



বাংলাদেশ আর্মি ইন্টারন্যাশনাল ইউনিভার্সিটি অব সায়েন্স এন্ড টেকনোলজি, কুমিল্লা  
 BANGLADESH ARMY INTERNATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY (BAIUST), CUMILLA

Mid Term Examination, Spring 2026  
 Department of Computer Science and Engineering

Level-3 Term-II

Course Code: CSE 321

Course Title: Data Communication

Credit Hour: 3.0

Exam Duration: 1 hour 30 Minutes

Full Marks: 90

**Notes:**

- Figure on the right of each question indicates marks for respective question.
- Answer *all the* questions.
- Course Outcomes are:

**CO1:** Explain the fundamental concepts, components, and functions of a data communication system, including data transmission methods, communication protocols, network models, and media used for reliable and efficient data exchange.

**CO2:** Apply different data communication models, data and signal related concepts, encoding schemes, error detection and correction, transmission and multiplexing techniques to achieve efficient and reliable data communication.

**CO3:** Analyze and differentiate data transmission systems in terms of bandwidth, signal impairments, channel capacity, media, error detection and correction methods, transmission techniques, multiplexing and high-speed networking technologies to determine their performance and operational efficiency in communication networks.

- A university is upgrading its old bus topology network to support online classes, VoIP calls, file sharing, and smart classroom systems. During peak hours, users experience slow communication, delays, and poor audio/video quality. The network administrator wants to analyze the communication system and propose a better network design.

To analyze the performance of the communication system, the network administrator studies the delay experienced by a large data frame transmitted through the campus backbone network. [CO3→C4]

- Select suitable transmission type and data flow mode for applications such as video conferencing, email communication, IoT classroom monitoring, and centralized database access. Justify your answer. 10

**OR,**

Define Transmission Impairments. Explain with suitable diagrams how Attenuation, Distortion, and Noise impair a digital signal during transmission.

b. Compare the existing bus topology with mesh topology topology in terms of:

- i) Reliability,
- ii) Cost,
- iii) Performance,
- iv) Network expansion.

c. If a frame of size 50 million bits is sent over the communication link having:

6

- i) Bandwidth = 5 Mbps
- ii) Distance = 2 km
- iii) Propagation speed =  $2 \times 10^8$  m/s ✓
- iv) Number of routers = 10
- v) Queuing delay per router =  $2 \mu\text{s}$  ✓
- vi) Processing delay per router =  $1 \mu\text{s}$  ✓

Calculate total delay. Which component of the total delay is dominant? Which one is negligible?

d. What does the Shannon capacity and Nyquist theorem have to do with communications? Can these be used together in practical aspects? ✓

6

2. You have been hired as a network consultant for a medium-sized organization that wants to implement a new enterprise network. The company has multiple departments located in different buildings and needs reliable communication for email, file sharing, video conferencing, and web-based applications. Management is confused about whether to follow the OSI model or the TCP/IP protocol suite. [C01→C4]

a. The company's network uses TCP/IP. Identify and explain the four types of addresses used in TCP/IP communication with the help of a suitable diagram. Clearly show how these addresses are used at different layers when two processes communicate over the internet.

15

b. When a packet travels from the sender's computer to the receiver's computer across multiple routers, which addresses change at each hop and which addresses remain constant throughout the journey? Justify your answer with proper reasoning.

5

c. Analyze the company's requirements and recommend the most suitable transport layer protocol for the following applications. Justify your choice by relating it to connection-oriented or connectionless service:

10

- i) Email transmission
- ii) Real-time video conferencing
- iii) File transfer of important official documents
- iv) Whether it is possible to use both TCP and UDP for a single application in this organization, and give a suitable example.

OR,

If a digital signal of 3 bits is sent over a low-pass channel, draw rough approximation of signal using first harmonic for each cases. Determine frequency and phase for each analog signal.

3. An ISP is planning to provide high-speed dedicated internet service to a corporate office using the existing telephone infrastructure (bandpass channel). The company requires downloading 150 pages per second. Each page contains 60 lines with 80 characters per line (using 8-bit ASCII). The ISP wants to use a digital signal with 32 levels for transmission. [CO2→C3]
- Calculate the minimum bit rate required to meet the company's demand. 3
  - How many bits can be represented by each signal level? Calculate the required symbol rate. 3
  - If baseband transmission is used, calculate: 4
    - Minimum bandwidth required (using first harmonic only)
    - Recommended bandwidth for better quality (using first three harmonics)
  - If the available channel is a bandpass channel with a bandwidth of 4 MHz, explain whether baseband transmission is possible. If not, what solution should the ISP use? Name the device used for this purpose. 10
  - Differentiate between baseband transmission and broadband transmission. What are the challenges we face at each type? 10