2025
Internet of Things

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

Answer any five, <u>question 1 is compulsory</u>

Question 1: A) Fill in the blanks: [10]

1. In M2M communication, devices exchange data without _____.

2. Smart home devices like lights and switches often use _____ for communication.

3. The biggest user problem in M2M is _____ due to different manufacturers using different protocols.

4. Machine-to-Cloud communication relies on _____ for heavy computation tasks.

5. IoT gateways help in _____ before sending data to the cloud.

6. Z-Wave and ZigBee are examples of _____ protocols.

7. In Machine-to-Gateway, a smartphone can act as a _____.

8. Cloud servers in IoT have high _____ and storage capacity.

9. Sensors in IoT generate _____ for processing.

10. The performance of Machine-to-Cloud depends on _____ availability.

B) Identify the following statements as true or false   [10]

(1) M2M requires a central server for device communication.

(2) ZigBee and Z-Wave devices can communicate directly.

(3) IoT gateways reduce cloud server load by pre-processing data.

(4) Machine-to-Gateway increases IoT device power consumption.

(5) Cloud-based IoT has unlimited storage and computation.

(6) Bluetooth 4.0 is used in smart home M2M communication.

(7) Sensors in IoT only collect data but never process it.

(8) Machine-to-Cloud is slower than M2M due to network dependency.

(9) A smart lock can directly communicate with a cloud server.

(10) IoT gateways translate protocols for device compatibility.

Question No 2: Answer in 1-2 sentences or a brief calculation. Each question carries two marks [20]

1. Name the three primary components of a conventional IoT network.
2. What is the main function of IoT sensors/devices?
3. Why are IoT gateways essential in an IoT system?
4. List two tasks performed by cloud servers in IoT.
5. What is the role of backhaul networks in IoT?
6. How do IoT gateways improve efficiency?
7. What type of data do IoT sensors typically handle?
8. Why can't sensors directly send raw data to the cloud?
9. (a) An IoT gateway receives data from 50 sensors, each sending 100 bytes/sec. Calculate the total data rate before preprocessing.

   (b) If preprocessing reduces data size by 20%, what is the new data rate for Q9?

Question No 3:

(a) Why is edge computing preferred over cloud computing for real-time applications in 5G networks? Name the three layers of edge computing architecture and one function of each. [2+3]

(b) How does the near-end layer reduce latency compared to far-end cloud servers? Explain one advantage of the hierarchical model in edge computing. How does SDN simplify edge computing management? [2+3]

c) An edge server processes data from 200 sensors, each generating 150 bytes every 2 seconds. Calculate the total data rate (in kbps) received by the edge server. If edge preprocessing reduces data size by 30%, find the new data rate (in kbps). [3+2]

d) Why is security challenging in edge computing with third-party operators? A mobile user requires a service with 50 ms latency. Explain whether edge or cloud computing is suitable and why. [2+3]

Question 4

a) i) Compare IoT, edge computing and cloud computing in terms of their transmission, storage and computation characteristics using a table format. [4]
   ii) Explain with a diagram how the three-layer architecture of edge computing benefits IoT systems. [3]
   iii) Why is edge computing particularly suitable for vehicle-to-vehicle communications compared to cloud computing? [3]
b) An IoT network with 500 sensors generates 200 bytes of data per sensor every second. Calculate:
   i) The total data rate before edge processing [2]

ii) The reduced data rate if edge nodes compress data by 40% [2]

iii) Discuss two advantages and two limitations of using edge storage versus cloud storage for IoT systems. [4]

iv) How does computation offloading in edge computing help conserve energy in IoT devices? [2]

Question No 5

(A) Transmission Advantages of Edge Computing in IoT [10]

B) Explain how edge computing addresses the latency/delay challenges in IoT systems compared to traditional cloud computing. Discuss the roles of computing latency and transmission latency in this context. [5]

b) The text mentions "Live Video Analytics" as a key application of edge computing. Analyze how edge computing improves transmission performance for such time-sensitive IoT applications, focusing on:

- Hierarchical architecture benefits [2]
- Network resource optimization [2]
- Real-world implementation challenges [1]

Question N0 6:

i) Define a Binomial Point Process (BPP) and explain why it is suitable for modeling IoT device distribution in a finite area. [5]

ii) Calculate the probability density function (PDF) of the distance R from the center of the circle to a nearest IoT device. [5]

(iii) Mention how we find out average SNR from the nearest IoT device to the receiver located at the centre of the circle. [10]