:** Apply basic security measures like encryption and authentication for IIoT devices.
9) **Energy Monitoring System:** Develop a system to monitor energy consumption in a smart home/industry.
10) **Smart Factory Prototype:** Build a small prototype demonstrating a smart factory with sensors, actuators, and cloud connectivity.

List of open Source software/learning Websites:

1. **Open-Source Software Tools**

Software	Description	Link
Node-RED	A flow-based development tool for visual programming of IoT and IIoT applications.	https://nodered.org/
Eclipse Mosquitto	A lightweight open-source MQTT broker for IoT communication.	https://mosquitto.org/
InfluxDB	An open-source time-series database designed for storing and retrieving sensor data in real-time.	https://www.influxdata.com/
Grafana	An open-source data visualization and monitoring tool that integrates well with InfluxDB and Prometheus.	https://grafana.com/
Prometheus	Open-source monitoring and alerting toolkit, often used in IIoT systems for real-time data monitoring.	https://prometheus.io/
OpenPLC	An open-source PLC (Programmable Logic Controller) for industrial automation and control systems.	https://www.openplcproject.com/
Arduino IDE	Open-source Integrated Development Environment for programming Arduino boards used in IIoT projects.	https://www.arduino.cc/en/software
ThingsBoard	An open-source IoT platform for device management, data collection, processing, and visualization.	https://thingsboard.io/
OpenHAB	Open-source platform for integrating IoT devices and building automation systems.	https://www.openhab.org/

2. **Learning Websites and Online Resources**

Website	Description	Link
Coursera	Offers online courses and specializations in IoT and Industrial IoT from top universities.	https://www.coursera.org/
edX	Provides free and paid courses on IoT, data analytics, and edge computing.	https://www.edx.org/

Kaggle	A platform for data science and machine learning, useful for IIoT data analytics projects.	https://www.kaggle.com/
GitHub	A platform for accessing open-source IIoT project repositories and collaborating with developers.	https://github.com/
IoT For All	A website offering tutorials, articles, and news related to IoT and IIoT technologies.	https://www.iotforall.com/
Hackster.io	Community-driven platform for IoT project tutorials and open-source hardware development.	https://www.hackster.io/
Adafruit Learning System	Provides tutorials and resources for using sensors, microcontrollers, and IoT devices.	https://www.adafruit.com/
ThingSpeak	An IoT analytics platform for cloud-based data collection and visualization.	https://thingspeak.com/
Udemy	Offers a wide range of paid and free courses in IoT, IIoT, and embedded systems development.	https://www.udemy.com/

3. Additional Resources

a. YouTube Channels:

- *Great Learning* – Tutorials on IoT, IIoT, and Cloud Computing.
- *The Engineering Mindset* – Videos on industrial automation and IoT systems.
- *DroneBot Workshop* – Hands-on tutorials for IoT hardware and software.

b. Online Communities and Forums:

- Stack Overflow – Ask questions and collaborate with developers working on IoT and IIoT.
- Reddit IoT – Discussions and news related to IoT and Industrial IoT technologies.