Final Assessment Test(FAT) – Apr/May 2025

Programme	M.C.A.	Semester	Winter Semester 2024-25
Course Code	PMCA505L	Faculty Name	Prof. Dinakaran M
Course Title	Data Communication and Networking	Slot	E1+TE1
		Class Nbr	CH2024250501725
Time	3 hours	Max. Marks	100

Instructions To Candidates
- Write only your registration number in the designated box on the question paper. Writing anything elsewhere on the question paper will be considered a violation.

Course Outcomes
CO1: Understand the basic concepts of data communication, protocols, and standards
CO2: Comprehend various switching techniques and analyze the performance of the network
CO3: Analyze various error detection and correction techniques and flow control mechanisms
CO4: Understand IP addressing techniques and various routing protocols
CO5: Identify suitable Transport layer protocol and Application layer protocol for real time applications

Answer all Questions (10 × 10 Marks)

01. You are tasked with designing a network for a company with four departments: HR, Sales, IT, and Research & Development (R&D). The company has 50 employees in total, with the following department-specific requirements:

    - HR Department: 10 employees, requires secure access to sensitive data, needs reliable communication for payroll and employee management.
    - Sales Department: 15 employees, needs high-speed access to customer databases, email communication, and frequent video conferencing.
    - IT Department: 5 employees, responsible for maintaining network infrastructure, requires high bandwidth for server management, access to internal systems, and secure connections.
    - R&D Department: 20 employees, needs fast and stable connections to share large research files, use cloud services for computational tasks, and access company databases securely.

    In addition to these departments, a backbone network is required to connect the departments efficiently, ensuring smooth communication between them.

    A. Propose a network topology for the overall company and suggest specific topologies for each department based on their unique needs. (5 Marks)

    B. Justify your choice of topologies for each department (HR, Sales, IT, R&D) based on factors such as scalability, cost, performance, fault tolerance, and how the topologies will integrate into the backbone network to ensure seamless communication and reliable performance across the company. (5 Marks)

    [10] (CO1/K3)

02. Consider yourself as a network design engineer and you are tasked with designing a city-wide IoT-based smart home network. The network needs to efficiently transmit data from various smart devices (such as security cameras, smart thermostats, and home automation systems) to a central server.

    A. Considering the need to maximize bandwidth utilization and ensure seamless communication, explain how multiplexing can be applied to this system. (7 Marks)

    B. Discuss how multiplexing would improve the efficiency of data transmission and justify your approach based on factors such as cost, performance, and scalability using its different types? (3 Marks)

    [10] (CO1/K2)

03. Consider yourself a network engineer with the task of designing a global video conferencing system for a multinational corporation that needs to ensure high-quality video and audio communication between employees across different regions. The corporation decides to use the internet to minimize costs while maintaining a reliable and low-latency connection for real-time communication.

A. Explain which switching can be applied to this video conferencing system over a public network. (5 Marks)

B. Discuss the advantages of using virtual circuit switching in this scenario compared to packet switching, specifically in terms of reliability, latency, and quality of service.
(5 Marks)

[10] (CO2/K3)

04. You are designing a communication system for a file transfer application between two remote offices using an unreliable network (such as the internet). The file transfer system needs to ensure that the data being sent is accurate and not corrupted during transmission. The network experiences occasional packet loss and errors during transmission.

a. Explain how check sum can be used as an error control mechanism to ensure the integrity of the data being transferred. Describe how the sender and receiver would implement this method to detect errors in the transmitted data. (5 Marks)

b. Consider the following data being sent from the sender to the receiver: (5 Marks)
- 11100010 10000100 10011001 00100100
- Calculate the checksum at the receiver's end and verify if the data has been received correctly (i.e., if there are no errors).
- Receiver receives 11100010 10000100 10011001 00100100 11111010
- Find out if there is any error?

[10] (CO3/K3)

05. Imagine you are designing a reliable file transfer application for a wireless communication system where the packets are sent between a sender and a receiver. The system uses the Go-Back-N ARQ protocol for error control. The sender is transmitting 30 packets with a window size of 4.

A. Explain how the Go-Back-N ARQ protocol works for error control. Describe the key features of the protocol, including the concept of the sliding window, sequence numbers, and how the protocol handles lost or corrupted packets. (5 Marks)

B. [I]. How will the sender and receiver react if packet 2 is lost? (2 Marks)

[II]. What if acknowledgement 5 is lost? (1 Mark)

[III]. Will GoBack-N ARQ use NACK if it loses 15th packet? (1 Mark)

[IV]. How many total packets will be discarded if every 12th packet is lost? (1 Mark)

[10] (CO3/K5)

06. TechWave Inc., a growing technology company, uses the private IP address range 100.100.0.0/16 for its internal network and is planning to expand its infrastructure to 5 regional offices. Each office has different IP address requirements based on the number of devices and the need for future scalability. The company has decided to implement Classless Inter-Domain Routing (CIDR) to ensure efficient address allocation across the regional offices.

Here are the requirements for each region:

- Headquarters (HQ) – Requires total 10 offices with at least 1,000 devices each.
- Research and Development (R&D) Office – Requires 12 departments with at least 350 devices each.
- Sales Office – There are 10 products each requires at least 250 sales persons.
- Customer Support Office – Each product requires at least 100 devices customer support officer.

A. Provide the following information for each subnet: (8 Marks)
- Subnet Address
- Subnet Mask (in both CIDR and dotted-decimal format)
- Valid Host Range
- Broadcast Address

B. Considering that TechWave Inc. might need to add 20% additional devices in each regional office in the next five years, suggest an optimal subnet allocation and find the remaining addresses for this case considering the growth? (2 Marks)

[10] (CO4/K6)

07. TechWave Inc. has recently implemented a wireless network consisting of 9 devices. Each device is connected to one or more neighboring devices with the corresponding link costs (ranging from 1 to 10). The company needs to set up an optimal routing protocol using Dijkstra's Algorithm to find the shortest path between devices. Below is the network diagram, where each link between devices has a specified cost:
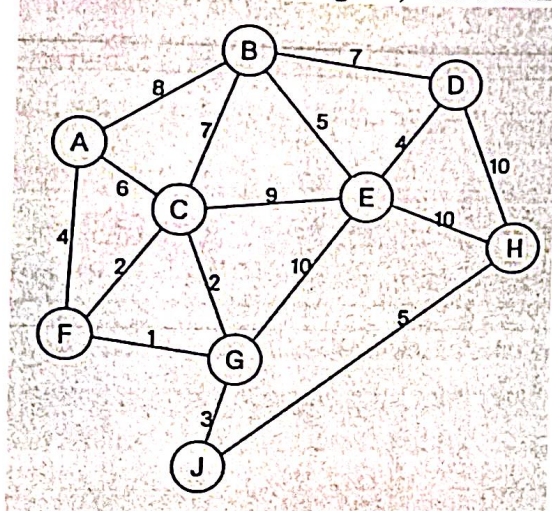
A. Using Dijkstra's Algorithm, compute the shortest path and routing table starting from the device A (root device) to all other devices in the network. (7 Marks)

B. Create a distance table (cost matrix) showing the minimum distance from device A to every other device. (3 Marks)

[10] (CO4/K5)

08. TechWave Inc., a rapidly growing technology company, has recently expanded its infrastructure to include multiple regional offices across the globe. Each office relies heavily on reliable communication for transferring large files, video conferencing, and maintaining real-time connections between departments. The company uses a high-speed network to ensure smooth collaboration between employees, with several applications requiring consistent and error-free data transmission. In the above scenario, how does the Transport layer contribute to forming and maintaining a reliable network for TechWave Inc. in the following aspects?

A. Explain the role of TCP in connection establishment? (4 Marks)

B. Demonstrate in what way flow between the devices are handled by TCP? (3 Marks)

C. Additionally, network engineering proposes to implement the UDP. Do you see any problems in taking his call? Justify your answer. (3 Marks)

[10] (CO5/K5)

09. TechWave Inc. operates a global network that supports critical services such as video conferencing, large file transfers, and real-time collaboration across multiple regional offices. Due to the increasing number of devices and network traffic, the company has started to experience congestion issues. As a result, some services, particularly video conferencing and file transfers, are becoming unreliable and slow. The network team needs to implement Quality of Service (QoS) and congestion management strategies to ensure that critical services maintain high performance while preventing congestion from affecting other applications.

A. How can congestion control mechanisms be utilized to address the network congestion issues at TechWave Inc.? (5 Marks)

B. Discuss the types of QoS techniques that can be applied? and how they help in ensuring that real-time applications like video conferencing and file transfers receive the necessary resources? (5 Marks)

[10] (CO5/K4)

10. TechWave Inc. is expanding its network infrastructure to include multiple regional offices, and the company is focusing on improving the performance and management of their network services. To manage this growth effectively, TechWave relies on several application layer protocols including DNS, FTP, and SNMP (Simple Network Management Protocol) to ensure smooth operations, efficient resource management, and reliable communication across its global network. How do the following application layer protocols contribute to the effective operation, management, and scalability of TechWave Inc.'s network infrastructure?

A. DNS (4 Marks)

B. FTP (3 Marks)

C. SNMP (3 Marks)

[10] (CO5/K2)

BL-Bloom's Taxonomy Levels - (K1-Remembering,K2-Understanding,K3-Applying,K4-Analysing,K5-Evaluating,K6-Creating)