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Daffodil International University

Faculty of Science & Information Technology

Department of Software Engineering

Midterm Examination, Spring 2026

Course Code: SE-225

Course Title: Data Communication and Computer Networking

Sections & Teachers: (A-J) KBB, RT, AMR, MH, HBM

Time: 1 Hour 30 Mins **Marks: 25**

Answer ALL Question

[The figures in the right margin indicate the full marks and corresponding course outcomes. All portions of each question must be answered sequentially.]

1.	A national defense agency is designing a communication network for 6 critical command centers scattered across rugged terrain. The primary requirement is maximum fault tolerance; the network must sustain communication even if multiple links or nodes fail simultaneously during a crisis. Cost and cabling complexity are secondary concerns, but latency should be minimized.			
	a)	**Investigate** the scenario to identify the most suitable network topology for this setup & justify your choice by explaining how this topology meets the agency's needs.	[Marks-2]	CLO- 1 *Level-4*
	b)	If the agency decides to add 20 more minor outposts to this network with a limited budget, **apply** your knowledge to modify the topology to balance the new cost constraints while maintaining high reliability for the original 6 centers.	[Marks-3]	
	"NebulaCloud", a data storage provider, has deployed a dedicated high-speed fiber optic backbone connecting their primary Data Center to a Regional Edge Node located 240 kilometers away. • Signal Physics: The laser transmitter at the Data Center injects a signal with a power of 8.0 mW. However, due to scattering and absorption in the glass, the signal power drops to 2.5 mW by the time it reaches the Edge Node. • Medium Properties: The fiber optic cable has a core refractive index that allows light to travel at a speed of $2.8\times10^{8}\ ms^{-1}$. • Traffic Data: During a scheduled backup, a 15 MB database snapshot is transmitted from the Data Center to the Edge Node. The network interface requires 0.5 seconds to fully push this entire file onto the link (Transmission Time).			

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	• Network Overhead: Due to router congestion, the frame experiences an average queuing delay of 5 milliseconds and a processing delay of 1.5 milliseconds at the receiver side.			
	c)	**Calculate** the attenuation per kilometer (in dB/km) of the fiber link	[Marks-2]	
	d)	**Compute** the total latency (in seconds) for transmitting that frame	[Marks-3]	
2.	A multinational bank has two major operational departments: • Department A (Trading Floor): Located in London, UK. This is a high-density environment with 200 workstations packed closely together. The room is filled with electronic equipment (multiple monitors per desk, servers, tickers), creating a noisy electromagnetic environment. • Department B (Data Analysis): Located in New York, USA. It contains 150 workstations in a standard office park. The bank requires a seamless network connecting these internal departments and a backbone linking the two countries.			CLO- 2 *Level-2*
	a)	As the network engineer, **discuss** which type of guided transmission medium should be used for each of the departments mentioned in the scenario.	[Marks-6]	
	b)	The London branch needs a high-speed backup link to a Disaster Recovery Center located on another skyscraper 5 km away. Laying a physical cable through the busy city streets is impossible. **Explain** which transmission media helps to meet this requirement & **discuss** advantages and disadvantages of this medium compared to wired methods.	[Marks-4]	
3.	A data link layer uses a bit-oriented framing protocol. A frame consists of a header, a payload, and a trailer. The protocol uses the bit pattern 01111110 (six consecutive 1s) as a flag to indicate the start and end of a frame. Consider a payload consisting of the following bit sequence: 00111111011111001			CLO- 3 *Level-3*
	a)	**Determine** the specific framing mechanism required to ensure the receiver can correctly distinguish the data from the frame delimiters & identify the final transmitted bit pattern of the following bit stream.	[Marks-2]	
	b)	If a Fixed-Sized Framing method were used instead (e.g., every frame is exactly 40 bits), and the payload was only 23 bits, **determine** how many bits of padding would be required?	[Marks-1]	
	c)	When a frame 1011001 is sent across the link, it is received as 1110011 at the destination. **Capture** the type of error that occurred and identify an appropriate error correction method that can be used to detect and correct this error.	[Marks-2]	