

SRM VALLIAMMAI ENGINEERING COLLEGE
(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF ELECTRONICS AND COMMUNICATION
ENGINEERING

QUESTION BANK



V SEMESTER

PEC501 – INTERNET OF THINGS

Regulation – 2023

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SUBJECT CODE & TITLE: PEC501 – INTERNET OF THINGS

SEM / YEAR: V / III

UNIT – I: FUNDAMENTALS OF IoT

Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

PART – A

Q.No.	Questions	CO	BT Level	Competence
1	Compare two IoT architectures oneM2M and IoTWF.	CO1	BTL2	Understand
2	Interpret the responsibilities of IT and OT in the IoT reference model	CO1	BTL2	Understand
3	Point out the challenges faced by Internet of Things.	CO1	BTL2	Understand
4	Summarize the benefits of convergence of IT and OT as IoT.	CO1	BTL2	Understand
5	List the applications of IoT.	CO1	BTL1	Remember
6	Define Big data.	CO1	BTL2	Understand
7	Mention two examples where Big data is generated in IoT systems.	CO1	BTL1	Remember
8	Sketch the IoT Reference model.	CO1	BTL2	Understand
9	Define IoT.	CO1	BTL1	Remember
10	List the layers and sublayers of the functional stack of core IoT.	CO1	BTL1	Remember
11	Identify the hierarchy of Fog, Edge and Cloud.	CO1	BTL2	Understand
12	Distinguish the following: active and passive sensor	CO1	BTL2	Understand
13	Write the difference between Invasive and non-invasive sensor.	CO1	BTL2	Understand
14	Write the evolutionary phases of IoT.	CO1	BTL2	Understand

15	How do you classify sensors and actuators layers ?	CO1	BTL1	Remember
16	Summarize the purpose of Sensors, Actuators and Smart Objects.	CO1	BTL2	Understand
17	What is called IoT ecosystem? Name the functional blocks of it.	CO1	BTL1	Remember
18	Mention the defining characteristics of Fog Computing.	CO1	BTL2	Understand
19	Enumerate the types of sensors.	CO1	BTL2	Understand
20	Compare Fog and Edge computing.	CO1	BTL2	Understand
21	Illustrate how sensors and actuators interact with the physical world?	CO1	BTL2	Understand
22	Identify the communication criteria used for connecting smartobjects.	CO1	BTL2	Understand
23	Summarize the functionalities of collaboration and process layer of IoTWF model.	CO1	BTL2	Understand
24	Point out the trends in smart objects.	CO1	BTL1	Remember
PART – B				
1	Describe the seven layers of IoT Reference model byIoTWF with necessary diagrams. (16)	CO1	BTL3	Apply
2	Illustrate each layer of the one M2M IoT standardized architecture with neat diagram. (16)	CO1	BTL3	Apply
3	(i)Analyze the IoT Challenges in detail. (10) (ii)Illustrate about the trends in smart objects that are impacting IoT (6)	CO1	BTL4	Analyze
4	(i)Summarize the evolutionary phases of the Internet. (10) (ii) Write a note on IoT and Digitization , (6)	CO1	BTL3	Apply
5	(i) Categorize the Alternative IoT Reference Models. (8) (ii) Describe the simplified IoT Architecture. (8)	CO1	BTL3	Apply
6	Draw and explain the expanded view of simplified IoT architecture with necessary diagrams. (16)	CO1	BTL3	Apply
7	(i)Examine about components of Core IoT functional stack (8) (ii) Write the example of sensor applications based on mobility and throughput. (8)	CO1	BTL4	Analyze
8	(i) Describe the architectural classification of ‘Things’ or ‘smart objects’ in core IoT functional stack with diagrams. (8) (ii) Write short notes on access technologies used in IoT. (8)	CO1	BTL3	Apply
9	Analyze the following functions of applications and analytics layer of IoT network. (i) Analytics versus Control applications (5) (ii) Data Versus Network analytics (5) (iii) Data analytics Versus Business benefits (6)	CO1	BTL4	Analyze
10	(i)Summarize the smart services offered by applications and analytics layer of IoT. (8) (ii)Summarize the responsibilities of IT and OT in the IoT reference model. (8)	CO1	BTL3	Apply
11	Draw the layered structure of IoT data management and compute stack with fog layer. Justify why fog layer is introduced in it. Also comment about Edge computing (16)	CO1	BTL3	Apply
12	Analyze in detail the hierarchy followed in Edge, Fog and Cloud with suitable illustration. (16)	CO1	BTL4	Analyze

13	Explain in detail about actuators and Micro Electro Mechanical Systems. (16)	CO1	BTL4	Analyze
14	List out and explain the communication criteria that must be considered in connecting smart objects (16)	CO1	BTL3	Apply
15	(i)Examine the different ways of categorizing sensors with necessary explanation (8) (ii)Give examples for any six types of sensors and relate its name with its principle of operation. (8)	CO1	BTL4	Analyze
16	Describe in detail about M2M ecosystem with necessary diagram. (16)	CO1	BTL4	Analyze
17	(i)Explain in detail about the sensors used in a smart phone with necessary diagram. (10) (ii) Write a note on biodegradable sensors for smart farming. (6)	CO1	BTL3	Apply

UNIT - II: MIDDLEWARE AND PROTOCOLS OF IOT

Middleware technologies for IoT system (IoT Ecosystem Overview – Horizontal Architecture Approach for IoT Systems – SOA based IoT Middleware) Middleware architecture of RFID, WSN, SCADA, M2M –Interoperability challenges of IoT Protocols for RFID, WSN, SCADA, M2M- Zigbee, KNX, BACNet, MODBUS - Challenges Introduced by 5G in IoT Middleware (Technological Requirements of 5G Systems - Perspectives and a Middleware Approach Toward 5G (COMPaaS Middleware) – Resource management in IoT.

PART – A

Q.No.	Questions	CO	BT Level	Competence
1	Define IoT Middleware.	CO2	BTL1	Remember
2	Mention the role of middleware in IoT systems.	CO2	BTL2	Understand
3	What are the key components of an IoT Middleware architecture?	CO2	BTL1	Remember
4	Differentiate between horizontal and vertical IoT architectures.	CO2	BTL2	Understand
5	Mention the need for middleware in the context of the Internet of Things.	CO2	BTL2	Understand
6	What is meant by a horizontal architecture approach in IoT systems?	CO2	BTL1	Remember
7	List the major components of the IoT ecosystem in the horizontal architecture approach.	CO2	BTL1	Remember
8	What is the importance of data management in horizontal IoT architecture?	CO2	BTL2	Understand
9	How does the horizontal architecture facilitate device interoperability in IoT?	CO2	BTL2	Understand
10	What is SOA (Service-Oriented Architecture) and how is it used in IoT middleware?	CO2	BTL1	Remember
11	Mention the concept of service discovery in SOA-based IoT middleware.	CO2	BTL2	Understand
12	What are the advantages of using SOA in IoT systems?	CO2	BTL2	Understand
13	Give the role of middleware in RFID-based IoT systems.	CO2	BTL2	Understand
14	What is the architecture of middleware in Wireless Sensor Networks (WSN)?	CO2	BTL1	Remember
15	Describe the middleware architecture for SCADA systems in the IoT context.	CO2	BTL2	Understand
16	How does middleware help in Machine-to-Machine (M2M) communications?	CO2	BTL2	Understand

17	Discuss the interoperability challenges in IoT protocols used for RFID systems.	CO2	BTL2	Understand
18	What are the challenges faced by IoT protocols in WSN environments?	CO2	BTL2	Understand
19	List the interoperability challenges of IoT protocols in SCADA systems.	CO2	BTL1	Remember
20	What issues arise in M2M communication due to protocol interoperability in IoT?	CO2	BTL2	Understand
21	What is Zigbee, and how is it used in IoT systems?	CO2	BTL1	Remember
22	Define the role of KNX in IoT communication systems.	CO2	BTL1	Remember
23	What is BACNet, and where is it applied in the IoT ecosystem?	CO2	BTL1	Remember
24	Explain the function of MODBUS in IoT systems	CO2	BTL2	Understand

PART – B

1	Analyze the role of middleware in an IoT ecosystem. How does the middleware architecture enable communication between heterogeneous IoT devices? (16)	CO2	BTL4	Analyze
2	Illustrate the working of a horizontal architecture approach in an IoT system. How does this approach enhance the interoperability of various IoT devices such as RFID, WSN, SCADA, and M2M? (16)	CO2	BTL4	Analyze
3	Discuss the role of Service-Oriented Architecture (SOA) in IoT middleware. How does SOA help in simplifying the integration and management of IoT systems and services? (16)	CO2	BTL4	Analyze
4	Describe how middleware acts as a mediator between IoT devices and cloud services. How does it address the challenges of device-to-cloud communication, security, and data privacy? (16)	CO2	BTL3	Apply
5	Examine the middleware architecture for RFID systems. How does it manage data acquisition, processing, and distribution in real-time to enable efficient tracking and management? (16)	CO2	BTL3	Apply
6	Demonstrate how middleware can optimize energy consumption and data aggregation in Wireless Sensor Networks (WSN). How does middleware help mitigate the limitations of sensor nodes? (16)	CO2	BTL3	Apply
7	Examine the role of middleware in SCADA systems. How does it facilitate the monitoring, control, and automation of industrial processes and remote assets in real-time? (16)	CO2	BTL4	Analyze
8	Contrast the middleware architecture in M2M (Machine-to-Machine) communication systems. How does middleware enable seamless communication between devices in industrial automation? (16)	CO2	BTL3	Apply
9	Describe the interoperability challenges between IoT protocols such as Zigbee, KNX, BACNet, and MODBUS. How does middleware help in bridging the gaps between these protocols for effective communication? (16)	CO2	BTL4	Analyze
10	Explain middleware solutions for overcoming protocol mismatches in an IoT environment. How can middleware ensure seamless communication between heterogeneous IoT devices using protocols like Zigbee and BACNet? (16)	CO2	BTL3	Apply
11	Examine how middleware provides a solution to protocol mismatches in IoT systems, specifically between protocols like Zigbee, KNX, and MODBUS. How does this enhance the system's performance and reliability? (16)	CO2	BTL3	Apply

12	Discuss the impact of 5G technology on the architecture and functionality of IoT middleware. How do the technological requirements of 5G, such as low latency and high throughput, affect middleware design? (16)	CO2	BTL3	Apply
13	Discuss the challenges introduced by 5G networks in IoT middleware. How does the dynamic and high-speed nature of 5G influence resource management, scalability, and network management? (16)	CO2	BTL3	Apply
14	Examine the middleware approach for IoT in a 5G-enabled environment. How does the COMPaaS (Cloud-based middleware) approach address the unique requirements of 5G for large-scale IoT deployments? (16)	CO2	BTL3	Apply
15	Examine the resource management challenges in IoT systems with the advent of 5G technology. How does middleware play a critical role in managing resources like bandwidth, processing power, and storage? (16)	CO2	BTL4	Analyze
16	Assess the role of middleware in resource management for IoT systems. How does middleware handle dynamic resource allocation, task scheduling, and optimization in large-scale IoT networks? (16)	CO2	BTL4	Analyze
17	Investigate how middleware supports resource management in IoT ecosystems. How does it ensure efficient utilization of network bandwidth, computational power, and storage resources in a distributed environment? (16)	CO2	BTL3	Apply

UNIT - III: COMMUNICATION AND NETWORKING

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Layer Protocols: CoAP and MQTT- Data aggregation & dissemination.

PART – A

Q.No.	Questions	CO	BT Level	Competence
1	Name the types of deployments of IEEE 802.15.4 standard.	CO3	BTL1	Remember
2	Write the relationship between IEEE 1901.2a and NB-PLC.	CO3	BTL2	Understand
3	Draw the high level ZigBee Protocol stack.	CO3	BTL1	Remember
4	List the topologies supported by IEEE 802.15.4 standard.	CO3	BTL1	Remember
5	Compare ZigBee and ZigBee IP.	CO3	BTL2	Understand
6	Identify the applications of IEEE1901.2a.	CO3	BTL2	Understand
7	Sketch the MAC Layer Security frame format of IEEE 802.15.4g/e.	CO3	BTL1	Remember
8	Mention the significance of IEEE 802.15.4 standard.	CO3	BTL2	Understand
9	Define the medium access methods used in IEEE 802.15.4 standard.	CO3	BTL1	Remember
10	Identify the applications of ZigBee protocol.	CO3	BTL2	Understand
11	How does the data rate vary in LoRaWAN?.	CO3	BTL2	Understand
12	Mention the importance of LoRaWAN layers.	CO3	BTL2	Understand
13	What are the protocols used for optimizing IP for IoT.	CO3	BTL1	Remember

14	Write about the concept of constrained nodes and constrained networks.	CO3	BTL2	Understand
15	What is an acronym of 6LoWPAN?	CO3	BTL1	Remember
16	Outline the features of 6LoWPAN.	CO3	BTL2	Understand
17	Differentiate 6LoWPAN from 6Lo.	CO3	BTL2	Understand
18	List the scheduling management mechanism in 6TiSCH.	CO3	BTL2	Understand
19	Why the protocol translation of SCADA is needed in IoT protocols.	CO3	BTL1	Remember
20	Classify the IoT Application Transport methods.	CO3	BTL2	Understand
21	Name the three level of QoS supported by MQTT.	CO3	BTL1	Remember
22	Identify the protocol used for resource-oriented applications in constrained networks.	CO3	BTL2	Understand
23	Mention the features of CoAP.	CO3	BTL2	Understand
24	Sketch the high level IoT protocol stack for CoAP and MQTT.	CO3	BTL2	Understand

PART – B

1	Illustrate the security header format of IEEE 802.15.4g/e and also specify the improvements in physical and MAC layers for IoT use cases. (16)	CO3	BTL3	Apply
2	Analyze the following access technologies with connectivity over IoT networks (i) IEEE 802.11g (8) (ii) IEEE 802.11ah (8)	CO3	BTL4	Analyze
3	(i) Draw and explain the MAC frame format of IEEE 802.15.4. (10) (ii) List the types of topology used in IEEE 802.15.4 protocol. (6)	CO3	BTL3	Apply
4	Explain in detail about ZigBee protocol with necessary diagrams. (16)	CO3	BTL3	Apply
5	Describe in detail about the protocol stacks utilizing IEEE 802.15.4 with necessary applications. (16)	CO3	BTL3	Apply
6	Describe about LoRaWAN architecture with necessary diagrams. (16)	CO3	BTL3	Apply
7	Compare and contrast the physical and MAC layers of IoT Access technologies with suitable illustrations. (16)	CO3	BTL4	Analyze
8	Explain the following: (i) LoRaWAN security (8) (ii) Narrowband Power line communication (8)	CO3	BTL3	Apply
9	Examine the role of wired access protocol IEEE1901.2a workinggroup in connecting smart objects. (16)	CO3	BTL4	Analyze
10	(i) Compare the characteristics of 6LoWPAN Protocol stack using adaptation layer with standard IP Protocol stack. (10) (ii) Mention the need for Optimizing IP for IoT using adaptation layer. (6)	CO3	BTL3	Apply
11	(i) Differentiate 6LoWPAN working group from 6Lo working group. (8) (ii) Write a detailed notes on RPL network (8)	CO3	BTL3	Apply
12	Categorize the IoT Application Transport Methods and explain in detail about Supervisory Control and Data Acquisition. (16)	CO3	BTL3	Apply
13	(i) Describe in detail about protocol stack for transporting serial DNP3 SCADA over IP. (8)	CO3	BTL3	Apply

	(ii) Write the difference between CoAP and MQTT. (8)			
14	Write short notes on (i) IoT constrained nodes (8) (ii) IoT constrained networks (8)	CO3	BTL3	Apply
15	Describe about Application Layer Protocols: (i) CoAP (8) (ii) MQTT (8)	CO3	BTL4	Analyze
16	Analyze the main characteristics of Constrained Application Protocol and Message Queuing Telemetry Transport Application Layer Protocols with necessary illustrations. (16)	CO3	BTL4	Analyze
17	Examine how the routing solution is achieved through Routing over Low Power and Lossy Networks with suitable diagrams. (16)	CO3	BTL3	Apply

UNIT- IV : IOT IMPLEMENTATION TOOLS

Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python, Implementation of IoT with Raspberry Pi.

PART – A

Q.No.	Questions	CO	BT Level	Competence
1	Define a variable in Python with an example.	CO4	BTL1	Remember
2	What are the different data types available in Python?	CO4	BTL1	Remember
3	Mention any two differences between Python 2 and Python 3.	CO4	BTL2	Understand
4	Explain the use of loops in Python.	CO4	BTL2	Understand
5	Define IoT. Mention any two applications.	CO4	BTL1	Remember
6	Define Machine Learning.	CO4	BTL1	Remember
7	List any two characteristics of IoT.	CO4	BTL1	Remember
8	Define the term "Smart Object" in the context of IoT.	CO4	BTL2	Understand
9	Differentiate between cloud computing and fog computing in IoT.	CO4	BTL2	Understand
10	What is an IoT protocol? Give any two examples.	CO4	BTL2	Understand
11	List any two communication models in IoT.	CO4	BTL1	Remember
12	Explain the publish-subscribe model in MQTT.	CO4	BTL2	Understand
13	How is data transmitted from sensor to cloud in an IoT system?	CO4	BTL2	Understand
14	What is a sensor node in IoT architecture?	CO4	BTL2	Understand
15	Define interoperability in the context of IoT tools.	CO4	BTL2	Understand
16	What is an embedded system?	CO4	BTL1	Remember
17	Name any two sensors used in embedded IoT applications.	CO4	BTL1	Remember

18	What is meant by analog and digital signals in sensor data?	CO4	BTL2	Understand
19	How is a temperature sensor interfaced with Arduino?	CO4	BTL2	Understand
20	What is Raspberry Pi?	CO4	BTL2	Understand
21	How can Python be used to read sensor data in Raspberry Pi?	CO4	BTL2	Understand
22	List any two features of Raspberry Pi.	CO4	BTL1	Remember
23	How does an ultrasonic sensor work in an IoT system?	CO4	BTL1	Remember
24	Explain the use of GPIO library in Raspberry Pi Python programming.	CO4	BTL1	Remember
PART – B				
1	Describe the object-oriented features of Python and discuss how they can be used to design reusable IoT modules. (16)	CO4	BTL4	Analyze
2	Analyze the various Python data structures and explain how they can be effectively used in IoT applications. (16)	CO4	BTL3	Apply
3	Explain the architecture of IoT and explain how different components such as sensors, connectivity, cloud, and application interact in a smart home system. (16)	CO4	BTL3	Apply
4	Demonstrate how Python's data structures can be utilized to process and store sensor data in an IoT system. (16)	CO4	BTL4	Analyze
5	Illustrate the steps to develop a Python script for automating device control in a smart home IoT application. (16)	CO4	BTL3	Apply
6	Examine the role of cloud services in IoT applications and discuss how Python interfaces with these services for data storage and analytics. (16)	CO4	BTL4	Analyze
7	Evaluate the challenges and solutions in integrating multiple sensors and actuators in a real-time IoT application using Python. (16)	CO4	BTL4	Analyze
8	Design a sensor-based embedded system for environmental monitoring and explain how the data is acquired, processed, and transmitted to the cloud. (16)	CO4	BTL4	Analyze
9	Investigate the impact of communication protocols (such as Bluetooth, Zigbee, WiFi) on the performance and reliability of sensor-based IoT applications. (16)	CO4	BTL4	Analyze
10	Illustrate the process of interfacing a temperature sensor with a microcontroller and writing Python code to read and display the sensor values. (16)	CO4	BTL3	Apply
11	Demonstrate the steps to set up a Raspberry Pi for IoT development and write a Python program to control an LED based on sensor input. (16)	CO4	BTL4	Analyze
12	Examine the architectural differences between Raspberry Pi and Arduino in the context of IoT applications and justify the selection for a specific use case. (16)	CO4	BTL4	Analyze
13	Describe how Raspberry Pi GPIO pins can be programmed using Python for controlling various home appliances in a smart home setup. (16)	CO4	BTL4	Analyze
14	Identify the key differences between analog and digital sensors. Discuss how signal conditioning is handled in embedded systems. (16)	CO4	BTL4	Analyze
15	Formulate a complete IoT solution for smart farming using Raspberry Pi, sensors (moisture, temperature), Python programming, and cloud integration for monitoring. (16)	CO4	BTL3	Apply
16	Implement a Python program on Raspberry Pi to monitor room temperature using a DHT11 sensor and trigger an LED if the temperature exceeds a threshold. (16)	CO4	BTL3	Apply
17	Examine a complete IoT solution for any suitable application using Raspberry Pi, Python programming, and cloud integration. (16)	CO4	BTL4	Analyze

UNIT - V: CASE STUDIES OF IOT

Case study of Home automations - Smart cities – Environment – Energy – Retail – Logistics – Agriculture – Industry - Health and life style.

PART – A

Q.No.	Questions	CO	BT Level	Competence
1	List two benefits of using smart lighting solutions in home automation.	CO5	BTL1	Remember
2	State the role of intrusion detection systems in smart homes.	CO5	BTL1	Remember
3	Explain how smart appliances contribute to energy efficiency in homes.	CO5	BTL1	Understand
4	Identify two key technologies used in home automation for remote control of devices.	CO5	BTL1	Remember
5	Describe how IoT-based home automation can improve security for residents.	CO5	BTL2	Understand
6	Mention two IoT applications commonly implemented in smart cities.	CO5	BTL2	Understand
7	Illustrate how smart parking systems help reduce urban congestion.	CO5	BTL1	Remember
8	List two features of smart road lighting in urban environments.	CO5	BTL2	Understand
9	Explain the significance of structural health monitoring in smart cities.	CO5	BTL2	Understand
10	State how IoT contributes to emergency response in urban areas.	CO5	BTL1	Remember
11	Name two environmental parameters commonly monitored using IoT sensors.	CO5	BTL1	Remember
12	Describe the function of weather monitoring stations in environmental IoT.	CO5	BTL2	Understand
13	List two advantages of using IoT for pollution monitoring.	CO5	BTL2	Understand
14	Explain how IoT aids in disaster management for environmental safety.	CO5	BTL1	Remember
15	Identify two ways smart meters enhance energy management in homes.	CO5	BTL2	Understand
16	Illustrate the role of IoT in integrating renewable energy sources into the grid.	CO5	BTL2	Understand
17	State two benefits of using smart grids in energy systems.	CO5	BTL2	Understand
18	Describe how IoT-based energy monitoring can reduce overall consumption.	CO5	BTL2	Understand
19	List two IoT applications in the retail sector.	CO5	BTL1	Remember
20	Explain how inventory tracking is improved by IoT in retail.	CO5	BTL1	Remember
21	Name two uses of IoT in logistics management.	CO5	BTL2	Understand
22	Describe how real-time tracking enhances supply chain efficiency.	CO5	BTL2	Understand
23	State two IoT applications that support precision agriculture.	CO5	BTL1	Remember
24	Explain the impact of soil moisture sensors on irrigation management in agriculture.	CO5	BTL2	Understand

PART – B

1	Illustrate the process of designing a smart home system that integrates lighting, security, and energy management using IoT devices, and explain how user preferences can be incorporated for automation. (16)	CO5	BTL3	Apply
2	Examine the challenges and solutions in ensuring data privacy and security in a home automation IoT network, considering multiple connected devices. (16)	CO5	BTL4	Analyze
3	Demonstrate how IoT-enabled traffic management systems can be implemented to reduce congestion and improve emergency response in urban areas. (16)	CO5	BTL3	Apply
4	Examine the impact of IoT-based waste management solutions on urban sustainability and resource optimization in smart cities. (16)	CO5	BTL4	Analyze
5	Construct a framework for deploying IoT sensors to monitor air and water quality in a metropolitan area, and describe how the collected data can be used for real-time environmental decision-making. (16)	CO5	BTL3	Apply
6	Examine the effectiveness of IoT-based environmental monitoring systems in supporting climate change mitigation strategies. (16)	CO5	BTL4	Analyze
7	Design an IoT-based smart grid system that enables real-time energy consumption monitoring and demand-response management for residential users. (16)	CO5	BTL3	Apply
8	Explain the role of IoT in optimizing renewable energy integration and grid stability in modern power systems. (16)	CO5	BTL3	Apply
9	Develop a solution for inventory management in retail using IoT technologies, detailing the workflow from product tracking to automated restocking. (16)	CO5	BTL3	Apply
10	Compare the benefits and limitations of using IoT for personalized marketing and customer behavior analysis in retail environments. (16)	CO5	BTL3	Apply
11	Describe an IoT-based system for real-time shipment tracking and condition monitoring in logistics, and explain how it enhances supply chain efficiency. (16)	CO5	BTL3	Apply
12	Examine the challenges in implementing IoT for predictive maintenance and asset management in large-scale logistics operations. (16)	CO5	BTL3	Apply
13	Develop a smart irrigation system using IoT sensors and actuators, and describe how it can improve water usage and crop yield. (16)	CO5	BTL4	Analyze
14	Evaluate the impact of IoT-based precision farming techniques on sustainable agriculture and resource management. (16)	CO5	BTL4	Analyze
15	Construct a predictive maintenance solution for industrial equipment using IoT-enabled sensors and data analytics, and outline the implementation steps. (16)	CO5	BTL3	Apply
16	Investigate the influence of IoT on industrial automation, focusing on productivity, safety, and operational efficiency. (16)	CO5	BTL4	Analyze
17	Design a wearable IoT health monitoring device and explain how it can be used for remote patient monitoring and proactive healthcare management. (16)	CO5	BTL4	Analyze