

(ii) Starting and ending flag bytes, with bit stuffing.

(iii) Character Count

Also, what will be the original data, if the output after byte-stuffing is given as :

FLAG A B ESC ESC C ESC ESC ESC FLAG
ESC FLAG D X FLAG.

(b) Write short notes on : (8)

(i) File Transfer Protocol

(ii) Simple Mail Transfer Protocol

7. (a) State Shannon's theorem. Determine the maximum achievable data rate for this channel based on Shannon's theorem when the communication channel has a bandwidth of 5 MHz and an SNR of 40 dB. (7)

(b) Draw the layered architecture of TCP/IP model explaining the services provided by each layer. Given an example network, if we change the LAN technology to a new one, which layers in the TCP/IP protocol suite need to be changed and why? List the layers at which routers and switches are used. (8)

(1500)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4133 H

Unique Paper Code : 2342012403

Name of the Paper : Computer Networks

Name of the Course : **B.Sc. (Hons.) Computer Science (UGCF NEP)**

Semester : IV

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. The paper has **two** sections. **All** questions in '**Section A**' are compulsory.
3. Attempt any **four** questions from '**Section B**'.
4. Parts of a question must be answered together.

Section A

1. (a) For each of the following four networks, discuss the consequences if a connection fails : (3)
 - (i) Five devices arranged in a mesh topology

P.T.O.

- (ii) Five devices arranged in a bus topology
- (iii) Five devices arranged in a ring topology
- (b) For each of the following network applications, indicate whether TCP or UDP would best fit the service requirements of the application, and justify. (3)
- (i) Multiplayer online first-person shooting game
 - (ii) Text-based instant messaging app
 - (iii) Video Streaming
- (c) Calculate the maximum data rate of a channel with a bandwidth of 200KHz when sixteen levels of digital signaling are used. (3)
- (d) Suppose a communication system has a bandwidth of 10 MHz. Using FDM, this bandwidth is divided into 5 equal frequency bands. Each band carries a separate signal with a bandwidth of 2 MHz. Calculate the total bandwidth required for multiplexing these signals using FDM. (3)
- (e) Name the layer of the OSI model which performs the following functions : (3)
- (i) Route determination

5. (a) Assume that a voice channel occupies a bandwidth of 4 kHz. We need to multiplex 10 voice channels with guard bands of 500 Hz using FDM. Calculate the required bandwidth. (5)
- (b) (i) A code includes the four four-bit codewords: 1001, 0110, 1010, and 0101.
- What is the minimum distance of this code?
 - What is the maximum number of errors that this code is guaranteed to detect?
 - What is the maximum number of errors that this code is guaranteed to correct?
- (ii) A 12-bit odd-parity Hamming code whose binary value is 111001001111 arrives at a receiver. What was the original value of the message ? Assume that not more than 1 bit is in error. (4+6)
6. (a) The following character encoding is used in a data link protocol: A: 7 11010101; B: 10101001; FLAG: 01111110; ESC: 10100011 Show the bit sequence transmitted (in binary) for the five-character frame: A ESC B ESC FLAG when each of the following framing methods are used : (7)
- (i) Flag bytes with byte stuffing.

(b) Differentiate between the following : (8)

(i) Unipolar and Bipolar Line Coding Schemes

(ii) Data Element and Signal Element

4. (a) Which algorithm is used in CSMA/CD networks, particularly in scenarios where multiple stations contend for the channel while transmitting long files? Give the functionality of the algorithm.

(5)

(b) Given the IP address 192.168.0.0/24, an organization needs to create two subnets with the following requirements: (10)

- Subnet 1: 50 hosts
- Subnet 2: 30 hosts

For each of these subnets, give the

(i) first IP address assigned

(ii) last IP address assigned

(iii) subnet mask in the w.x.y.z/s notation

(iv) identify the range of IP addresses available

(v) number of host and network bits

(ii) Process-to-process delivery

(iii) Error Correction and error Detection

(f) State the significance of the following special IP addresses : (3)

(i) 127.0.0.1

(ii) 255.255.255.255

(iii) 0.0.0.0

(g) What is the purpose of following flag bits with respect to TCP header? (3)

(i) SYN

(ii) FIN

(iii) DF

(h) In a mesh network configuration comprising eight devices, how many ports does each device require to establish direct connections with every other device in the network? Furthermore, what is the total count of physical links necessary to facilitate data communication between all interconnected devices? (3)

(i) Give three differences between circuit switching and packet switching? (3)

- (j) Name the protocols to be used in the following scenarios : (3)
- (i) To map an IP address to a MAC address
 - (ii) To map a MAC address to an IP address
 - (iii) To assign the IP addresses to the host automatically

Section B

2. (a) Compare and contrast TCP and UDP (User Datagram Protocol) in terms of their features, advantages, and disadvantages. Discuss scenarios where each protocol would be suitable for data transmission. (7)
- (b) Consider a network comprising five routers labeled as A, B, C, D, and E. The interconnections and their associated costs are given as follows :
- Link between A and B: Cost 2
 - Link between A and C: Cost 4
 - Link between B and C: Cost 1
 - Link between B and D: Cost 5
 - Link between C and D: Cost 3
 - Link between C and E: Cost 7
 - Link between D and E: Cost 2

Using Dijkstra's algorithm, illustrate the step-by-step process of determining the shortest path from router A to router E. (8)

3. (a) Consider a Go-Back-N ARQ protocol operating over a network. The window size (W) is 4, and the sequence numbers range from 0 to 7. Assume that frames with sequence numbers 0, 1, 2, and 3 have been successfully received by the receiver, and the receiver has sent acknowledgment (ACK) for frames up to sequence number 3. Now, due to network congestion, the frame with sequence number 4 is lost. (7)
- (i) What is the size of the window for sender and receiver?
 - (ii) Calculate the range of valid sequence numbers at the sender's side after the loss of frame with sequence number 4.
 - (iii) Determine the range of sequence numbers expected by the receiver after it has sent ACK for frames up to sequence number 3.
 - (iv) Explain how the sender and receiver handle the loss of frame 4 and maintain synchronization using sequence numbers in the Go-Back-N ARQ protocol.