

**BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI**  
**I SEMESTER 2023-2024**  
**CS G518 – IoT Design and Development**  
**Mid Semester Test (Closed Book)**

**Date: 12 Oct, 2023**

**Time: 90 minutes**

**MM: 25**

---

**Q.1 [3 marks]** Comment (T/F) on the correctness of the following sentences on comparing WebSocket and REST

- a. CoAP and MQTT are both heavyweight protocols designed for high-performance applications.
- b. CoAP uses the HTTP protocol as its underlying transport mechanism.
- c. MQTT is a stateless protocol, making it efficient for stateful communication in IoT applications.
- d. CoAP is typically used for scenarios where bi-directional communication is not required.
- e. MQTT is commonly used in scenarios where reliability and real-time communication are essential, such as remote monitoring and control.
- f. CoAP and MQTT both support Quality of Service (QoS) levels to control message reliability.
- g. CoAP is based on the concept of socket and port, similar to WebSocket.
- h. MQTT clients communicate directly with one another in a peer-to-peer manner, without the need for a central broker.
- i. WebSocket is a low-level protocol based on the concept of socket and port, which are the underlying transport mechanism, whereas REST is based on CRUD operation.
- j. Both WebSocket and REST are bi-directional, i.e. both-way operation from client to server and vice versa is possible.
- k. The WebSocket approach is ideal when there is a lot of getting requests, whereas REST is better for real-time scalable applications.
- l. WebSocket is a stateful protocol, whereas REST is based on a stateless protocol. (True/False)
- m. WebSocket connections can scale vertically on a single server, whereas REST, which is HTTP-based, can scale horizontally.
- n. WebSocket is ideal and better fitted for occasional communication in a typical GET request scenario, whereas REST is suitable for high loads, such as real-time scalable chat applications.
- o. WebSocket works better when a new TCP connection is created every time the client or the server needs to communicate, whereas, for an HTTP request, the same TCP connection is used.

**Q.2 [2 marks]** What is the role of GPIO BCM (Broadcom SOC channel) and BOARD pin numbering systems in Raspberry Pi, and how do they differ in terms of pin identification and usage in GPIO programming for Raspberry Pi projects?

**Q.3 [2 marks]** What is LDR sensor. What are its applications. Explain the working principle behind an LDR functions as a light sensor.

Q.4 [2 marks] Write a Python program for a Raspberry Pi that continuously reads temperature values and prints the temperature only when it changes by more than 1% from the previous reading. Make appropriate assumptions.

Q.5 [5 marks] Design an HTTP-based REST API for an IoT system in the context of a smart city's environmental monitoring platform. The system includes various environmental sensors placed throughout the city to collect data on air quality, temperature, humidity, and noise levels. Users should be able to access real-time sensor data, control specific IoT devices (e.g., air purifiers or noise-reduction systems), and configure sensor settings. Following RESTful principles, design the API with the following steps: 1) Identify the primary resources, such as sensors, IoT devices, and sensor configurations; 2) Create URIs for each resource, ensuring consistency with RESTful principles 3) Determine resource representations in JSON format, like a representation of an air quality sensor reading; 4) Assign HTTP methods to URIs (e.g., GET to retrieve sensor data, POST to create sensor configurations, PUT to update device settings, and DELETE to deactivate devices).

Q.6 [3 marks] How does IPv6 mitigate the limitations of IPv4 and how do these solutions affect the scalability and security of network infrastructure compared to IPv4? Additionally, in what specific ways does IPv6 address the shortcomings of Network Address Translation (NAT), contributing to improved network functionality, security, and addressing challenges?

Q.7 [3 marks] What is the fundamental difference in the mechanisms used to achieve communication for IPv6 anycast addresses and multicast addresses? Additionally, how can anycast addresses be employed in routing scenarios, including the concept of source-selected policies and identifying routers belonging to particular Internet service providers or routing domains, while considering the distinct mechanisms of both types of communication?

Q.8 [3 marks] Compare routing at the network layer using the Routing Header option in the IPv6 header and the mesh routing option in the 6LoWPAN dispatch header. In a wireless routing context, how do the Routing Header option in the IPv6 header and the mesh routing option in the 6LoWPAN dispatch header differ in their approaches to routing, and can you provide scenarios where each mechanism is more suitable?

Q.9 [2 marks] Explain the working principles of the different Quality of Service (QoS) levels in MQTT, specifically: At most once (QoS 0), At least once (QoS 1), and Exactly once (QoS 2). Include a message exchange diagram illustrating the communication between an MQTT client and the broker for each QoS level.

-----END OF THE PAPER-----