

1. A) Show that the maximum number of edges in a simple graph with  $n$  vertices is:  $[n(n-1)/2]$ .  
 B) What do you mean by planarity of a graph?  
 C) Show that 'every self loop is a circuit but not every circuit is a self loop'.  
 D) What is Dominance Number? Give example.

$[3 + 2 + 2 + 3 = 10]$

2. A) Define principle of Inclusion-Exclusion with proper example.  
 B) Show that the ring-sum of two cut set is either a third cut set or an edge disjoint union of two cut sets.  
 C) What is Chromatic Number? Mention three properties of Chromatic Number.
- $[3 + 3 + (1 + 3) = 10]$
3. A) Discuss Pigeonhole Theorem with example. What are its applications in Computer Science?  
 B) What is a spanning forest?  
 C) Define vertex covering and edge covering with example.

$[(3 + 2) + 2 + 3 = 10]$

4. A) Mention the properties of Kuratowski's two graphs.  
 B) Define Isomorphism with proper example.

$[5 + 5 = 10]$

5. A) What is embedding?  
 B) A connected graph has 9 vertices having degrees 2, 2, 2, 3, 3, 3, 4, 4 and 5. Determine the number of edges and regions in that graph.  
 C) Define 'Menger's theorem' for vertex connectivity with example.

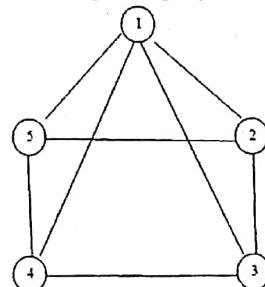
$[2 + 3 + 5 = 10]$

6. Define the following with proper diagram:  
 A) Articulation Point      B) Disconnected graph  
 D) Rooted Binary Tree      E) Hamiltonian Path  
 G) Sub-graph      H) Series edge      I) Chords

C) Graph Fusion  
 F) Regular Graph  
 J) Infinite Region

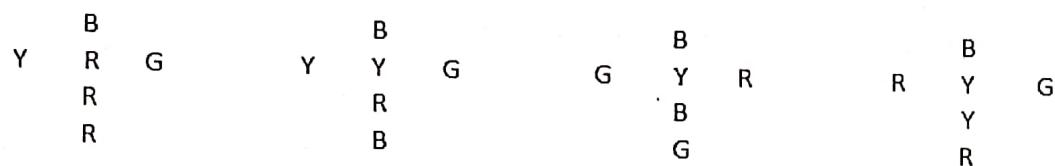
$[2 \times 10 = 20]$

7. A) Find the Chromatic Polynomial from the given graph:



P.T.O.

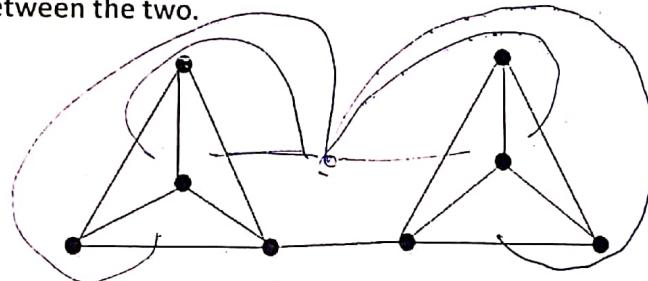
B) Given 4 cubes whose 6 faces are coloured with R, B, G, and Y. Is it possible to stack the cubes one on top of another to form a column such that no colour appears twice on any of the 4 sides of this column? Explain your answer.



C) Minimize the following switching function using covering concept:

$$f = A'B'CD' + A'B'C'D' + ABCD + A'BCD + A'BCD' + A'B'CD + AB'C'D'$$

D) Find out the geometric dual of the given graph and verify the relation between vertices, edges and regions between the two.



E) Suppose in an interview, four applicants A1, A2, A3 and A4 are there for seven positions p1, p2, p3, p4, p5, p6 and p7. The eligibility criteria are as follows:

$$A1 \rightarrow p1, p2, p5 \quad A2 \rightarrow p1, p2, p3, p5, p7 \quad A3 \rightarrow p1, p2 \quad A4 \rightarrow p2, p5$$

Is it possible to hire all the applicants and assign each a job? If no, then how many maximum applicants can be hired?

$$[6 \times 5 = 30]$$

Enrolment No. [ ]

B.Tech 5<sup>th</sup> Semester Mid-Term Examination, 2018  
 Subject: - GRAPH THEORY AND COMBINATORICS  
 Paper Code: - UCS05B09

Total Marks: -50

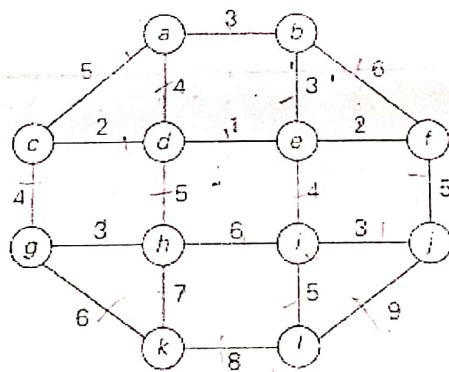
Time: 2:00 hrs

Attempt all the questions.

- ✓ 1. a) "In a tree every vertex is a cut-vertex" - justify the claim.  
 b) From the given encoding sequence, find out the *Prüfer decoding sequence* and *reconstruct* the original tree.  
 (3, 3, 4, 1, 5, 5, 1, 6, 6, 6, 2, 1, 3, 9, 9)  
 c) Can there be a path longer than a Hamiltonian path in a simple connected graph? Why?  
 $[3 + (2+2) + 3 = 10]$

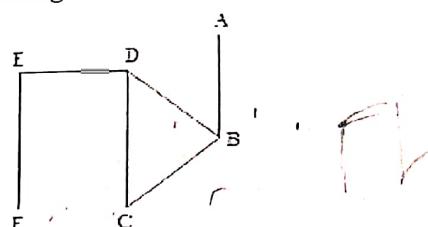
- ✓ 2. a) A simple, connected graph has the degree sequence as: 2, 2, 3, 4, 4, 5. How many *edges and regions* the graph has? The graph can be *planar or non-planar* – support your answer.  
 b) Show that – "*the ring sum of two cut set is either a third cut set or an edge disjoint union of two cut sets*".  
 c) Define *Decomposition*.  
 $[(2+2) + 4 + 2 = 10]$

- ✓ 3. a) A tree has 5 vertices of degree 2, 3 vertices of degree 3 and 4 vertices of degree 4. How many *pendant vertices* are there?  
 b) Using *Prim's algorithm* find out the *shortest spanning tree* from the given graph. What is the *weight* of the tree?



- ✓ c) What is a *separable graph*?  
 $[3 + (5+1) + 1 = 10]$

- ✓ 4. a) Using *Kirchhoff's Matrix Tree Theorem* find out the number of *spanning trees* in the following graph. *Draw* all those spanning trees.



- b) With proper example show the relation between - *fundamental circuit and fundamental cut set*.  
 $[(4+2) + 4 = 10]$

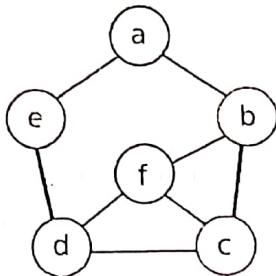
P.T.O.

5. a) Given 4 cubes whose 6 faces are coloured with R, G, B and Y. Is it possible to stack the cubes one on top of another to form a column such that no colour appears twice on any of the 4 sides of this column? Explain your answer.

B	B	B	B
Y    R    G	Y    Y    G	G    Y    R	R    Y    G
R	R	B	Y
R	B	G	R

b) What do you mean by 2-isomorphism?

c) What do you mean by Fusion? Fuse vertices d and f in the following graph and draw the resulting graph.



$$[5 + 2 + (1+2) = 10]$$

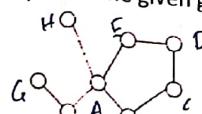
ATTEMPT ALL THE QUESTIONS

1. a)  $G$  is an undirected graph with  $n$  vertices and 25 edges such that each vertex of  $G$  has degree at least 3. Then what is the maximum possible value of  $n$ ?

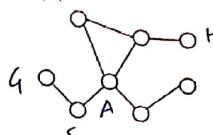
b) Which of the following statements is/are TRUE for undirected graphs?  
 P: Number of odd degree vertices is even. Q: Sum of degrees of all vertices is even.

- i) P Only    ii) Q only    iii) Both P & Q    iv) None of them

- c) Which of the following graphs is isomorphic to the given graph and why?



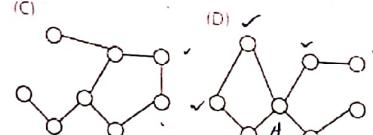
(A)



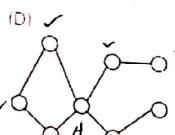
(B)



(C)



(D)



- d) Discuss with proper example how Counting Tree was originated.

- e) From the given sequence, find out the Prüfer decoding sequence and reconstruct the original tree.

- (i) (3, 3, 11, 11, 8, 8, 8, 9, 10, 12)    (ii) (3, 3, 4, 1, 5, 5, 1, 6, 6, 6, 2, 1, 3, 9, 9)

- f) Given 4 cubes whose 6 faces are coloured with R, G, B and Y. Is it possible to stack the cubes one on top of another to form a column such that no colour appears twice on any of the 4 sides of this column? Explain your answer.

Y    R    G

Y    Y    G

G    Y    R

R    Y    G

$$[1 + 1 + 2 + 2 + (2 + 2) + 5 = 15]$$

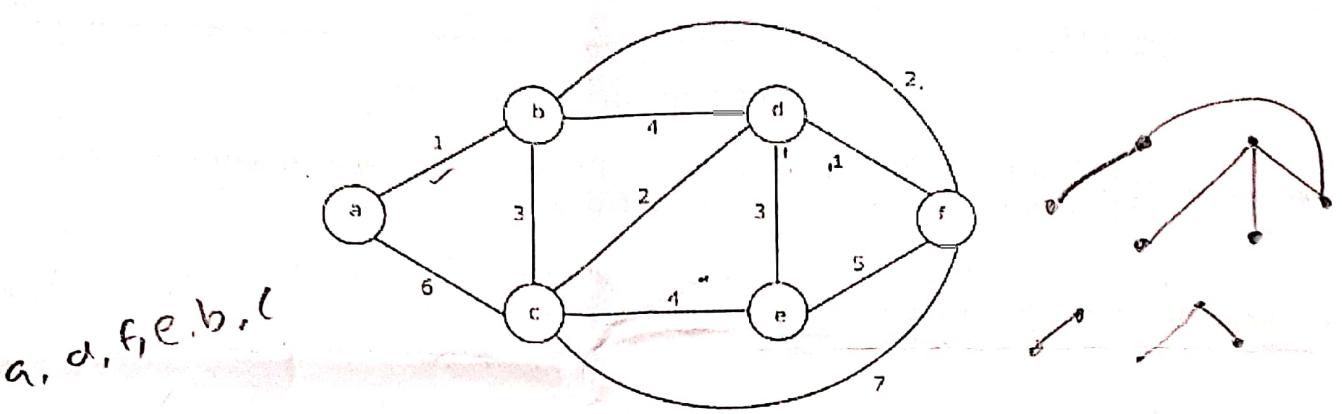
2. a) Explain how Euler graph solves Konigsberg Bridge problem.

- b) Which of the following sequences cannot be the degree sequence of any graph? Why?

- I. 7, 6, 5, 4, 4, 3, 2, 1    II. 6, 6, 6, 3, 3, 2, 2    III. 7, 6, 6, 4, 4, 3, 2, 2    IV. 8, 7, 7, 6, 4, 2, 1, 1  
 A. I & II    B. III & IV    C. II & IV    D. IV only

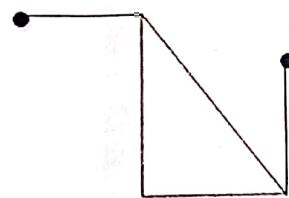
- c) Which one of the following cannot be the sequence of edges in a minimum spanning tree using Kruskal's algorithm? Explain.

7 6 5 4 6 3 2 1    6 6 6 6 3 3 2 2    6 6  
 1 8 5 5 2 2 1 1  
 4 4 1 1 1 0 9  
 X 3 0 0 0



- A. ab, df, bf, dc, de      B. ab, df, dc, bf, de      C. df, ab, bf, de, dc      D. df, ab, dc, bf, de

d) Using Kirchhoff's Matrix Tree Theorem find out the number of spanning trees in the given graph. Draw all those spanning trees.



Q. Find the shortest spanning tree from the given graph. What is

B.Tech 5<sup>th</sup> Semester Mid Term Examination 2017  
Data Communication  
UCS05B07

S<sub>5</sub> (UCS05B07) CSE

Full Marks: 50

Time: 2 hours

[The figure in the margin indicate full marks for the question]

Answer all the questions.

1.

- (a) For  $n$  devices in a network, what is the number of cable links required for a mesh, ring, bus and star topology? (5 X 2 = 10)
- (b) If the peak voltage value of a signal is 30 times the peak voltage value of the noise, what are the SNR and  $\text{SNR}_{\text{dB}}$ ?
- (c) Find the following:
- Hamming weight of code vector  $x = 01011110$
  - Hamming Distance between the code words 11010100 and 01011110
- (d) The following bit stream is encoded using VRC, LRC and even parity. Locate and correct the error if it is present.  
11000011 11110011 10110010 00001010 | 00101010 00101011 10100011 01001011  
11100001
- (e) Find the checksum of the following message:  
10110001, 10101011, 00110101, 10100001

2.

- (a) A TV channel has a bandwidth of 6 MHz, if we send a digital signal using one channel, what are the data rates if we use one harmonic, three harmonics and five harmonics? (5 X 2 = 10)
- (b) Generate the CRC code for the data word 110010101. The divisor is 10101.
- (c) A bit word 0101 is to be transmitted. Construct the even parity seven bit Hamming code for this data.
- (d) We want to measure the performance of a telephone line (4 KHz of bandwidth). When the signal is 20 V, the noise is 6 mV. What is the maximum data rate supported by this telephone line?
- (e) Solve the following:
- A signal has passed through three cascaded amplifiers, each with a 5 dB gain. What is the total gain? How much is the signal amplified?
  - A signal travels from point A to point B. At point A, the signal power is 200 W. At point B, the power is 170 W. What is the attenuation in decibels?

3.

- (a) If the bandwidth of the channel is 8 Kbps, how long does it take to send a frame of 200,000 bits out of this device? (5 X 2 = 10)
- (b) A line has a SNR of 2000 and a bandwidth of 5000 KHz. What is the maximum data rate supported by this line?
- (c) What is the bandwidth of a signal that can be decomposed into five sine waves with frequencies at 0, 30, 40, 120 and 300 Hz? Draw the spectrum assuming all peak amplitudes are same.
- (d) What is the capacity of a channel in each of the following cases:
- Bandwidth: 20 KHz,  $\text{SNR}_{\text{dB}} = 40$
  - Bandwidth: 1 MHz,  $\text{SNR}_{\text{dB}} = 20$
- (e) The attenuation of a signal is -12 dB. What is the final signal power if it was originally 4 W?

(5 X 2 = 10)

- 4.
- (a) A signal with 300 milliwatts power passes through 10 devices, each with an average noise of 3 microwatts. What are the SNR and  $\text{SNR}_{\text{dB}}$ ?
  - (b) How many bits can fit on a link with a 3 ms delay if the bandwidth of the link is:
    - i. 2 Mbps
    - ii. 15 Mbps
  - (c) What is the Nyquist sampling rate for each of the following signals?
    - i. A low pass signal with bandwidth of 300 KHz
    - ii. A band pass signal with bandwidth of 300 KHz if the lowest frequency is 100 KHz?
  - (d) In a digital transmission, the sender clock is 0.3 percent faster than the receiver clock. How many extra bits per second does the sender send if the data rate is 2 Mbps?
  - (e) A low pass signal with a bandwidth of 300 KHz is sampled using 1024 levels of quantization.
    - i. Calculate the maximum data rate of the digitized signal.
    - ii. Calculate  $\text{SNR}_{\text{dB}}$  for this signal.
    - iii. Calculate PCM bandwidth of this signal.

(4 + 2 + 2 + 2 = 10)

- 5.
- (a) Draw the graph for the data stream 01010101 using polar NRZ - L, polar NRZ - I, RZ, Manchester, Differential Manchester, AMI, Pseudoternary, MLT - 3 scheme.
  - (b) Draw the graph for the following data streams using 2B1Q scheme:
    - i. 0011001100110011
    - ii. 0101010101010101
  - (c) What is the result of scrambling the sequence 1110000000 using the following techniques? Assume that the last non zero signal level has been positive.
    - i. B8ZS
    - ii. HDB3 (The number of nonzero pulses is odd after the last substitution)
  - (d) We want to transmit 500 characters with each character encoded as 8 bits.
    - i. Find the number of transmitted bits for synchronous transmission
    - ii. Find the number of transmitted bits for asynchronous transmission

Enrolment No. 

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S<sub>5</sub>(UCS05B07)-CSE

## B.Tech. Fifth Semester Mid Term Examination- 2018

Name of Subject: Data Communication

Paper Code: UCS05B07

Full Marks: 50

Time: 2 Hours

The figures in the margin indicate full marks for the questions

Candidates are required to give their answers in their own words as far as practicable

All questions are compulsory

1. a) What is physical topology? Discuss any two topologies with their merits and demerits.  
 b) Draw the graph of the 2B1Q scheme and MLT-3 scheme for the DataStream: **0000000001010101**, assume that the last signal level has been positive. (Transition table for 2B1Q scheme is given in figure 1.)  
 c) What is the result of scrambling the sequence **11100000000000** using B8ZS scrambling technique? Assume that the last non-zero signal level has been positive. (4+4+2=10)

Previous level: positive		Previous level: negative	
Next bits	Next level	Next level	Next bits
00	+1	-1	
01	+3	-3	
10	-1	+1	
11	-3	+3	

Transition table

2. a) What are the three modes of communication between two devices? Discuss briefly. **S, MDFD**  
 b) Find the 8-bit data stream for each case depicted in Figure 2.  
 c) An analog signal has a bandwidth of 20 KHz. If we sample this signal and send it through a 30 Kbps channel, what is the  $\text{SNR}_{\text{db}}$ ? **(4+4+2=10)**

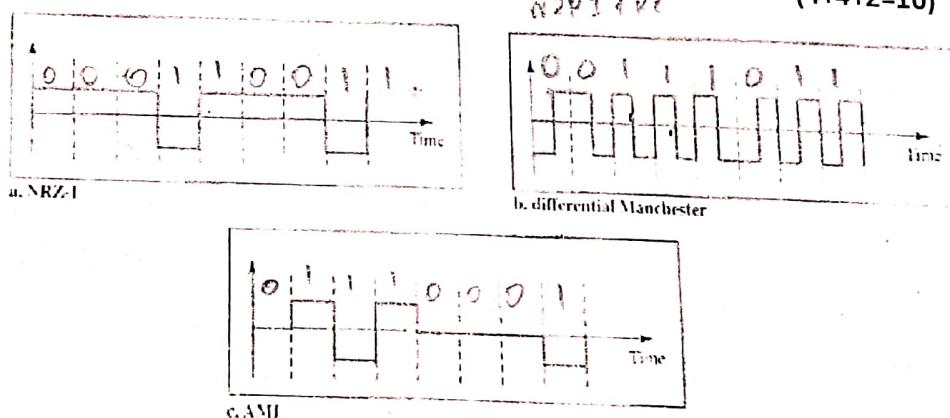


Figure 2

3. a) What do you mean by transmission impairment? Discuss three cause of impairment.

- b) What is the Nyquist sampling rate for each of the following signal?
- Low pass signal with bandwidth of 200 KHz.
  - A band-pass signal with bandwidth of 200 kHz if the lowest frequency is 100 KHz.
- c) A Manchester signal has data rate of 100 kbps. Using figure 3, calculate the value of the normalized energy for frequency at 0 Hz, 50 KHz, 100 KHz. (4+4+2=10)

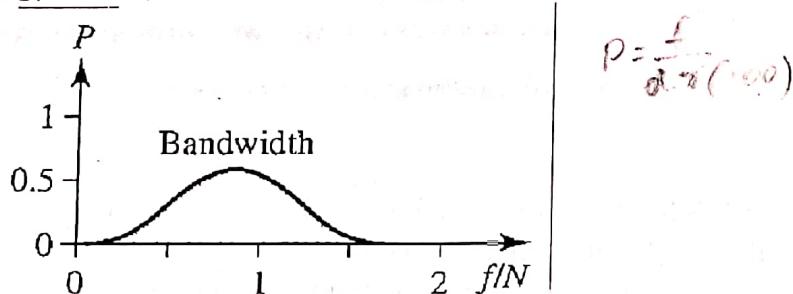


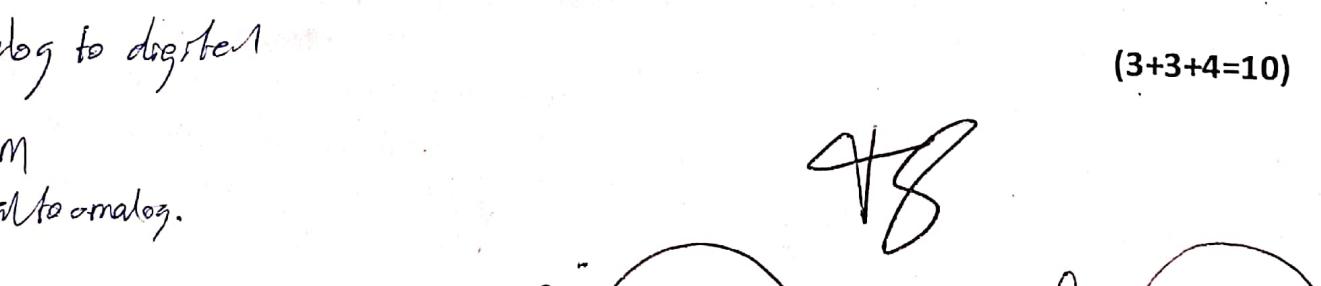
Figure 3

4. a) What do you mean by modulation? What are the different types of modulation? AM, FM, PM
- b) We want to transmit 1000 characters with each character encoded as 8 bits.
- Find the number of transmitted bits for synchronous transmission.
  - Find the number of transmitted bits for asynchronous transmission.
- c) An analog signal has a bit rate of 8000 bps, and baud rate of 1000 baud. How many data elements are carried by each signal element? How many signal elements do we need?

(4+4+2=10)

5. a) Define baseline wandering and its effect on digital transmission.
- b) Compare and contrast PCM and DM.
- c) Draw the constellation diagram for the following:
- ASK with peak amplitude value of 1 and 3.
  - QPSK with peak amplitude value of 3.

(3+3+4=10)



Enrolment No. [ ]

B.Tech 5<sup>th</sup> Semester End Term Examination 2017  
Data Communication  
UCS05B07

S<sub>5</sub> (UCS05B07) CSE

Full Marks: 100

Time: 3 hours

[The figure in the margin indicate full marks for the question]

Answer all the questions.

1)

- (4 + 2 + 2 + 3 + 2 + 2 = 15)
- a. What is the total delay (latency) for a frame of size 10 million bits that is being sent on a link with 15 routers each having a queuing time of 2  $\mu$ s and a processing time of 1  $\mu$ s. The length of the link is 3000 Km. the speed of light inside the link is  $2 \times 10^8$  m/s. The link has a bandwidth of 6 Mbps.
  - b. What is the length of a bit in a channel with a propagation speed of  $2 \times 10^8$  m/s if the channel bandwidth is 20 Mbps?
  - c. A periodic composite signal contains frequencies from 20 to 30 KHz, each with amplitude of 8 V. Draw the frequency spectrum.
  - d. What is the bit rate for each of the following signals?
    - i. A signal in which 2 bit lasts 0.001 s
    - ii. A signal in which 5 bit lasts 4 ms
    - iii. A signal in which 15 bits last 20  $\mu$ s
  - e. A periodic composite signal with a bandwidth of 3000 Hz is composed of two sine waves. The first one has a frequency of 100 Hz with maximum amplitude of 30 V; the second one has maximum amplitude of 10 V. Draw the bandwidth.
  - f. What is the transmission time of a packet sent by a station if the length of the packet is 2 million bytes and the bandwidth of the channel is 300 Kbps?

2)

- (2 + 2 + 2 + 3 + 2 + 2 = 15)
- a. We have a channel with 5 KHz bandwidth. If we want to send data at 150 Kbps, what is the minimum SNR<sub>dB</sub>? What is SNR?
  - b. A non periodic composite signal contains frequencies from 10 to 40 KHz. The peak amplitude is 12 V for the lowest and highest signals and is 30 V for the 25 KHz signal. Assuming that the amplitude changes gradually from the minimum to the maximum draw the frequency spectrum.
  - c. Which signal has a wider bandwidth: a sine wave with a frequency of 200 Hz or a sine wave with a frequency of 300 Hz?
  - d. We have a baseband channel with a 2 MHz bandwidth. What is the data rate for this channel, if we use NRZ, Biphasic, 2B1Q and MLT – 3 coding schemes?
  - e. An analog signal has a bandwidth of 40 KHz. If we sample this signal and send it through a 50 Kbps channel, what is the SNR<sub>dB</sub>?
  - f. What is the result of scrambling the sequence 0110000000 using B8ZS and HDB3?
  - g. What is the maximum data rate of a channel with a bandwidth of 300 KHz if we use four levels of digital signaling?

3)

(5 + 2 + 2 + 2 + 2 + 2 = 15)

- Draw the graph for the data stream 00110011 using unipolar NRZ, polar NRZ - L, polar NRZ - I, RZ, Manchester, Differential Manchester, AMI, Pseudoternary, MLT - 3 scheme.
- Draw the graph for the following data stream using 2B1Q scheme:
  - 1111011101111111
  - 0000000000000000
- Find the bandwidth for AM, FM (set  $\beta = 5$ ) and PM (set  $\beta = 1$ ) if we need to modulate an 8 KHz voice.
- What is the required bandwidth for ASK, FSK with  $2\Delta f = 4$  KHz and QPSK if we need to send 6000 bps? Let  $d = 1$ .
- Calculate the baud rate for the given bit rate and type of modulation:
  - 4000 bps, FSK
  - 6000 bps, ASK
  - 8000 bps, QPSK
- What is the number of bits per baud for the following techniques:
  - ASK with 4 different amplitudes
  - FSK with 16 different frequencies
  - PSK with 8 different phases

4)

(3 + 2 + 2 + 2 + 2 + 2 + 2 = 15)

- Calculate the bit rate for the given baud rate and type of modulation:
  - 2000 baud, ASK
  - 2000 baud, FSK
  - 2000 baud, BPSK
- The telephone line has 4 KHz bandwidth. What is the maximum number of bits we can send using ASK and QPSK techniques? Let  $d = 0$ .
- Assume that a voice channel occupies a bandwidth of 4 KHz. We need to multiplex 12 voice channels with guard bands of 500 Hz using FDM. Calculate the required bandwidth.
- Four channels, two with a bit rate of 200 Kbps and two with a bit rate of 150 Kbps are to be multiplexed using multiple slots TDM with no synchronization bits. Assume 4 bits from the first 2 sources and 3 bits from the second 2 sources are multiplexed; find size of a frame in bits, frame rate, frame duration and data rate.
- We need to use synchronous TDM and combine 20 digital sources, each of 100 Kbps. Each output slot carries 1 bit from each digital source, but one extra bit is added to each frame for synchronization. Find size of a frame in bits, frame rate, frame duration and data rate.
- Ten sources, six with a bit rate of 200 Kbps and four with a bit rate of 400 Kbps are to be combined using multilevel TDM with no synchronization bits. The unit of data is 1 bit. Find the size of a frame in bits, frame rate, frame duration and data rate.
- Two channels, one with a bit rate of 190 Kbps and another with a bit rate of 180 Kbps are to be multiplexed using pulse stuffing TDM with no synchronization bits. The unit of data is 1 bit. Find the size of a frame in bits, frame rate, frame duration and data rate.

5)

$$(2 + 2 + 2 + 2 + 3 + 2 + 2 + 3 = 20)$$

- a. We have a digital medium with a data rate of 12 Mbps. How many 64 Kbps voice channels can be carried by this medium if we use DSSS with the Barker sequence?
- b. The codeword is received as 1100100101011. Check whether there are errors in the received codeword, if the divisor is 10101.
- c. Show the contents of the five output frames for a synchronous TDM multiplexer that combines four sources sending the following characters. Note that the characters are sent in the same order that they are typed. The third source is silent.  
Source 1 message: HI  
Source 2 message: ALOHA  
Source 3 message:  
Source 4 message: HELLO
- d. Calculate CRC for the frame 110101011. The generator polynomial is  $x^4 + x + 1$  and write the transmitted frame.
- e. The 7 bit hamming codeword received by a receiver is 1011011. Assuming even parity, state whether the received codeword is correct or wrong. If wrong, locate the bit in error.
- f. Why in Go - Back - N ARQ, the size of send window must be less than  $2^m$ ?
- g. Explain the reason for moving from Stop - and - Wait ARQ Protocol to Go - Back - N ARQ Protocol.
- h. How six numbers of 6 MHz channels is shared in an area with 100000 subscribers where each subscriber needs one channel to send data in the upstream direction?
- i. Compare and contrast a traditional cable network with a hybrid fiber - coaxial network.

6)

$$(3 + 2 + 2 + 2 + 3 + 2 + 2 + 2 + 2 = 20)$$

- a. How Session Initiation Protocol (SIP) tracks the callee if she is not sitting at her terminal?
- b. A bit word 1011 is to be transmitted. Construct the even parity seven bit hamming code for this data.
- c. What is the remainder obtained by dividing  $x^7 + x^5 + 1$  by the generator polynomial  $x^3 + 1$ ?
- d. What is the significance of twisting in twisted - pair cable?
- e. Why in Selective Repeat ARQ, the size of send and receive window must be at most one half of  $2^m$ ?
- f. Compare and contrast Go - Back - N ARQ Protocol with Selective Repeat ARQ.
- g. How can only thirty three number of 6 MHz channels be shared between groups of subscribers in the downstream direction?
- h. How bandwidth is divided in ADSL using Discrete Multitone Technique?
- i. How does jitter affect real time audio/video? How to overcome jitter?

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