D/L/TX

Reg. No: 22BCJ0189

VIT
Vellore Institute of Technology

Final Assessment Test – November 2024

Course: BCSE308L - Computer Networks

Class NBR(s): 1969/1971/1973/1976/1978/1982/1984/ 1986/1988/1991/1994/1996/1999/2002/2005/2009/ 2011/2013/2016/2018/2021/2023

Slot: D2+TD2

Time: Three Hours

Max. Marks: 100

- **KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE**
- **DON'T WRITE ANYTHING ON THE QUESTION PAPER**

Answer ALL Questions

(10 X 10 = 100 Marks)

1. A company wants to design a network for its new office building that spans four floors. The IT team needs to connect various departments such as finance, HR, and engineering located on different floors. The network must support high-speed internet access, secure communications, and the ability to handle large amounts of data being transferred within the office.

   The following requirements must be met:

   a) Each department should have its own dedicated segment to reduce traffic congestion.
   b) The network should be scalable to accommodate future expansions.
   c) Security is important, so there must be provisions for isolating departments and preventing unauthorized access to data.
   d) A wireless network should cover common areas like the lobby and cafeteria.

   Based on the scenario above, answer the following:

   i) What type of network topology would you recommend? Justify your choice.
   ii) Explain how VLANs (Virtual LANs) can help with security and traffic management in this network.
   iii) How would you implement a wireless network that ensures sufficient coverage and security in common areas?
   iv) Suggest methods to future-proof this network for scalability.

2. i) A circuit-switched network has a setup time of 2 seconds. If the data transmission rate is 64 kbps (kilobits per second) and a user needs to send a 1 MB (megabyte) file, **[5]**

   Calculate the total time required to send the file.

   ii) In a circuit-switched network, the propagation delay between two nodes is 15 milliseconds, and the setup time is 100 milliseconds. If the data transmission rate is 10 Mbps and the user needs to send 5 MB of data, **[5]**

   Calculate the total time required for the communication.

3. i) Consider a 16-bit checksum used for error detection. A sender is transmitting the following three 16-bit data words: [5]

Data 1: 10011001 11001101.
Data 2: 10101010 11110000.
Data 3: 11010111 00101101.

Calculate the checksum that the sender will append to the data.

ii) A sender wants to transmit the message `110101` using a CRC with a generator polynomial. [5]

$G(x)=x^3+x+1$ (which corresponds to the binary `1011`). Find the transmitted codeword.

4. In a Class B network with the IP address **172.16.0.0** and the default subnet mask, calculate the maximum number of hosts that can be accommodated.

i. Calculate the number of subnets and hosts in a /20 subnet.
ii. Determine the valid host range for the subnet 172.16.0.0/22?
iii. What is the next subnet for 172.16.0.0/24?
iv. How many total addresses arc in a /19 subnet?

5. Describe the key fields in the IPV4 header and discuss the purpose of each? List the main fields of IPV6 header?

6. a) A small company is designing its internal network, and the IT team wants to determine the most efficient paths for data to travel between its servers. The network consists of **6 servers: S1, S2, S3, S4, S5, and S6**. The servers are connected by cables with different data transfer times (weights), as shown in the table below: [7]

Server 1	Server 2	Data Transfer Time (ms)
S1	S2	7 ms
S1	S3	9 ms
S1	S6	14 ms
S2	S3	10 ms
S2	S4	15 ms
S3	S4	11 ms
S3	S6	2 ms
S4	S5	6 ms
S5	S6	9 ms

The IT team wants to optimize communication between the servers by calculating the **shortest path** (in terms of data transfer time) from **Server S1** to all other servers in the network.

Task:

i) Using **Dijkstra's Algorithm**, determine the shortest path from **Server S1** to all other servers (**S2, S3, S4, S5, and S6**).
ii) For each destination server, list the path taken and the total transfer time.
iii) Describe hoe the algorithm works step-by-step, including:

- How the algorithm selects the next node to visit.
- How the algorithm updates the shortest known path to each node.

b) A company, "GlobalTech," operates an international network spanning several offices across different continents. The company uses routers to connect their networks, and these routers exchange routing information to ensure data can flow between all offices efficiently. Initially, the company used a Distance Vector routing protocol (RIP), but after experiencing slow convergence times and occasional routing loops, they are considering switching to a Link State routing protocol (OSPF). [3]

Questions:

Routing Loop Prevention:

In the company's current Distance Vector setup (RIP), a router failure caused a routing loop in the network. Explain why routing loops can occur in Distance Vector protocols and describe two techniques (e.g., split horizon, hold-down timers) used to prevent this issue.

7. i) Elucidate the role of Queuing Mechanisms in Congestion Control. [5]
   ii) Deliberate some common Congestion Avoidance Mechanisms used in TCP? [5]

8. An international company, "NetCom Corp," provides IT services for several clients. They manage web servers, file servers, email systems, and network devices for clients around the globe. The company uses a variety of protocols to handle different tasks, including FTP for file transfers, HTTP for web services, SMTP for email communication, and SNMP for network monitoring and management. The IT team has been tasked with ensuring smooth operations across all services, and they are facing specific challenges with each protocol.

Questions:

i) One of the clients reports issues when uploading large files to the company's file server. The transfer seems to take too long, and sometimes it fails mid-way. [5]
   a. Explain how FTP works and identify two potential issues that could be causing the slow transfers or failures.
   b. What can the IT team do to improve the reliability and speed of file transfers using FTP?

ii) The company's web server, which hosts a critical application, is experiencing high traffic loads, causing some users to report slow page load times. [2.5]
   a. Explain how HTTP functions in the context of web browsing.
   b. What techniques can the IT team implement to optimize HTTP performance and reduce the impact of high traffic on the web server?

iii) The IT team notices that some clients are complaining about email delays and failures in sending emails. The emails get stuck in the outbox or fail to reach their destinations. [2.5]
   a. Describe how SMTP handles email delivery and what could cause delays or failures in this protocol.
   b. Suggest two strategies the IT team can use to troubleshoot and resolve email delivery issues in their SMTP server.

9.a) i) In a Slotted ALOHA system, the channel has a transmission capacity of 1 Mbps. The average packet size is 1000 bits. [5]

Calculate the maximum throughput of the system.

ii) In a Slotted ALOHA network, 10 users are attempting to send packets, and each user generates packets at a rate of 0.5 packets per second. [5]

Calculate the probability of a packet collision when one user attempts to send a packet.

OR

9.b) i) In a local area network (LAN) using CSMA, a device called **Device A** wants to transmit data. Before sending, it listens to the channel and detects that it is idle. Device A begins transmitting its data. Just after it starts transmitting, **Device B** also senses that the channel is idle and starts transmitting simultaneously. [5]

Explain what happens next and how CSMA helps manage this situation.

ii) A network engineer is trying to decide whether to implement a CSMA or CSMA/CD protocol in a newly designed local area network. Discuss the advantages of using CSMA/CD over CSMA in terms of efficiency and collision management. [5]

10.a) An IP datagram has arrived with partial information the header 4500005400030000 2066...

i) What is the header size
ii) Are there any options in the packet?
iii) What is the size of the data
iv) Is the packet fragmented
v) How many more routers can the packet travel to?

OR

10.b) In a network using a link-state routing protocol, consider routers **A, B, C, D**, and **E**, connected as follows:

- **A** is connected to **B** and **C**.
- **B** is connected to **A**, **C**, and **D**.
- **C** is connected to **A**, **B**, and **E**.
- **D** is connected to **B**.
- **E** is connected to **C**.

i) If a new link is established between routers **B** and **E** with a cost of 4, explain: [5]

- The process of LSA flooding across the network.
- How routers update their link-state databases and recalculate their shortest paths.

ii) After the new link is established, calculate the new shortest path from **Router D** to **Router E**. [5]

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