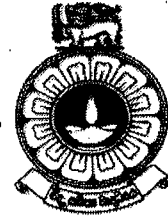


The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical & Computer Engineering



Study Programme : Bachelor of Science Honours in Engineering
Name of the Examination : Final Examination
Course Code and Title : EEX5434 Data Communications & Networking
Academic Year : 2024/25
Date : 11th March 2026
Time : 0930-1230h
Duration : 3 hours

General instructions

1. Read all instructions carefully before answering the questions.
 2. This question paper consists of **Five (5)** questions in **Six (6)** pages.
 3. Answer all **Five (5)** questions. All questions carry equal marks.
 4. Answer for each question should commence from a new page.
 5. This is a **Closed Book** Examination.
 6. Answers should be in clear handwriting.
 7. Do not use Red colour pen.
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Question 01

- a. Explain the concept of Protocol Data Units (PDUs) in relation to encapsulation and decapsulation in the OSI model. (05 marks)
- b. A company is designing a wireless sensor network to monitor temperature and humidity in a smart factory. Each sensor node needs to transmit data at a rate of 100 kbps to a central controller.

The available communication channel has the following characteristics:

- Bandwidth = 10 kHz
- Signal-to-Noise Ratio (SNR) = 15 dB

- (i) Using Shannon's capacity theorem, determine whether the required data rate can be theoretically supported or not by this channel. Show all necessary calculations. (05 marks)
- (ii) If the same channel is assumed to be noiseless, use the Nyquist theorem to calculate the minimum number of signal levels required to achieve the given data rate. (04 marks)
- (iii) Each sensor generates a data packet of 2 kB every measurement cycle. Calculate the minimum time required to transmit one such packet over this channel, assuming the system operates at the required data rate of 100 kbps. (02 marks)
- c. Encode the binary data sequence **11010110** and illustrate the corresponding waveform using the following encoding schemes: (04 marks)
1. Manchester
 2. Differential Manchester

Question 02

- a. Differentiate between IPv4 and IPv6 with respect to: (02 marks)
- (i) Address space
 - (ii) Address representation
- b. The ABC Campus network consists of five divisions on different floors of a building, interconnected via a high-speed fibre backbone. A private address block **10.10.0.0/21** has been allocated for the entire network.

The divisions and their internal network requirements are as in Table Q2.

Table Q2

Floor	Division	Required Hosts
1	Laboratories	390
2	Data Centre	180
3	Support Services	120
4	Administration	200
5	Academic	360

All floors are connected using Layer-3 core switch. Each division will be configured as a separate subnet and assigned a VLAN number. Inter-VLAN routing is implemented at the core layer.

- (i) Calculate the total number of required IP addresses and verify whether the given IP block 10.10.0.0/21 is sufficient. Show all working. (04 marks)
- (ii) Design a complete IP addressing scheme using VLSM (Variable Length Subnet Masking) for all divisions using the given address block 10.10.0.0/21. Your answer must include: (10 marks)
- Subnet address
 - Subnet mask (CIDR and dotted decimal)
 - Usable host IP range
 - Broadcast address
- (iii) The point-to-point links between the core switch and respective floor access switch must use separate /29 subnets. Allocate suitable IP addresses for these links. (04 marks)
- Core ↔ Floor 1 (Laboratories)
 Core ↔ Floor 2 (Data Centre)
 Core ↔ Floor 3 (Support Services)
 Core ↔ Floor 4 (Administration)
 Core ↔ Floor 5 (Academic)

Question 03

- a. Compare Distance Vector Routing and Link State Routing under the following headings: (06 marks)
- (i) How is the information exchanged & updated
 - (ii) Convergence speed
 - (iii) Memory requirement
- b. Figure Q3 shows a network which has six nodes and the cost for each interface at a particular instance is as given in the Figure Q3. Use **Distance Vector routing protocol** to determine the shortest path from **A** to all other nodes of the network by using Table Q3. (10 marks)

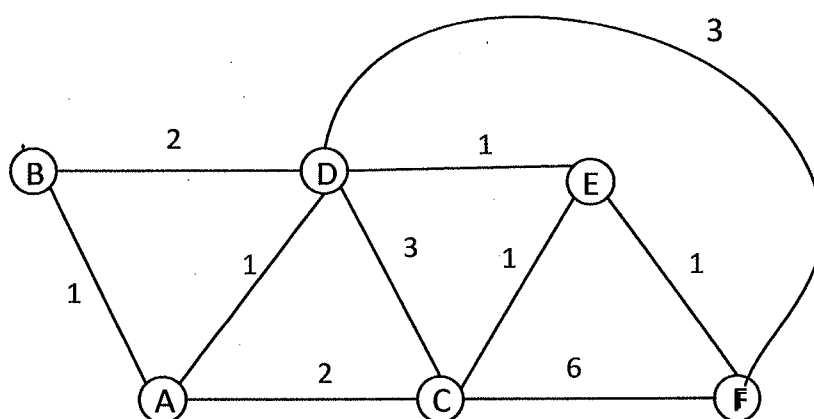


Figure Q3

Table Q3

Iteration	B		C		D		E		F	
	Cost	Path	Cost	Path	Cost	Path	Cost	Path	Cost	Path

- c. In certain failure scenarios, the network administrator observes that the routing protocol requires an unusually long time to reach a stable state. (04 marks)
- (i) Identify the distance vector routing problem responsible for this behaviour.
 - (ii) It is stated that BGP does not experience this problem. Explain why BGP is not affected.

Question 04

- a. (i) Compare TCP and UDP in terms of: (03 marks)
- I. Header size
 - II. Overhead
 - III. Suitability for real-time applications
- (ii) Explain how the three-way handshake in TCP, ensures reliable and synchronized communication. (04 marks)
- (iii) "A SYN flood attack exploits the normal operation of the TCP three-way handshake by flooding a server with a large number of SYN (synchronize) requests." Briefly explain how the three-way handshake is exploited in this situation. (04 marks)
- b. (i) A Selective Repeat system uses a 4-bit sequence number field. (05 marks)
- i. What is the maximum allowable window size?
 - ii. Justify your answer using an example.
- (iii) Compare Selective Repeat and Go-Back-N in terms of: (04 marks)
- i. Operation
 - ii. Buffer requirements
 - iii. Retransmission overhead
 - iv. Suitability for high error-rate links.

Question 05

- a. (i) Compare the following email protocols with respect to their operations: (03 marks)
- i. SMTP
 - ii. POP3
 - iii. IMAP
- (iii) Discuss how MIME works together with SMTP to support rich email communication. (03 marks)
- b. A client in a Sri Lankan campus network requests the IP address of the domain cba.mit.edu. Explain, with the aid of a neat diagram, the complete DNS resolution process, assuming that no relevant information is available in any cache. (06 marks)

- c. A university campus network hosts its own DNS server for the domain mit.edu. Suddenly, users report that domain names cannot be resolved, although the server hardware appears to be functioning normally. The technical team confirms that a Distributed Denial of Service (DDoS) attack has occurred. (02 marks)

Propose two technical countermeasures that can be implemented to protect the DNS infrastructure from DDoS attacks.

- d. A university campus network has multiple buildings, each with hundreds of devices, including computers, IoT sensors, and Wi-Fi access points. Network administrators often need to reconfigure access control, prioritize traffic for online lectures, and dynamically allocate bandwidth. Currently, these tasks require manually configuring each switch and router. (06 marks)

Explain how implementing Software Defined Networking (SDN) could simplify network management in this scenario. Include at least two advantages.

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