

University of Rajshahi
Department of Computer Science and Engineering
B. Sc. Engg. Part-III Even Semester Examination-2020 (Session: 2017-2018)
Course: ICE3261 (Communication Engineering)
Marks: 52.5 Times: 3 Hours
[Answer Six (06) questions taking any three (03) from each section]

Section A

1. a) What are meant by data and data communication? What are the different forms of data that can be communicated? 4
- b) Distinguish between half-duplex and full-duplex transmission modes. 2
- c) Given a receiver with an effective noise temperature of 100° and a 10 MHz bandwidth. Find the thermal noise level at the receiver's output. 2.75

2. a) What is the length of a bit in a channel with the propagation speed of 2×10^8 m/s if the channel bandwidth is: i) 10 Mbps ii) 100 Mbps iii) 1 Gbps 1.5
- b) Suppose a periodic composite signal is generated by combining 5 harmonics of 2 KHz signal. Calculate its bandwidth and draw the frequency spectrum. 3
- c) A sine wave is offset $1/6$ cycle with respect to time 0. What is its phase in degree and radians? 2
- d) We measure the performance of a telephone line having 4 KHz of bandwidth. When the signal is 10 V, the noise is 5 mV. What is the maximum data rate supported by this telephone line? 2.25

3. a) Draw the graph of the AMI and MLT-3 scheme for each of the following data streams, assuming that the last signal level is positive: i) 11111111 ii) 01010101 iii) 00011000 3
- b) What is meant by self-synchronization? Mention the name of a line coding technique that can achieve self-synchronization. Explain your answer with example. 3.75
- c) Explain how 8B/10B block coding scheme can achieve error detection? 2

4. a) List three different techniques in serial transmission and explain the differences. 2.5
- b) What is the Nyquist sampling rate for each of the following signals? 2
 - 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
- c) Why addressing is necessary in statistical TDM? 1.25
- d) Suppose we have 9 sampled amplitudes as -6.1, 7.5, 16.2, 20, 11, -5.5, -20, -9.4, and -6 in PCM. We decide to have 8 quantization levels. Find the output encoded words (bit stream) after quantization by drawing necessary figures. 3

Section B

5. a) Define carrier signal and explain its role in analog transmission. 2.75 •
b) Draw the constellation diagram for ASK, BPSK, and QPSK signals. Mention the information that can be deduced by analyzing each of the diagrams. 3 —
c) Explain how a Quadrature PSK (QPSK) can be implemented with two separate Binary PSK (BPSK) with necessary diagram. 3
6. a) If the bandwidth of an audio signal is 5 KHz, what will be required bandwidth of each AM radio station? Find the total number of usable AM stations assuming the allocated carrier frequency range from 530 KHz to 1700 KHz. 2.75
b) Four channels, two with a bit rate of 300 Kbps and two with a bit rate of 150 Kbps, are to be multiplexed using multiple-slot TDM with no synchronization bits. Answer the following questions: i) What is the size of a frame in bits? ii) What is the frame rate? iii) What is the duration of each frame? iv) What is the data rate? 3
c) Describe the goals of multiplexing. 2
d) Which of the three multiplexing techniques are used in analog transmission? 1
7. a) How does a single bit error differ from a burst error? 1.75 •
b) Given the dataword 101001111 and the divisor 10111. Generate the CRC codeword at the sender side. 3 —
c) What are the advantages and disadvantages of using optical fiber for data communication? 4 —
8. a) What do you know about frequency bands for satellite communication? 2 •
b) What is MEO satellite? Describe it with the example of GPS? 3.75 •
c) What type of propagation does satellite communication use? How does that mode differ from other propagation modes? 3

Sumon

University of Rajshahi
Department of Computer Science and Engineering
B.Sc. Engg. Part-3 Odd Semester 2019
Course: ICE3151 (Communication Engineering)
[Answer any three (03) questions from each Section.]

Library of Rajshahi University
Dept. of Computer Science & Engineering
University of Rajshahi

Time: 3 Hours

Full Marks: 52.5

Section-A

1. (a) What is meant by data communication? Explain all the basic components used in a data communication system. 4
- (b) Explain half-duplex and full-duplex data transmission with appropriate examples. 2
- (c) How does digital signal differ from analog signal? A signal has been received that only has values of -1, 0 and 1. What types of signal they are? Draw the signals. 2.75
2. (a) We send a digital signal from one PC on a LAN to another PC. Is this baseband or broadband transmission? 1.75
- (b) How many bits can fit on a link with a 2 ms delay if the bandwidth is i) 1Mbps ii) 100 Mbps? 2
- (c) The attenuation of a signal is -10 dB. What is the final power if it was originally 10 W? 2
- (d) A network actually sends 12000 frames per minute with each carrying an average of 10000 bits. The throughput of the network is one-fifth of the bandwidth. What is the bandwidth of the network? 3
3. (a) Draw the digital signals encoded using NRZ-L and NRZ-I for the bit stream 11100010. Mention the problems occurred for this bit combination with each technique. (Last non-zero signal level has been positive.) 3.75
- (b) Define baseline wandering and mention its effect on digital transmission. 2
- (c) Draw the resulted signal of scrambling the sequence 1100000000001 using B8ZS and HDB3 scrambling techniques. (Last non-zero signal level has been positive.) 3
4. (a) Define block coding and give its purposes. The input stream to a 4B/5B block encoder is 0100 0000 0000 0000 0000 0001. What is the length of the longest consecutive sequence of 0s in the input and output of the encoder? 3
- (b) Name and distinguish between the three different techniques in serial transmission. 3
- (c) What is the purpose of pulse code modulation (PCM)? Explain its quantization step in brief. 2.75

Section-B

5. (a) Define carrier signal and explain its role in analog transmission. 2.75
- (b) Calculate the baud rate for the given bit rate and type of modulation 3
- i) 4000 bps, QPSK, ii) 3000 bps, FSK, iii) 36000 bps, 64-QAM
- (c) Define constellation diagram. Draw the constellation diagram for the following: 3
- i) ASK with peak amplitude values of 1 and 3;
- ii) BPSK with peak amplitude value of 2;
- iii) QPSK with peak amplitude value of 3; and
- iv) 8-QAM with two peak amplitude values of 1 and 3 and four different phases.

6. (a) What are the goals of multiplexing? 2
- (b) We need to use synchronous TDM and combine 40 digital sources, each of 100 Kbps. Each output slot carries 1 bit from each source, but one extra bit is added to each frame for synchronization. Answer the following questions: 3
- What is the size of the output frame in bits?
 - What is the output frame rate?
 - What is the output data rate?
- (c) Four channels, two with a bit rate of 300 Kbps and two with a bit rate of 150 Kbps, are to be multiplexed using synchronous TDM. How the disparity in the input data rates can be handled? 2
- (d) Why addressing is necessary in statistical TDM? 1.75
7. (a) Why error correction is more difficult than detection? 1.75
- (b) Given the dataword 10011 and the divisor 1011. Generate the CRC codeword at the sender side. Show how a single bit error can be detected at the receiver side. 4
- (c) What is the purpose of cladding in an optical fiber? Calculate the bandwidth of the light propagating through optical fiber for the following wavelength ranges (assume the propagation speed of optical fiber 2×10^8 m): 3
- 1000 to 1200 nm
 - 1000 to 1400 nm
8. (a) What is satellite communication? What do you know about satellite orbits? 2
- (b) What is a VSAT? What are the uses and characteristics of VSAT? 4
- (c) Describe the GEO satellite. 2.75

University of Rajshahi
Department of Computer Science and Engineering
B.Sc. (Engg.) Part-3 (Even Semester), Examination 2018
Course: ICE3261 (Communication Engineering)

Time: 3 Hours

Full Marks: 52.5

[Answer any three (03) questions taking from each Section]

Section-A

1. (a) Identify and explain the components of a complete data communication system. 3.50
- (b) What are the differences between half-duplex and full-duplex communication mode? 2.50
- (c) A non-periodic composite signal contains frequencies from 10 to 30KHz. The peak amplitude is 10V for the lowest frequency and is 30V for the highest frequency signal. Calculate the bandwidth and draw the frequency spectrum. 2.75

2. (a) What is the bit rate for each of the following signals? 3.00
 - i. A signal in which 1 bit lasts 0.001 s.
 - ii. A signal in which 1 bit lasts 2 ms.
 - iii. A signal in which 10 bits last 20 μ s.
- (b) Suppose a signal with 200 milliwatts power passes through 20 devices, each with an average noise of 2 microwatts. Compute the SNR and SNRdB? 3.00
- (c) Suppose, we have a channel with a 1-MHz bandwidth. The SNR for this channel is 63. What are the appropriate bit rate and signal level? 2.75

3. (a) Discuss different techniques for analog encoding of digital data. 4.00
- (b) Find out the NRZI code of the binary string: 01001100011. 2.00
- (c) Draw the resulted signal of scrambling the sequence 110000000001 using B8ZS and HDB3 scrambling techniques. (Last non-zero signal level has been positive.) 2.75

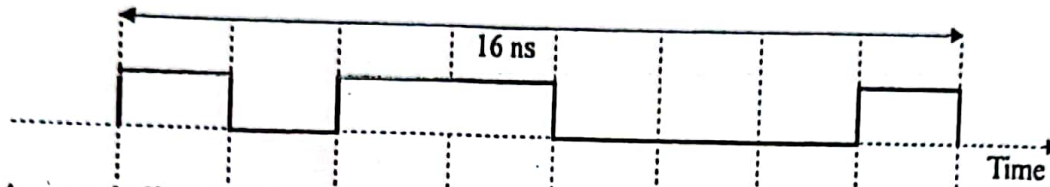
4. (a) Define block coding and its purpose. 1.75
- (b) We have sampled a low-pass signal with a bandwidth of 300 KHz using 1024 levels of quantization. Then
 - i) Calculate the bit rate of the digitized signal.
 - ii) Calculate the PCM bandwidth of this signal.
- (c) Explain the modulation technique for Delta Modulation. 3.00
- (d) What are the advantages and disadvantages of parallel communication? 2.00

Section-B

5. (a) Draw the constellation diagram for the following cases. Find the peak amplitude value for each case and define the type of modulation (ASK, FSK, PSK or QAM). The numbers in parentheses define the values of I and Q respectively. 4.00
- i. Two points at (3, 0) and (4, 0);
 - ii. Two points at (3, 0) and (-3, 0);
 - iii. Four points at (2, 2), (-2, 2), (-2, -2) and (2, -2);
 - iv. Two points at (0, 5) and (0, -5).
- (b) What is the number of bits per baud for the following techniques? 3.00
- i. ASK with four different amplitudes;
 - ii. FSK with eight different frequencies;
 - iii. PSK with four different phases;
 - iv. QAM with a constellation of 128 points.
- (c) Which characteristics of an analog signal are changed to represent the lowpass analog signal in each of the following analog-to-analog conversions? 1.75
- i. AM ii. FM iii. PM
6. (a) How does a single bit error differ from a burst error? 1.75
- (b) Given the dataword 101001111 and the divisor 10111. Generate the CRC codeword at the sender side. 3.00
- (b) Distinguish between synchronous and statistical TDM. 2.00
- (c) We need to use synchronous TDM and combine 20 digital sources, each of 200 Kbps. Each output slot carries 2 bit from each source and one extra bit is added to each frame for synchronization. Find (i) output frame rate and (ii) output data rate. 2.00
7. (a) Write short notes on twisted pair cable. 3.00
- (b) Draw the frequency spectrum of electromagnetic waves mentioning the broad groups. Differentiate omnidirectional and unidirectional waves. 2.75
- (c) Name the advantages of optical fiber over twisted-pair and coaxial cable. 3.00
8. (a) What do you mean by VSAT? How does it work? Explain. 2.75
- (b) What is geostationary satellite? Find out its orbital height. 4.00
- (c) What do you mean by active and passive satellite? 2.00

Section-A

1. (a) Explain the characteristics that the effectiveness of a data communication system depends on. 3
(b) What are the approaches that we can use to transmit a digital signal? Find the bit rate and bit duration for the following signal: 3



- (c) A nonperiodic composite signal contains frequencies from 10 to 30 KHz. The peak amplitude is 10 V for signal with the lowest frequency and is 30 V for signal with the highest frequency. Assuming that the amplitudes change gradually from the minimum to the maximum, draw the frequency spectrum. 2.75
2. (a) Suppose a signal travels through devices A and B. For device A the power of the signal is reduced to one-tenth and for device B it is increased ten times. Compute the attenuation in decibel for both cases. 3
(b) What is throughput? A network with bandwidth of 10 Mbps can pass only an average of 12,000 frames per minute with each frame carrying an average of 10,000 bits. Find the throughput of the network. 3
(c) How the latency of a link is measured? Find the propagation time and the transmission time for a 5-MB (megabyte) message (an image) if the bandwidth of the network is 1 Mbps? Assume that the distance between the sender and the receiver is 12,000 km and that light travels at 2.4×10^8 m/s. 2.75
3. (a) Define baseline wandering and its effect on digital communication. 2
(b) Draw the graph of the AMI and MLT-3 scheme using each of the following data streams, assuming that the last signal level is positive: (i) 11111111 (ii) 01010101 (iii) 00011000 3
(c) Why scrambling technique is used? Show the result of scrambling the sequence 100000000100001 using B8ZS and HDB3 techniques. Assume that the last non-zero signal level has been positive. 3.75
4. (a) Write a short note on the different techniques of analog encoding of digital data. 4
(b) Explain Delta Modulation with an example. 3.75
(c) Elaborate: PCM, PFM and PTM. 1

Section-B

5. (a) What is the purpose of carrier signal in modulation? How is QAM related to PSK and ASK? 3
- (b) An analog signal has a bit rate of 8000 bps and a baud rate of 1000 baud. How many data elements are carried by each signal element? How many signal elements do we need? 2.75
- (c) Draw the constellation diagram for the following: 3
- (i) QPSK with a peak amplitude value of 3.
- (ii) 8-QAM with two different peak amplitude values, 1 and 3, and four different phases.
6. (a) What is multiplexing? 1
- (b) Describe the process of cyclic redundancy check (CRC). 3.75
- (c) Explain the Frequency Division Multiplexing (FDM). 4
7. (a) What is the purpose of cladding in an optical fiber? State some applications of optical fiber. 3
- (b) A light signal is travelling through optical fiber. What is the delay in the signal if the length of the optical fiber is 5 m, 500 m and 1 Km (assume a propagation speed of 2×10^8 m). 3
- (c) What is microwave? Mention some of its characteristics and applications. 2.75
8. (a) How does sky propagation differ from line-of-sight propagation? 2
- (b) What is orbit of a satellite? Which type of orbit does a GEO satellite have? Verify your answer. 3.75
- (c) State some applications for each type of satellites. 3

University of Rajshahi
Department of Computer Science and Engineering
B.Sc. Engg. Part-3 Even Semester 2016
Course: ICE3261 (Communication Engineering)

Time: 3 Hours.

Full Marks: 52.5

[Answer any six (06) questions taking three (03) from each Section.]

Part A

1. (a) What is meant by data communication? Give a real world example of a data communication system and explain all the basic components that it has. 4
- (b) Give an example of full duplex transmission mode. Explain how it uses this mode. 2
- (c) How does digital signal differ from analog signal? A signal has been received that only has values of -1, 0 and 1. Is this an analog or digital signal? 2.75
2. (a) Define periodic signal and frequency spectrum. A periodic composite signal with a bandwidth of 2000 Hz is composed of two sine waves. The first one has a frequency of 100 Hz with maximum amplitude of 20 V; the second one has maximum amplitude of 5 V. Draw the frequency spectrum 3.75
- (b) What do you mean by attenuation? The attenuation of a signal is -10 dB. What is the final signal power if it was originally 5 W? 3
- (c) A line has a signal-to-noise-ratio of 2000 and a bandwidth of 5000 KHz. What is the maximum data rate supported by this line? 2
3. (a) Draw the graph of the NRZ-L scheme using each of the following data streams, assuming that the last signal level is positive: (i) 00000000 (ii) 11111111 (iii) 01010101 (iv) 00110011 2
- (b) What are the differences between serial and parallel transmission? 2
- (c) Consider the data stream 10001101. What would be the major disadvantages of using NRZ-L to encode this data stream? How will RZ encoding attempt to solve the problems? What would be the new problems raised by RZ encoding? Show the encoded signals. 4.75
4. (a) Explain the Pulse Code Modulation (PCM) process with block diagram. 4.75
- (b) What is differential PCM? Discuss the principle of Delta Modulation (DM). Why DM is used in voice transmission? 4

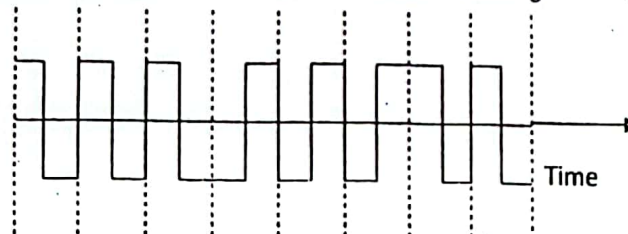
Part B

5. (a) Describe the goals of multiplexing? How does FDM combine multiple signals into one? Explain. 3
- (b) Which of the three multiplexing techniques is common for fiber-optic links? Explain the reason. 3
- (c) The bandwidth of an audio signal is 5 kHz. The AM stations are allowed carrier frequencies anywhere between 1100 kHz and 1250 kHz. If two consecutive AM stations' carrier frequencies are separated by an AM bandwidth then find the number of possible AM stations. 2.75
6. (a) A digital signaling system is required to operate at 9600 bps. What would be the minimum bandwidth requirement of the channel if a signal element encodes (i) 4-bit word, and (ii) 8-bit word? 3
- (b) How are binary values represented in amplitude shift keying and what is the limitation of this approach? 1.75
- (c) Explain PSK and QAM in details. 4
7. (a) If we want to transmit multiple signals through an optical fiber, what propagation mode (s) should we use? Explain. 3
- (b) Which signals are called infrared? How does sky propagation differ from line-of-sight propagation? 3
- (c) Name the advantages of optical fiber over twisted pair and coaxial cable. 2.75
8. (a) Explain different methods that are used by unguided signals to travel from the source to destination. 3
- (b) What is a footprint? According to Kepler's law, what is the period of a satellite that is located at an orbit approximately 35,786 km above the earth (radius of earth is 6378×10^3 m). 3
- (c) What is the purpose of GPS? Explain the triangulation principle that is used by GPS. 2.75

Answer any Six (06) questions taking at least three from both the groups.

PART A

1. a) What is meant by data communication? Explain a simplified data communication model. 4.25
b) What do you mean by simplex, half-duplex and full-duplex data flow? 3
c) Define bandwidth and spectrum of a signal. 1.5
2. a) What are bit rate and bit interval? What are their counter parts in analog signal? 2
b) What do you mean by bandwidth of analog and digital signal? How do they differ? 2
c) Define phase and periodic signal. Consider two signals having same frequencies. When the first signal is at its maximum amplitude, the second signal has amplitude of zero. What is the phase shift between the two signals? 2.75
d) A telephone line can transmit signals with frequency range from 300 to 3300 Hz. If its signal-to-noise ratio is 3162, then calculate the highest bit rate of the line. 2
3. a) What is DC component? Why is this undesirable? 2
b) Find out NRZ-L and NRZ-I code of the binary string: 01001110. 2
c) What is the major disadvantage in using NRZ encoding? How does RZ encoding attempt to solve the problem? 2
d) What is the data stream if the following signal is encoded using: 2.75
(i) Manchester encoding (ii) Differential Manchester encoding.



4. a) What is modulation? What is the purpose of the carrier signal in modulation? 2
b) What is the difference between bit rate and baud rate? Give an example where both are same and another where they are different. 2
c) Explain any analog modulation technique. 3
d) Describe the 4-PSK method with constellation diagram. 1.75

PART-B

5. a) What is multiplexing? Explain your idea about why and how multiplexing is used in data communication. 3
b) Suppose, we are trying to transmit several analog signals using a single link. The bandwidth of the link is greater than the combined bandwidths of the signals. Which multiplexing technique can be used in this case? Explain the basic process of this method. 3.75

- c) Suppose, four 1-Kbps connections are multiplexed together. A unit is 1 bit. Find (i) the duration of a time slot, and (ii) the duration of a frame. 2
6. a) Explain how data is transmitted through an optical fiber. What is the purpose of cladding in an optical fiber? 3.75
- b) Discuss the modes of propagating light along optical fiber. 2
- c) Why is coaxial cable superior to twisted pair cable? Give a use for each class of guided media. 3
7. a) What are the three major steps in block coding? How can block coding aid in synchronization? 2.75
- b) What is quantization in PCM? What is the sampling rate for PCM if the frequency ranges from 1000 to 4000 Hz? What would be the bit rate if 8 bits/sample are used? 3
- c) Compare the two methods of serial transmission. Discuss the advantages and disadvantages of each. 3
8. a) What is satellite communication? What do you know about satellite orbits? 2
- b) Describe about GEO satellite. 4
- c) What is VSAT? What are the characteristics of VSAT? 2.75

University of Rajshahi
Department of Computer Science and Engineering
B.Sc. Engg. Part 3 Even Semester Examination 2014
Course No. : ICE3261 (Communication Engineering)
Marks: 52.5 **Time: 3 Hours**

(Answer any three questions from each Part)

Part-A

1. (a) Define analog and digital data. 2
 (b) Why digital transmission is the better over analog transmission? 2
 (c) What is Nyquist Bit rate and Shannon capacity? Define bit rate and bit interval. 3
 (d) Consider a noiseless channel with a bandwidth of 100 kHz transmitting a signal with two signal levels. What is the maximum bit rate of this channel? 1.75
2. (a) What is modulation? Why it is necessary? 2
 (b) Give a mathematical expression of an amplitude Modulated wave. 4.75
 (c) Why carrier wave is needed in modulation? 2
3. (a) What do you mean by frequency modulation? 2
 (b) Define i) Modulation Index ii) Deviation Ratio and ii) Percentage Modulation. 3
 (c) An FM signal has resting frequency of 105 MHz and highest frequency of 105.03 MHz when modulated by a signal of frequency 5 KHz. Determine i) frequency deviation ii) carrier swing iii) modulation index and iv) lowest frequency reached by the FM wave. 3.75
4. (a) How do asynchronous and synchronous transmissions differ? Which is better suited to large blocks of characters, and why? Which is more efficient? 4
 (b) Explain various steps in pulse code modulation. 3
 (c) Explain ASK digital-to-analog modulation technique. 1.75

Part-B

5. (a) What is transmission media? Write down the classification of transmission media. 2
 (b) Distinguish between guided and unguided media. 2.75
 (c) What is the difference between unshielded twisted pair and shielded twisted pair? 2
 (d) What is crosstalk? How is it minimized in case of twisted-pair of wire? 2
6. (a) Define line coding. Write the applications of line coding. 2
 (b) What are the desirable properties of line coding? 1.75
 (c) Categories the line coding schemes. How does NRZ-L differ from NRZ-I? 2
 (d) Assume a data stream is 01001110. Encode this stream using the encoding schemes: 3
 (i) Unipolar (ii) RZ and (iii) Manchester.
7. (a) Explain the properties of communication satellite that make them popular. 2
 (b) What are the categories of satellite based on the location of orbit? 2
 (c) What is the period of satellite? 2
 (d) Why two separate frequencies are used for uplink and downlink transmission in case of satellite communication? 2.75
8. (a) What are the advantages and disadvantages of fiber optic communications? 2.75
 (b) What is the need of Cladding? 1.5
 (c) Differentiate between single mode and multimode fiber. 1.5
 (d) What is the difference between acceptance angle, critical angle and numerical aperture? A step index fiber has a core and cladding refractive index of 1.50 and 1.46 resp. what is the value of NA and acceptance angle of the fiber? 3

University of Rajshahi
Department of Computer Science and Engineering
B. Sc. Engg. Part-3 Odd Semester Examination 2014 (2010-11)
Course: ICE-3161 (Communication Engineering)
Full Marks: 52.5 Time: 3 Hours

Answer Six questions taking any Three questions from each section

Section - A

1. a) Define analog and digital data. 2
 b) What do you mean by Frequency spectrum and Bandwidth? 3
 c) A digital signal has a bit rate of 2000 bps. What is the duration of each bit (bit interval)? 1.75
 d) Define Nyquist Bit Rate and Shannon Capacity. 2

2. a) Consider a noiseless channel with a bandwidth of 3000 Hz transmitting a signal with two signal levels. What is the maximum bit rate? 2.75
 b) We have a channel with a 1MHz bandwidth. The SNR for this channel is 63; what is the appropriate bit rate and signal level? 3
 c) Discuss various types of transmission impairment. 3

3. a) Assume a data stream is 10001110. Encode this stream, using the following encoding schemes 7
 - i. Unipolar
 - ii. NRZ-L
 - iii. NRZ-I
 - iv. RZ
 - v. Manchester
 - vi. Differential Manchester
 - vii. AMI

- b) What is the sampling rate for PCM if the frequency ranges from 1000 to 4000 Hz?

4. a) Discuss Asynchronous and Synchronous transmission with their advantages and disadvantages. 4.75
 b) What do you mean by modulation? What is the role of carrier signal? 2
 c) Discuss briefly about Amplitude Shift Keying. 2

Section - B

5. a) Among the following three tasks, which one is the most important for a data communication system and why? 2.75
 - i. Deliver data to the correct destination
 - ii. Deliver data accurately
 - iii. Deliver data in a timely manner

- b) What do you mean by a composite signal? Is it possible to represent a composite signal as a combination of simple sine waves? 2

- c) What do you know about the following noises 4
 - i. Thermal noise
 - ii. Induced noise
 - iii. Crosstalk
 - iv. Impulse noise

6. a) Discuss about Phase Shift Keying (PSK). 2.75
 b) Discuss Quadrature Amplitude Modulation (QAM). 3
 c) Differentiate between Pulse Frequency Modulation (PFM) and Pulse Time Modulation (PTM). 3

7. a) Why do we need multiplexing in data communication? 2
 b) Discuss about Frequency-division multiplexing (FDM). 3.75
 c) Discuss Interleaving process of TDM briefly. 3

8. a) What are the advantages of Satellite Communication? 1
 b) According to Kepler's law, what is the period of a satellite that is located at an orbit approximately 35786 km above the earth? 2.75
 c) Describe various categories of Satellites. 5