

MID SEMESTER EXAMINATION
DURATION: 1 Hour 30 Minutes

SUMMER SEMESTER, 2017-2018

FULL MARKS: 100

CSE 4405: Data and Telecommunications

Programmable calculators are not allowed. Do not write anything on the question paper.
 There are 4 (four) questions. Answer any 3 (three) of them.
 Figures in the right margin indicate marks.

1. a) What is data communication? Describe the components and fundamental characteristics of effective data communication system. 2+8.33
- b) What do you understand by network topology? Mention the basic network topologies. For N devices in a network, what are the numbers of cable links required for each of the topologies? 2+2+4
- c) Differentiate among the roles of logical address and physical address? 4
- d) What are the layers of OSI model? How does OSI model differ from TCP/IP protocol suite? Write down the functionalities of middle three layers of TCP/IP protocol suite. 2+3+6
2. a) What is throughput? A network with bandwidth of 100 Mbps can pass only an average of 120,000 frames per minute with each frame carrying an average of 10,000 bits. What is the throughput of this network? 2+4
- b) What do you understand by transmission impairment? Explain different factors causing transmission impairments with appropriate examples. 11.33
- c) State and explain the Shannon capacity formula. How does Shannon capacity formula differ from Nyquist bit rate formula? What does the Nyquist theorem have to do with communication? 5+2+3
- d) Consider a channel having SNR 50 and bandwidth 2 MHz. What will be the approximate signal level and bit rate? 3+3
3. a) Write short notes on any two of the followings: 4x2
 - i. DC Component
 - ii. Self-Synchronization
 - iii. Baseline Wandering
- b) Find out the bit sequence for the given digital signals from the following figures. For Figure 1, consider NRZ and NRZ-I coding. For Figure 2, consider Manchester and Differential Manchester coding schemes. 4x2

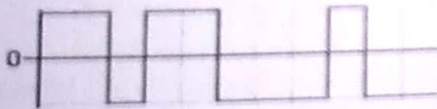


Figure 1

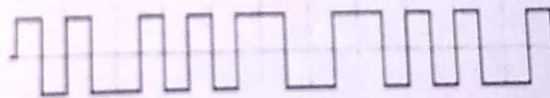


Figure 2

- c) Consider a bit stream: 0110001001. Draw corresponding digital signal for following line coding schemes and also comment on the bandwidth requirement of each of the scheme. 3x3
 - i. AMI
 - ii. Polar RZ
 - iii. MLT-3
- d) What do you mean by scrambling? Briefly explain the B8ZS scrambling technique. 2+6.33
4. a) With necessary diagrams and equations, explain the Pulse Code Modulation (PCM) technique for digitization. 12.33
- b) Give the taxonomy of digital-to-analog conversion techniques. Which of the techniques is the most susceptible to noise? Justify your answer. 3+3
- c) Briefly explain the concept of a constellation diagram. Give constellation diagram for the following: 4+5
 - i. Binary ASK
 - ii. BPSK
 - iii. QPSK
 - iv. 4-QAM
 - v. 16-QAM
- d) You have an available bandwidth of 200kHz which spans from 1500 to 1700 kHz. What would be the bit rates and carrier frequencies if you modulate your data using ASK and FSK? (Assume $\Delta f = 1/2$) 3+3

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There are **4 (four)** questions. Answer any **3 (three)** of them.
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1. a) What do you understand by Data Communications? Explain the fundamental characteristics on which the effectiveness of data communications depends upon. 7
- b) Suppose an office has 6 (six) departments and in each of the department there are 4 (four) computers. Use hybrid network topology to connect them efficiently and give justification for your used topologies. 12.33
- c) Define protocol and explain the key elements of protocol. 7
- d) Explain three basic network criteria and mention the metrics to measure them. 7
2. a) What are the layers of OSI model? Write down the functionalities of each of the layers. 21
- b) What is a peer-to-peer process? How a particular process is identified on a host in TCP/IP protocol? 5
- c) What is the advantage of combining the session, presentation, and application layer in the OSI model into one single application layer in the Internet Model? 7.33
3. a) Define bandwidth for both analog and digital signal. Calculate the bit rate required for high-definition TV (HDTV) with 1080p resolution at 60fps. 6.33
- b) What do you understand by transmission impairment? Explain different factors causing transmission impairments with appropriate examples. 13
- c) Differentiate between Broadband transmission and Baseband transmission. 6
- d) Prove that, in case of digitization, the sampling rate should be at least twice the highest frequency contained in the signal. 8
- a) What do you understand by DC Component of a signal? Explain how a digital signal with zero DC component is better for transmission. 7
- b) Encode the bit pattern 1010110010 into following encoding techniques 7.33
 - i. NRZ-I
 - ii. NRZ-L
 - iii. Manchester
 - iv. Differential Manchester
 - v. Multilevel 2B1Q
- c) Explain the basic mechanisms of the modules of Pulse Code Modulation (PCM). 12
- d) What is Nyquist bit rate? Calculate the theoretical highest bit rate of a regular telephone line. A telephone line normally has a bandwidth of 3000 Hz (300 to 3300 Hz) assigned for data communications. The signal to noise ratio is usually 3162. 7

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SEMESTER FINAL EXAMINATION
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SUMMER SEMESTER, 2017-2018
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There are **8 (eight)** questions. Answer any **6 (six)** of them.

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1. a) What are the layers in TCP/IP protocol suite? Explain the followings in terms of OSI model. 2+9
- Process to process delivery
 - Host to host delivery
 - Node to node delivery
- b) What is the difference between a port address, a logical address, and a physical address? Observe Figure 1 carefully where the packet header format is given. Each device is attached with a specific logical address and physical addresses. Complete each of the packet headers with appropriate logical and physical addresses. 3+6

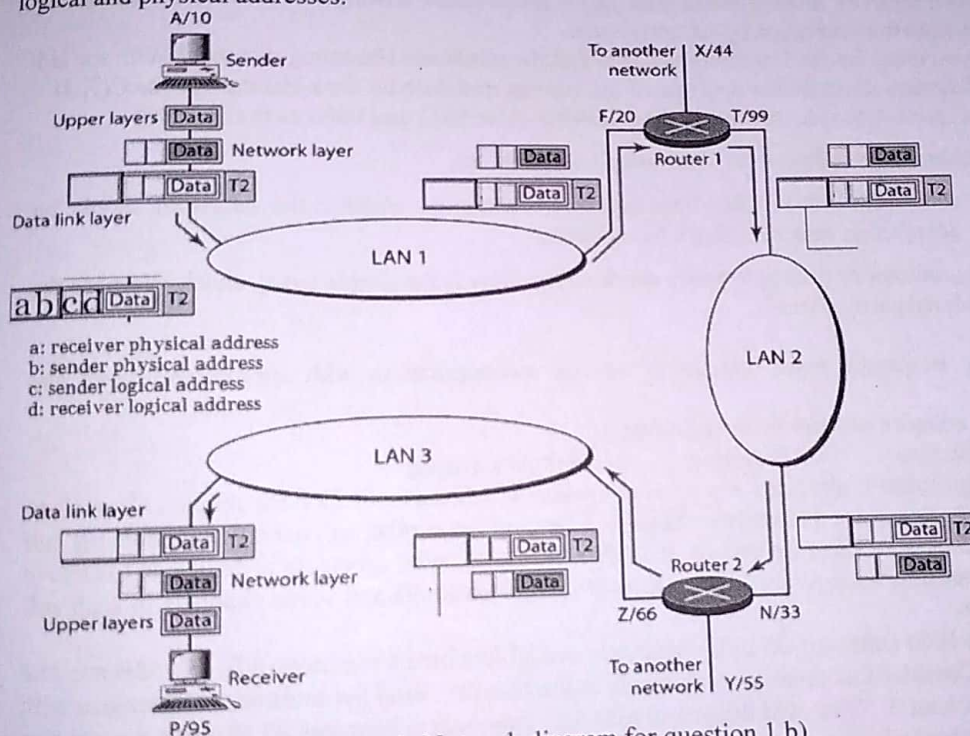


Figure 1: Network diagram for question 1.b)

- c) What do you mean by switching? Compare and contrast a circuit-switched network with a packet-switched network. 13.33
2. a) Define the followings with example: 10
- Jitter
 - Attenuation
 - Throughput
 - Bandwidth-Delay Product
- b) What do you mean by 'data element' and 'signal element'? A signal is carrying data in which one data element is encoded as two signal elements. If the bit rate is 200 kbps, find the signal rate where $c=1/2$. 4+3
- c) Compare and contrast pulse code modulation (PCM) with delta modulation (DM); discuss using their module diagram. 12.33
- d) A composite periodic signal is decomposed into six sine waves with frequencies of 150, 250, 350, 450, 550 and 650 kHz, what is its bandwidth? Draw the spectrum, assuming all components have amplitude of 20 V. 2+2

3. a) Write short notes on any **three** of the following modulation technique:
 i. MLT-3 ii. AMI iii. On-off keying (OOK) iv. Phase Modulation 3x4
 v. Manchester
- b) What do you mean by scrambling? Consider a bit stream: 11000010000000000. Draw corresponding digital signal for the following line coding schemes. 3+6
 i. B8ZS ii. HDB3
- c) With necessary diagrams explain the working principal of a fiber optic cable. Name different propagation modes of optical channels. 12.33
4. a) What do you mean by multiplexing? Distinguish between synchronous and statistical time division multiplexing (TDM). 3+6
 b) Briefly explain frequency hopping spread spectrum (FHSS). What is the main motivation of using FHSS that outweighs its bandwidth efficiency? 7+3
 c) Draw the send and receive window for 'Selective Repeat ARQ' protocol. Using 5-bit sequence numbers, what is the maximum size of send and receive windows for 'Go-Back-N ARQ' protocol? 33
 d) A sender sends a series of packets to the same destination using 'Go-Back-N ARQ'. If the header of the frame allows 5 bit sequence number that starts with 0, what is the sequence number after sending 100 packets? If the sender uses 'Stop-and-Wait ARQ' protocol for flow control then what should be the sequence number after sending 100 packets. 5+3
5. a) What do you mean by a linear block code and a cyclic code? Distinguish between forward error correction and error correction by retransmission. 4+3
 b) What do you mean by the Hamming distance and the minimum Hamming distance? With the aid of block diagrams illustrate the structure of the encoder and decoder for a Hamming code C(7, 4). 4+6
 c) Using CRC error detection scheme do the following. (Use 1011 and 0000 as the divisors) 8
 i. Generate the codeword of 1001 using CRC encoder.
 ii. A codeword 1000110 has been received. Determine whether the dataword should be accepted or rejected using CRC decoder.
- d) Mention the limitations of simple parity check codes. How is the simple parity check related to the two-dimensional parity check? 8.33
6. a) Explain the frequency reuse concept in cellular communication with appropriate figure and equation. 11.33
 b) Write short notes on any **two** of the followings- 4x2
 i. Grade of Service ii. Sectoring iii. Multipath Fading
 c) A 30 MHz spectrum is allocated to a wireless system which uses two 25 KHz simplex channels to provide full duplex voice and control channels. Compute the number of channels available per cell if that system uses 7-cell reuse pattern. If 1 MHz of the allocated spectrum is dedicated to control channels, determine an equitable distribution of control channels and voice channels in each cell of that system. 6
 d) A system has 1000 cells with 25 traffic channels available where a minimum SIR of 15dB must be maintained. Consider that there are 6 channels in the first tier. Find the minimum cluster size with path loss exponent 3. What will happen if path loss exponent n becomes 4? Will the cluster size increase or decrease? 8
7. a) Neatly sketch the GSM system architecture. How does HLR and VLR work for a roaming user? 10.33
 b) Give the taxonomy of all logical channels available in GSM. 5
 c) Write short notes on any two of the followings- 5x2
 i) Cell dragging ii) Umbrella Cell Concept iii) MAHO
 d) Suppose a new mobile communication standard is specified as an alternative to GSM with the following frequency specifications 8

Uplink: 1400-1550 MHz

Downlink: 1600-1750 MHz

The new standard also specifies that two carrier frequencies would be working at 400 KHz distance for better voice quality. As a telecommunication engineer, calculate the following specification of the new standard.

i. Wavelength

8. a) With the aid of subscriber information of call establishment
 b) Draw the Guard Period
 c) Mention four GSM following

i. Wavelength

ii. Bandwidth

iii. Duplex Distance

iv. No of Radio Channels

203

8. a) With the aid of necessary diagram explain how a call to a mobile user initiated by a PSTN subscriber is established. Mention the name of different logical channels used in different stages of call establishment. 12.33
- b) Draw the normal burst used in GSM. What is the significance of using Training sequence (T) Guard Period (GP) and Stealing bits (SF) in a GSM burst? 2+6
- c) Mention different stages of the GSM transmission process in appropriate order. Demonstrate how four GSM bursts (each of 156.25 bits) are constructed from a 20 milliseconds voice signal following the steps of the GSM transmission process. 3+10

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There are **8 (eight)** questions. **Question no. 2 is mandatory.** Answer any **5 (five)** from the rest of them.
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- a) What do you understand by Data Communications? Explain the components of a communication system. 7
- b) Explain the types of data communication based on data flow. 7
- c) What do you understand by network topology? Explain the basic network topologies with their strengths and weaknesses. 14
- d) You have two computers connected by an Ethernet hub at home. Is this is LAN, a MAN or a WAN? Justify your answer with appropriate reason. 5

[Mandatory Question]

- a) What is OSI model of communication? Write down the names of each of the layers of OSI model and mention functionalities of each of them. 7×3
- b) Explain four types of addressing with appropriate examples. 4×3
- c) How OSI and ISO are related to each other? 2
- a) Write down the names of protocols working in each layers of TCP/IP protocol suite. 10
- b) What do you understand by Shannon Capacity? Consider you have a channel with bandwidth 1.0 MHz. The SNR for this channel is 63. What are the appropriate bit rate and signal levels. 8
- c) What is latency? What are the components of latency? Explain each of them with appropriate examples. 15
- a) Explain different types of data transmission mode with appropriate diagrams. 4×3
- b) Encode the bit pattern **1011 0011** into following encoding techniques 10
 - i. NRZ-I
 - ii. NRZ-L
 - iii. Manchester
 - iv. Differential Manchester
 - v. Multilevel 2B1Q
- c) What are the techniques used for Digital-to-analog conversion? Explain each of them briefly. 11
- a) What is multiplexing? Explain the Frequency Division Multiplexing (FDM) process with appropriate diagram. 15
- b) What are the strategies used when the input of a multiplexing have different frequencies? Explain each of them with appropriate examples or diagrams (if necessary). 3×3
- c) Compare the delay time in Circuit Switching Networks and Datagram Networks with appropriate diagram. 9

6. a) Give the taxonomy of switched networks. Explain three phases of a circuit switched network's data transmission.
- b) What do you understand by Cyclic Redundancy Check (CRC)? If both of the devices using CRC technique agrees that the divisor should be **1010**. Generate appropriate codeword for the dataword **1001** for the format $C(7,4)$. Also show how you can check whether the received codeword has been changed or not.
- c) What is minimum hamming distance? A coding scheme has a Hamming distance $d_{\min} = 5$. What is the error detection and correction capability of this scheme?
7. a) Explain the architecture of a Satellite Communication System with appropriate diagram. Why the uplink frequency of Satellite Communication System is greater than the downlink frequency?
- b) What are the different modes of propagation in fiber optic cable? Explain each of them with appropriate diagram.
- c) Explain the mechanisms of antennas used in unicast transmission and reception of radio waves with appropriate diagram.
8. a) What is GSM? With appropriate diagram, show the various components of a GSM network. Briefly mention the functionalities of each of the components.
- b) Explain the problems of satellite communication system with examples.
- c) In Figure 1, if the received signal power at point 4 is 20 mW, then calculate the initial transmission power at point 1.

