

Course Name: **Principles of Data Communications**

Course Code: **CS200**

Date: 06/12/2021

Time: 9.30 AM - 12.30 PM

Duration: 3 Hours

Max. Marks: 100

ANSWER ALL QUESTIONS

1. (a) Assume ten devices are arranged in a mesh topology. How many cables are needed? How many ports are needed for each device? [3]
(b) Draw a hybrid topology with star and bus networks. [3]
(c) Assume we have an isolated link (not connected to any other link) such as a private network in a company. Do we still need addresses in both the network layer and the data-link layer? Justify your answer. [4]
2. (a) Assume we have created a packet-switched internet. Using the TCP/IP protocol suite, we need to transfer a huge file. What are the advantage and disadvantage of sending large packets? [5]
(b) The Internet is made up of a large number of networks. Their arrangement determines the topology of the Internet. Write a short note on the Internet topology. [5]
3. (a) Assume that SNR(dB) is 48 and the channel bandwidth is 2 MHz. Calculate the theoretical channel capacity. [3]
(b) Let a bandwidth of 2000 Hz (100 to 2100 Hz) be assigned for data communication. The SNR is 4020. What will be the capacity for this channel? [3]
(c) We need to send 500 Mbps over a noiseless channel with a bandwidth of 100 kHz. How many signal levels do we need? [4]
4. (a) If a binary signal is sent over a 5-kHz channel whose signal-to-noise ratio is 10 dB, what is the maximum achievable data rate? [3]
(b) What are the advantages of fiber optics over copper as a transmission medium? Is there any downside of using fiber optics over copper? [3]
(c) Five signals, each requiring 500 Hz, are multiplexed onto a single channel using FDM. What is the minimum bandwidth required for the multiplexed channel? Assume that the guard bands are 50 Hz wide. [4]

5. (a) A signal has a fundamental frequency of 1000 Hz. What is its period? [2]
- (b) For the bit stream 1000010111, sketch the waveforms of:
- i. NRZ-L
 - ii. NRZ-I
 - iii. Manchester
 - iv. Differential Manchester [8]
6. (a) Five 1-kbps connections are multiplexed together. A unit is 1 bit. Find (i) the duration of 1 bit before multiplexing, (ii) the transmission rate of the link, (iii) the duration of a time slot, and (iv) the duration of a frame. [5]
- (b) Distinguish between synchronous and statistical TDM. [5]
7. (a) Calculate the Hamming distance between the following codewords:
- i. 011100, 011011
 - ii. 1110101, 0010110 [5]
- (b) Assuming even parity, find the parity bit for each of the following data units: 001101, 110101, 1100, 0000, 11011 [5]
8. (a) Suppose that a message FF32 E321 1543 BB21 A142 is transmitted using Internet Checksum. What is the value of the checksum? [5]
- (b) Compute the frame check sequence if the data to send $D = 1011010010$ (10 bits) and predefined pattern $P = 110010$ (6 bits). Receiver receives 101101001000110. Identify if any error occurred while transmission. [5]
9. (a) Apply Shannon Fano coding procedure for the following message ensemble.
- $[x] = [x_1; \quad x_2; \quad x_3; \quad x_4; \quad x_5; \quad x_6; \quad x_7; \quad x_8]$
 $[P] = [1/16; \quad 1/16; \quad 1/4; \quad 1/8; \quad 1/16; \quad 1/8; \quad 1/4; \quad 1/16]$
- [5]
- (b) Apply Huffman coding on the following text:
- Digital data [5]
10. (a) Consider a scenario where there are 'n' stations on a link and all are waiting to transfer data through that channel. In this case, all 'n' stations would want to access the link/channel to transfer their own data. Problem arises when more than one station transmits the data at the moment. How is this problem solved in wired LAN? [5]
- (b) In WLANs, the hidden terminal problem is a transmission problem that arises when two or more stations who are out of range of each other transmit simultaneously to a common recipient. How is hidden node problem handled? [5]