Subject Code	Subject Name	Period per Week		Credit
28563	**Sensor & IoT System**	**T**	**P**	**C**
		2	**3**	**3**

Rationale	Sensor & IoT System is the most significant area of diploma in Computer Science & Technology. To work with Sensor & IoT System should have the knowledge, skills and attitude of Sensor and IoT, IoT Architecture, Raspberry pi and Arduino, IoT Architecture, IoT devices, Connectivity in IoT, Security in IoT , Data analytics in IoT, IIoT in agriculture, IoT standards and interoperability, Regulatory and ethical considerations, Future trends in IoT and IIoT.
Learning Outcome (Theoretical)	After Completing the subject, students will be able to: 1. Interpret Sensor and IoT 2. Illustrate IoT Architecture **3.** Interpret Raspberry pi and Arduino. 4. Explain IoT Architecture 5. Explain IoT devices and sensors 6. Describe connectivity in IoT 7. Illustrate security in IoT 8. Describe data analytics in IoT 9. Explain IIoT in agriculture 10. Explain IoT standards and interoperability 11. Explain regulatory and ethical considerations 12. Describe future trends in IoT and IIoT
Learning Outcome (Practical)	After undergoing the subject, students will be able to: 1. Assemble a basic IoT sensor node using Arduino. 2. Assemble a basic IoT sensor node using raspberry pi. 3. Establish a simple wireless IoT network using Wi-Fi or Bluetooth. 4. Use Python or other tools to analyze sensor data. 5. Integrate IoT devices with cloud platforms. 6. Design a basic IIoT solution using a Raspberry Pi as the edge device and the Google Cloud IoT platform for cloud integration. 7. Develop a system to control and monitor home appliances remotely using IoT technology. 8. Construct a weather station to collect and shares real-time weather data using IoT sensors, providing local weather information. 9. Implement an IoT-based solution to monitor soil moisture, temperature, and other environmental factors for optimizing agricultural practices. 10. Design a smart parking solution to uses IoT sensors to detect and relay information about available parking spaces in real-time. 11. Implement a system to optimize traffic flow by monitoring and controlling traffic signals based on real-time data. 12. Create a quality control system in manufacturing that utilizes IIoT sensors to ensure product consistency and reliability.

Detailed Syllabus (Theory)

Unit	Topics with contents	Class (1 Period)	Final Marks
1	**INTRODUCTION to IoT & IoT ARCHITECTURE** 1.1 Define IoT. 1.2 State the Application of IoT. 1.3 State the Layers of the IoT architecture. 1.4 Explain components and technologies involved in Sensor and IoT. 1.5 Describe Edge computing and cloud computing in IoT 1.6 List different Communication protocols in IoT. 17 Explain MQTT and CoAP.	3	6
2	. **IoT DEVICES AND SENSORS** 2.1 Interpret different type of IoT devices & sensors. 2.2 State the Sensor technologies for data collection methods. 2.3 Describe the role of actuators in IoT systems. 2.4 List Innovative IoT devices. 2.5 Mention the applications of various types of sensor.	3	6
3	**RASPBERRY PI AND ARDUINO** 3.1 Interpret Arduino and Rasbrry pi . 3.2 State the Architecture of Arduino and Rasbrry pi . 3.3 Describe general purpose input/output(GPIO) pins of Raspberry pi and Arduino 3.4 Explain Digital and Analog I/O interfacing with Arduino . 3.5 State Digital and Analog I/O interfacing with Rasbrry pi 3.6 Describe Sensor interfacing with raspberry pi and arduino 3.7 State Serial communication raspberry pi and arduino 3.8 Explain Arduino programming language 3.9 Interpret Rasbrry pi programming language	4	6
4	**IIoT IN MANUFACTURING** 4.1 Define IIoT. 4.2 State the application of IIoT. 4.3 Explain Smart factories and Industry 4.0. 4.4 Describe the role of IoT to optimize the production process. 4.5 Distinguish between consumer IoT and industrial IoT. 4.6 State the Challenges and opportunity of IIoT. 4.7 Describe Regulatory landscape for IoT and IIoT.	3	6
5	**IoT IN AGRICULTURE** 5.1 Interpret Precision farming and smart agriculture. 5.2 Describe applications of IoT for crop management. 5.3 Explain Automation in agricultural processes. 5.4 Explain Challenges and opportunities to implement IoT in agriculture industry. 5.5 Mention the best practices of IoT in in agriculture industry	3	6
6	**CONNECTIVITY IN IoT** 6.1 List different Communication technologies In IoT. 6.2 Explain 5G and LPWAN. 6.3 Interpret Wireless and wired connectivity options. 6.4 State IoT protocols for efficient data transfer. 6.5 Describe Scalability and reliability considerations for connectivity in IoT.	3	6
7	**SECURITY IN IoT**	4	6

	7.1 Describe the Threats and vulnerabilities in IoT systems. 7.2 State Encryption and authentication in IoT. 7.3 Discuss Best practices and Security considerations in IoT architecture. 7.4 Explain Privacy concerns in the age of connected devices. 7.5 Explain Privacy and data protection regulations for IoT and IIoT. 7.6 Describe the necessity of ethics to implement the IoT in Industry. 7.7 State the Ethical considerations in the development and deployment of IoT technologies		
8	**DATA ANALYTICS IN IoT** 8.1 Define Data Analytics. 8.2 State the Importance of data analytics in IoT. 8.3 Explain Big data and machine learning for IoT applications. 8.4 State the role of IoT for Predictive maintenance and anomaly detection. 8.5 Mention the process to Predictive maintenance and anomaly detection using IoT.	3	6
9	**IoT STANDARDS AND INTEROPERABILITY** 9.1 State IoT standards and protocols. 9.2 Describe Importance of interoperability in IoT ecosystems. 9.3 State Initiatives and organizations promoting IoT Standardization. 9.4 List successful interoperable IoT solutions.	3	5
10	**FUTURE TRENDS IN IOT AND IIoT** 10.1 Describe the evolution of IoT and IIoT. 10.2 State the Emerging technologies shaping the future of IoT. 10.3 Define AI, Block chain, IoE, Big data analytics, Cloud computing, augmented reality, Virtual reality, simulation and additive manufacturing. 10.4 State the Impact of AI and block chain in IoT applications. 10.5 Describe the Challenges and opportunities to implement the AI. 10.6 State the Predictions for the evolution of IoT and IIoT in the future. 10.7 List the promising IoT practices industry in Bangladesh.	3	6
	TOTAL	**32**	**60**

DETAILED SYLLABUS (PRACTICAL)

SL.	EXPERIMENT NAME	Class (3 Period)	Marks (Continuous)
1	**ASSEMBLE A BASIC IoT SENSOR NODE USING ARDUINO** 1.1 Connect DHT11 Sensor to Arduino. 1.2 Connect ESP8266 Wi-Fi Module. 1.3 Install Libraries. 1.4 Write Arduino Code to blink a LED. 1.5 Upload Code to Arduino. 1.6 Monitor Serial Output.	1	2
2	**ASSEMBLE A BASIC IoT SENSOR NODE USING RASPBERRY PI.** 2.1 Connect DHT11 Sensor to Raspberry Pi. 2.2 Configure Raspberry Pi. 2.3 Install Necessary Libraries. 2.4 Write Python Script. 2.5 Run the Script.	1	2

3	**ESTABLISH A SIMPLE WIRELESS IoT NETWORK USING WI-FI OR BLUETOOTH.** 3.1 Set Up Raspberry Pi as IoT Sensor Node. 3.2 Set Up Computer as IoT Gateway. 3.3 Run the IoT System.	1	2
4	**APPLY PYTHON OR OTHER TOOLS TO ANALYZE SENSOR DATA.** 4.1 Modify iot_gateway.py to Store Data. 4.2 Write Python Script to store data. 4.3 Run the Scripts.	1	2
5	**INTEGRATE IOT DEVICES WITH CLOUD PLATFORMS LIKE AWS, AZURE, OR GOOGLE CLOUD.** 5.1 Set Up Google Cloud IoT Core Project. 5.2 Set Up Cloud IoT Core. 5.3 Install Necessary Libraries on Raspberry Pi. 5.4 Write Python Script and save as iot_google_cloud.py. 5.5 Run the Python Script on Raspberry Pi.	2	2
6	**DEVELOP A SYSTEM THAT ALLOWS USERS TO CONTROL AND MONITOR HOME APPLIANCES REMOTELY USING IOT TECHNOLOGY.** 6.1 Set Up Google Cloud IoT Core Project. 6.2 Set Up Cloud IoT Core. 6.3 Install Necessary Libraries on Raspberry Pi. 6.4 Write Python Script to control a light. 6.5 Run the System.	1	2
7	**IMPLEMENT AN IoT-BASED SOLUTION TO MONITOR SOIL MOISTURE, TEMPERATURE, AND OTHER ENVIRONMENTAL FACTORS FOR OPTIMIZING AGRICULTURAL PRACTICES.** 7.1 Set Up Raspberry Pi. 7.2 Create a Firestore Database. 7.3 Set Up Cloud IoT Core. 7.4 Write Python Script and save as agricultural_monitor.py 7.5 Run the System. 7.6 Verify Data in Firestore.	1	2
8	**DESIGN A SMART PARKING SOLUTION THAT USES IoT SENSORS TO DETECT AND RELAY INFORMATION ABOUT AVAILABLE PARKING SPACES IN REAL-TIME.** 8.1 Set Up Raspberry Pi. 8.2 Create a Firestore Database. 8.3 Set Up Cloud IoT Core. 8.4 Write Python Script and save as smart_parking.py 8.5 Run the System. 8.6 Verify Data in Firestore.	1	2
9	**IMPLEMENT A SYSTEM THAT OPTIMIZES TRAFFIC FLOW BY MONITORING AND CONTROLLING TRAFFIC SIGNALS BASED ON REAL-TIME DATA.** 9.1 Set Up Raspberry Pi. 9.2 Create a Firestore Database. 9.3 Set Up Cloud IoT Core. 9.4 Set Up Pub/Sub Topic. 9.5 Write Python Script and save as traffic_control.py. 9.6 Create a Cloud Function to Control Traffic Lights. 9.7 Run the System. 9.8 Verify Data in Firestore.	2	2

	Total	16	25

NECESSARY RESOURCES (TOOLS, EQUIPMENT AND MACHINERY):

SL	Item Name	Quantity
1	**Arduino Boards:** • Arduino Uno or Arduino Nano, • Arduino MKR or ESP8266/ESP32 for IoT-specific projects	
2	**Raspberry Pi(**Raspberry Pi 3 or Raspberry Pi 4**)**	
3	**Sensors** • Temperature and humidity sensors (DHT11/DHT22). • Light sensors (LDRs or digital light sensors). • Motion sensors (PIR sensors). • Ultrasonic distance sensors. • Gas sensors. • Accelerometers and gyroscopes.	
4	Actuators: ▪ LEDs (various colors). ▪ Servo motors. ▪ Stepper motors. ▪ DC motors	
5	Communication Modules: •WiFi modules (ESP8266 or ESP32). •Bluetooth modules. •RFID/NFC modules. •GSM/GPRS modules.	
6	Power Supplies: •Power banks or batteries for mobile projects. •USB power adapters.	
7	Software and Development Tools: • Arduino IDE, • Raspberry Pi OS, • Python, • IoT Platforms, • Integrated Development Environments (IDEs)	
8	Additional Components: • Breadboards and Jumper Wires: • Resistors and Capacitors • Power Supply Components • USB Cables • Storage • Cases and Enclosures	
9	Optional Tools: • Sensors and Actuators Kits • Robotics Kits • IoT Development Boards	

RECOMMENDED BOOKS:

SL	Book Name	Writer Name	Publisher Name & Edition
01.	Introduction to Sensors in IoT and Cloud Computing Applications	Ambika Nagaraj	
02.	Internet of Things (IoT)	Dr Kamlesh Lakhwani (Author), Dr Hemant Kumar Gianey (Author), Joseph Kofi Wireko (Author)	

03.	Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud (Make: Projects) 1st Edition, Kindle Edition by Cuno Pfister (Author) Format: Kindle Edition	Cuno Pfister	Make Community, LLC
	IoT based Projects: Realization with Raspberry Pi, NodeMCU and Arduino	**Rajesh Singh**	

WEBSITE REFERENCES:

SL	Web Link	Remarks
1	https://mrcet.com/downloads/digital_notes/EEE/IoT%20&%20Applications%20Digital%20Notes.pdf	
2	https://nibmehub.com/opac-service/pdf/read/IoT%20Fundamentals.pdf	
3	https://bridgera.com/wp-content/uploads/2018/10/IoTeBook3.pdf	
4	https://www.psgrkcw.ac.in/wp-content/uploads/2021/08/IoT-Applications-Lab-Manual-IT.pdf	
5	https://copyprogramming.com/howto/internet-of-things-a-hands-on-approach-pdf	
6	https://www.spiceworks.com/tech/iot/articles/what-is-iiot/#_002	
7	https://www.techtarget.com/iotagenda/definition/Industrial-Internet-of-Things-IIoT#:~:text=The%20industrial%20internet%20of%20things%20(IIoT)%20is%20the%20use%20of,enhance%20manufacturing%20and%20industrial%20processes.	
8	https://iopscience.iop.org/book/mono/978-0-7503-3663-5/chapter/bk978-0-7503-3663-5ch1.pdf	
9	https://www.machinemetrics.com/blog/industrial-internet-of-things-iiot	