(A)

CSC425

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# EXAM 1

## 1) True/ False (7 POINTS)

T a- In a frame, the trailer usually contains an error checking component. T

T b- The header of a frame of a packet contains the source and destination addresses. T

F c- The smaller the BER of the channel, the shorter the maximum packet size used. F

T d- Bit stuffing is used to prevent incorrect interpretation of the user-data field. T

T e-Twisted pair cables are easy to install, very cheap and immune to crosstalk problem. T

f f-With coax, duplex data communication can be provided only when two separate cables are used, one for the transmit channel and the other for the receive channel. F

f g- A data link layer provides error detection and end-to-end acknowledgement across multiple links. F

## 2) Match the OSI layer to the appropriate function (7 POINTS):

| | | |
|---|---|---|
| d | Application layer d | a) Ensures messages are delivered error free and in order. |
| e | Presentation layer c | b) Determines route from source to destination. |
| f | Session layer f | c) Packet sent as a bit stream. |
| a | Transport layer a | d) Represents services that directly support user applications. |
| b | Network layer b | e) Deals with formatting, display and encryption. |
| g | Data Link layer g | f) Provides synchronisation between user tasks. |
| c | Physical layer e | g) Deals with framing, data transparency and error control. |

3) A signal is transmitted through a coaxial cable with an attenuation of 10 dB/Km. The signal passes one amplifier where the signal strength is amplified 4 times. How far from the starting point is the signal strength attenuation 4 dB? (8 POINTS)

$Amp = 10 \log_{10} 4 = 6\,dB \Rightarrow 6 - 10x = -4$ for x = 1 Km

4) FSK modulation: First *Draw* then *Estimate* the bandwidth required of a channel to transmit 300bps. Assume the frequency shift is 800Hz, and the *fundamental* frequency components are received *only*. Finally *Select* possible values for the frequency of the 2 carriers that suit the PSTN (10 POINTS)

BR = 300bps

B = 800Hz

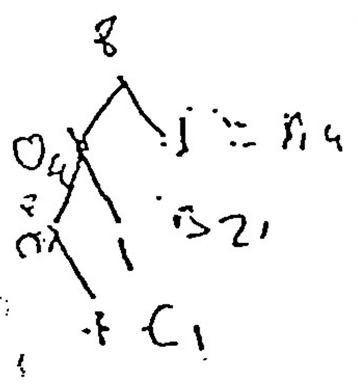
B = BR = 75Hz

5) Fill in the following properties in the appropriate boxes: (10 POINTS)

- ≤ 1 Mbps. ≤ 19.2 Kbps . 10 Mbps. ≤ 100 Mbps. Unlimited.
- High propagation delay. Crosstalk. Immune to electrical noise. Skin effect problem. Its geometry allows higher frequency signals.
- Local connections only. Used for baseband and broadband communications. Used in telephone and data networks. Perfect as LANs backbone. Connect remote areas.

| | Type | Bit Rate | Problem/ characteristic | Application |
|---|---|---|---|---|
| 1- | 2-wire open lines | ≤19.2Kbps | Crosstalk. | Local connections |
| 2- | Twisted-pair lines | ≤10Mbps | Skin effect | Used in telephone networks |
| 4- | Optical fibre | ≤100Mbps | Immune to electrical noise. | Perfect as LANs. |
| 3- | Coaxial cables | 10 Mbps | Its geometry allows higher frequencies | Used for baseband and broadband |
| 5- | Satellites (GEO) | Unlimited | High propagation delay. | Connections. |

6) The following string of characters AAAABBCD needs to be transmitted.



- First, calculate the relative frequencies of the characters: $P_A(\frac{4}{8}), P_B=\frac{2}{8}, P_C=\frac{1}{8}=P_D$.
- Second, Provide the *Huffman code tree*.
- Calculate the average number of bits per codeword. Any 2 (0.5+1)+2(0.25+1)+(1.75×5/2) =
- At the receiver, decode the following Huffman coded string of characters:

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| A | | B | | A | | D | | C | | A | B | | A | |

(12 POINTS)

7) A data source that sends data at a rate of 4800 bits/s is attached to a communication channel. Calculate the minimum required bandwidth (in Hz) of the channel if:

a) Noise cannot be neglected; here assume that the power of the signal at the receiver is 31 times the noise power. $C=W\log_2(1+\frac{S}{N})=4800=W\log_2 32 \Rightarrow W=\frac{\log_{10}32}{\log_{10}2}$

b) Noise can be neglected; here assume that each signal element transmitted represents 4 bits of data.

(12 POINTS)

$\therefore m=\log_2 H \Rightarrow m=\frac{\log_{10}H}{\log_{10}2} \Rightarrow \log_{10}H=m\log_{10}2 \Rightarrow 4\times 0.3=1.2$.

a) $\frac{5\times10^7}{56} = 892\text{ s}$ b) Prob(char corrupted) $= 1-(1-P)^{N} =$

Prob $= NP = 10\times10^{-4} = 10^{-3}$

∴ $\frac{1}{1-10^{-3}} \times 892$

8) It is required to transmit 1000 invoices between 2 cities running asynchronous modems at 56 Kbps. Assume the average length of each invoice is 5000 characters and each characters is made of 10 bits (8 bits + 1 start bit + 1 stop bit). How long will it take to transmit these 1000 invoices (file transfer time).

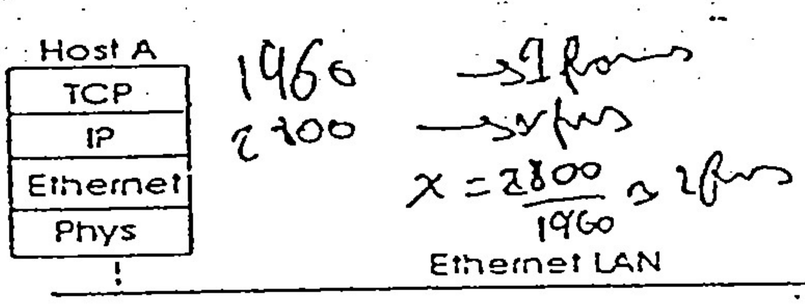
a) First assume that the BER is negligible.

b) Second assume that the BER $= 10^{-3}$ (12 POINTS)

9) In the network shown below, 2800 Bytes of data are delivered from an application on Host A to its transport layer. From the transport layer it is delivered down through the layers to be transmitted onto the Ethernet LAN. The destination of the data is Host B. Assume a TCP header and an IP header of 20 Bytes each. Also assume that the Ethernet header is 14 Bytes and the Ethernet trailer is 4 Bytes. How many frames are transferred over the Ethernet LAN if the maximum data packet size on the LAN is 1518 Bytes? Describe the structure of these frames. (10 POINTS)

INFRAME 1 $\Rightarrow$ (518 − [(4×20) + 14 + 4]) = 1460 bytes (data packet size) $\Rightarrow$

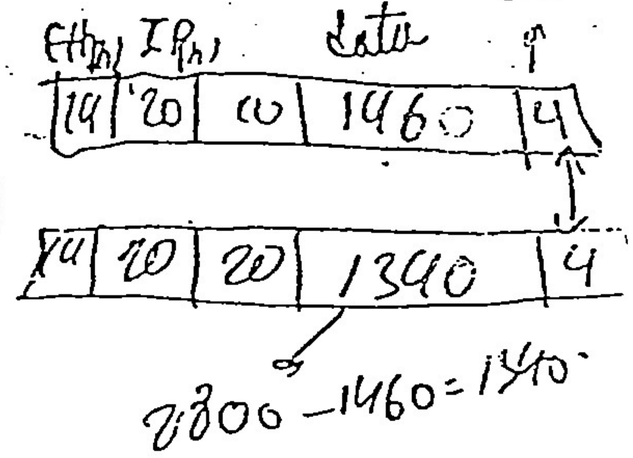
# frames $= \frac{2800}{1460} = 1.917 \approx 2$




1460 → 1 frame

2100 → 2 frames

$x = \frac{2800}{1460} \approx 2$ frames



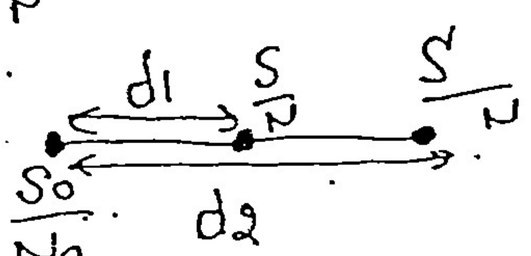

10) The received signal power in a wireless communication channel obeys the inverse square law, i.e. $S_{received} = \frac{S_{transmitted}}{d^2}$,

where $d$ is the distance separating the receiver from the source.

Consider a wireless channel with bandwidth $W = 10\,KHz$, the signal to noise ratio $\left(\frac{S}{N}\right)$ measured at distance $d_0 = 4\,\text{m}$ is 10. If the channel is intended to transmit at maximum data rate $C = 20Kb/s$, what is the maximum range (i.e. $d_{max}$) of the wireless channel in order to transmit the information reliably. Assume that the noise level $N$ does not change with distance. (12 POINTS)

Sol: $W = 10\text{kHz}$ for $d_0 = 4\text{m} \Rightarrow \frac{S}{N} = 10$

$C_{max} = W\log_2\left(1+\frac{S}{N}\right) = 20\text{kb/s}$




$\Rightarrow 20 = 10\log_2\left(1+\frac{S_2}{N}\right) \Rightarrow 2 = \log_2\left(1+\frac{S_2}{N}\right) \Rightarrow 1+\frac{S_2}{N} = 2^2 \Rightarrow \frac{S_2}{N} = 3 \Rightarrow S_2 = 3$