MID-SEMESTER EXAMINATION, DECEMBER-2022
COMPUTER NETWORKING (CSE 3034)

Programme: B.Tech (CSE, CSIT) **Semester:5th**
Full Marks: 30 **Time: 2 Hours**

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
CO1-Able to understand the architectural principles of computer networking and compare different approaches to organising networks.	L1, L2, L3	1(a),2(a), 1(b), 2(b), 1(c),2(c)	12
CO2-Able to analyze the physical characteristics and functions of the physical devices and interfaces so that transmission can occur in different transmission medium.	L1, L2, L3	3(a), 3(b), 3(c), 4(a), 4(b), 4(c)	12
CO3-Able to examine various Data Link layer design issues and Data Link protocols.	L1, L2, L3	5 (a),(b),(c)	6

*Bloom's taxonomy levels: Knowledge (L1), Comprehension (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

Answer all questions. Each question carries equal mark.

1. (a) Differentiate between computer network, subnet, and internetwork. 2

   (b) Classify the networks on the basis of scale. 2

   (c) An image is 1024 x 1024 pixels with 4 bytes/pixel. Assume the image is uncompressed. How long does it take to transmit it over a 56-kbps modem channel? Over a 1-Mbps cable modem? Over a 10-Mbps Ethernet? Over 100-Mbps Ethernet? 2

2. (a) What are the seven layers of OSI reference model? Briefly summarizes the principles that were applied to design the layers in OSI model. 2

(b) Explain with neat diagram the architecture of INTERNET. 2

(c) What is the difference between synchronous and asynchronous transmission? Explain ATM virtual circuit? 2

3. (a) Explain briefly the functions of Physical layer. 2

(b) Assume you want to send 8 bits first at 600 bps, then at 38400 bps over an ordinary phone line of bandwidth 3 KHz. 2

i). Calculate the highest harmonic passed through the telephone line in both cases.

ii). In which case signal received would be difficult to reconstruct ?

(c) What is the maximum data rate in a noisy 4-kHz channel with SNR 20 dB? 2

4. (a) What are the key components of an optical transmission system? Name the advantages of optical fiber over coaxial cable. 2

(b) A modem constellation diagram has data points at the following coordinates: (1, 1), (1, -1), (-1, 1), (-1, -1), (2, 2), (2, -2), (-2, 2), (-2, -2). 2

i). Draw constellation diagram.

ii). How many bps can a modem with these parameters achieve at 1200 baud?

(c) What is the goal of multiplexing? Distinguish between FDM and TDM. 2

5. (a) Explain briefly the functions of Data Link layer. 2

(b) Suppose an 8 bit transmitted data is 11000010. Using the Hamming algorithm determine what check bits would be transmitted with the data? 2

(c) The following character encoding is used in a data link protocol: 2

A: 01000111; B: 11100011; FLAG:01111110; ESC: 11100000

Show the bit sequence transmitted (in binary) for the four-character frame: A B ESC FLAG when each of the following framing methods are used:

i). Flag bytes with byte stuffing.

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

End of Questions

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INTERNAL ASSESSMENT EXAMINATION

Q.No	Mark Obtaines (a b c)	Full Marks
1.	2 2 2	
2.	2 2 2	
3.	2 2 2	
4.	2 2 2	
5.	2 2 2	
6.		
7.		
8.		
9.		
10.		
Total	30	30

EXAMINER

INVIGILATOR

Excellent

Writing Space

(1) (a) Computer network is a collection of autonomous computers interconnected by a single technology to exchange information among hosts.

- Subnet is a group/collection of routers whose role is to convey messages from sending host to receiving host.

- Internetwork is a network of networks, i.e. a group/collection of interconnected networks.

(b) Size of image = 1024 × 1024 pixels
= 1024 × 1024 × 4 bytes
= 1024 × 1024 × 4 × 8 bits
= 33554432 bits

- Time taken to transmit over 56 kbps modem channel

$= \frac{33554432}{56 \times 10^3} \approx 599.186$ seconds

- Time taken to transmit over 1 Mbps cable modem

$= \frac{33554432}{1 \times 10^6} \approx 33.554$ seconds

- Time taken to transmit over 10 Mbps Ethernet

$= \frac{33554432}{10 \times 10^6} \approx 3.355$ seconds

- Time taken to transmit over 100 Mbps Ethernet

$= \frac{33554432}{100 \times 10^6} \approx 0.335$ seconds

(b)

Interprocessor distance	Area covered	Example
1 m	Square metre	Personal Area Network (PAN)
10 m	Room	Local Area Network (LAN)
100 m	Building	
1 km	Campus	
10 km	City	Metropolitan Area Network (MAN)
100 km	Country	Wide Area Network (WAN)
1000 km	Continent	
10,000 km	Planet	The Internet

Classification of Networks on the basis of Scale

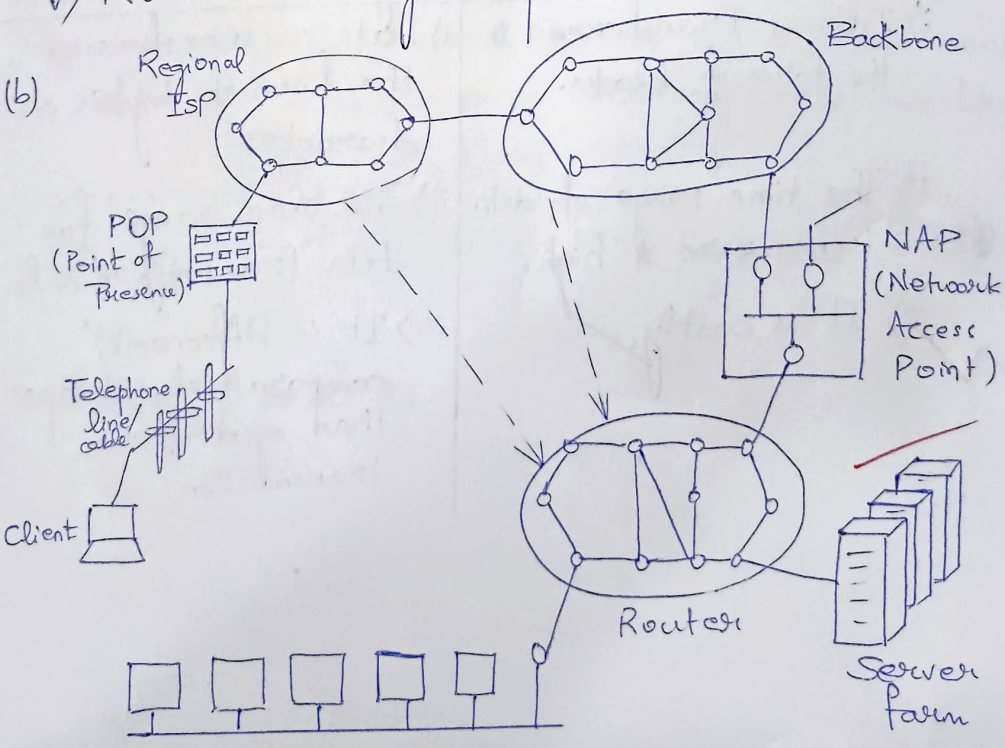
(5) (a) • The 7 layers of OSI reference model are:

i) Application layer
ii) Presentation layer
iii) Session layer
iv) Transport layer
v) Network layer
vi) Data link layer
vii) Physical layer

12 • The principles that were applied to design the layers in OSI model are as follows:

i) Layers are created when different abstractions are needed.
ii) Each layer has a well-defined function.
iii) The function of each layer is defined, keeping in mind the definitions of ~~In~~ Internet Service Protocols.
iv) Minimize data transmission across interfaces
v) Number of layers optimum

(b)



The Architecture of INTERNET

→ The client calls his/her ISP over a dial-up telephone line.
→ The client machine gets connected to the regional ISP through POP (Point of Presence).
→ The ISP's regional network is a group of of machines providing telecom services in places where they are located.
→ If the packet ~~sent by~~ defined for host is directly served by the same ISP, then the packet is delivered to the host, otherwise it is forwarded to the backbone operator.
→ If the destination host is directly connected to the backbone operator, then ~~it is~~ the packet is delivered to the host, otherwise it is sent to other ISP's backbone operator through NAP (Network Access Point).
→ Finally the packet is delivered to the host.

(c)

Synchronous transmission	Asynchronous transmission
i) Data is transferred in the form of blocks.	i) Data is transferred in the form of bytes or characters.
ii) The time range of data transmission is high.	ii) The time range for data transmission is low.
iii) It is costly.	iii) It is efficient/ comparatively cheaper than synchronous transmission.

(a) The functions of Physical layer are as follows:

i) The physical layer is concerned with transmission of raw data bits over the communication channel.

ii) It accepts data from the upper layer and converts it into 1's and 0's to transmit in media.

iii) It checks how the data is encoded onto the media for data transmission.

(b) Given data

No. of bits = $n = 8$

Data rate : $R_1 = 600$ bps, $R_2 = 38,400$ bps

Bandwidth = $BW = 3$ kHz $= 3000$ Hz

i) Highest harmonic passed through telephone line in

Case 1 $= \frac{BW}{R_1/n} = \frac{3000}{600/8} = \frac{24000}{600} = 40$ harmonics

Case 2 $= \frac{BW}{R_2/n} = \frac{3000}{38,400/8} = \frac{3000}{4800} = 0.625$ harmonic

ii) The signal received would be difficult to reconstruct in case 2 where the bits are sent at 38,400 bps over an ordinary telephone line.

(c) Given data

Noisy channel, $H = 4$kHz $= 4000$ Hz, SNR = 20 dB

SNR = 20 dB

$\Rightarrow 10\log_{10}\left(\frac{S}{N}\right) = 20$ dB

$\Rightarrow \frac{S}{N} = 10^2$

$\Rightarrow \frac{S}{N} = 100$

Now, using Shannon's theorem for noisy channel,

max^m data rate = $H \log_2\left(1 + \frac{S}{N}\right)$ bits/sec

$= 4000 \times \log_2 (1 + 100)$ bits/sec

$= 4000 \times \log_2 (101)$ bits/sec

$= 4000 \times 6.658$ bits/sec

$= \frac{4}{4000} \times 6658$ bits/sec

$= 26,632$ bits/sec

≈ 26.6 kbps

∴ The maximum data rate in a noisy 4 kHz channel with SNR 20 dB is 26.6 kbps.

(4)(a) • The key components of an optical transmission system are as follows:

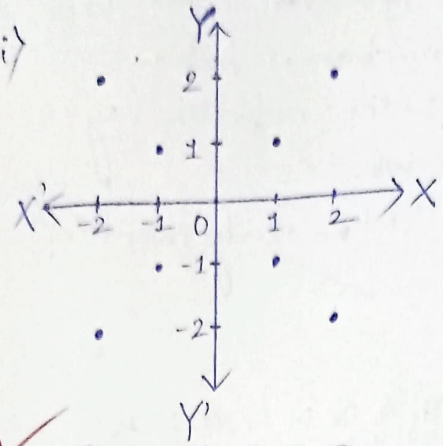
i) Light emitting source
ii) Transmission medium
iii) Detector

• The advantages of optical fiber over coaxial cable are as follows:

i) Optical fiber can handle much higher bandwidth than coaxial cable.
ii) It is ultrathin and light weighted.
iii) It is not affected by any power surges, power failures or EM radiations.
iv) Its installation cost is low for new routers.
v) Due to low attenuation, repeators need to be placed in only every 100 kms for longer distances.

(b) Data points at coordinates (1,1), (1,-1), (-1,1), (-1,1), (2,2), (2,-2), (-2,2), (-2,2)

i)



Constellation Diagram

ii) Given Baud rate = S = 1200 baud

n = 8 for 8 different combinations

$r = \log_2(n) = \log_2(8) = \log_2(2^3) = 3\log_2 2 = 3$

$N = r \times S = 3 \times 1200 = 3600$ bps

∴ A modem with these parameters can achieve 3600 bps at 1200 baud.

(c)

FDM	TDM
i) FDM stands for Frequency Division Multiplexing.	i) TDM stands for Time Division Multiplexing.
ii) Frequency sharing is performed.	ii) Time sharing is performed.
iii) It works only for analog signals.	iii) It works for both digital and analog signals.
iv) It has high conflict.	iv) It has low conflict.
v) Wiring is complex.	v) Wiring is simple.
vi) Interference of signals is high.	vi) Interference of signals is low or negligible.
vii) It faces the problem of crosstalk.	vii) It rarely/hardly faces the problem of crosstalk.
viii) It is used in optical fibers or other copper cable.	viii) It is used in telephone lines and ISPs.

(5) (a) The functions of data link layer are:

i) It performs framing of transmitted data.

ii) It acts as a medium/channel between the physical layer and the network layer in OSI reference model.

iii) It performs/neglects acknowledgement of transmitted data.

(b) Given

8 bit transmitted data $\underset{D_{12}}{1}\ \underset{D_{11}}{1}\ \underset{D_{10}}{0}\ \underset{D_9}{0}\ \underset{D_7}{0}\ \underset{D_6}{0}\ \underset{D_5}{1}\ \underset{D_3}{0}$.

Check bits (using Hamming Algorithm):

$C_1 = D_3 \oplus D_5 \oplus D_7 \oplus D_9 \oplus D_{11}$

$= 0 \oplus 1 \oplus 0 \oplus 0 \oplus 1$

$= 0$

$C_2 = D_3 \oplus D_6 \oplus D_7 \oplus D_{10} \oplus D_{11}$

$= 0 \oplus 0 \oplus 0 \oplus 0 \oplus 1$

$= 1$

$C_4 = D_5 \oplus D_6 \oplus D_7 \oplus D_{12}$

$= 1 \oplus 0 \oplus 0 \oplus 1$

$= 0$

$C_8 = D_9 \oplus D_{10} \oplus D_{11} \oplus D_{12}$

$= 0 \oplus 0 \oplus 1 \oplus 1$

$= 0$

∴ The check bits which would be transmitted with the data are $C_1 = 0$, $C_2 = 1$, $C_4 = 0$, $C_8 = 0$, i.e. 0010.

(c) Given

A: 01000111

B: 11100011

A B ESC FLAG

FLAG: 01111110

ESC : 11100000

i) Flag bytes with byte stuffing

01111110 01000111 11100011 11100000

F A B E

11100000 11100000 01000111 11100011 ~~01111110~~

E E F F

+2

ii) Starting and ending flag bytes, with bit stuffing

01111101 0 01000111 11100011 11000000

11100000 11100000 01000111 11100011 01111101 0