Course Code:0714 02 CSE 3101	**Year: Third**	**Term: First**
Course Title: Data Communication and Computer Networks		
Course Status: Core		
Credit: 3.00		
Prerequisite(s): None		
Rationale	This subject aims to introduce the basic concept and essential knowledge in data communications and computer networks.	

	Course Contents	**CLOs**
	Section A	
1	Data Communication Model: Analog and digital signal, Time domain signal, Frequency domain signal, Time domain to frequency domain conversion.	1, 2
2	Channel Capacity: Nyquist and Shanon.	2
3	Transmission Impairments: attenuation, delay distortion, noise.	1, 2
4	Transmission Media: wired (twisted pair, coaxial cable, optical fiber), wireless (ground wave, sky wave, line-of-sight).	1, 2
5	Signal Encoding: NRZ, AMI, Manchester, B8ZS, HDB3, ASK, PSK, FSK, QPSK, QAM, Constellation Diagrams, PCM, DM.	3
	Section B	
1	Introduction to Computer Network: Definition of internet, The network edge, Network code, Network access and physical media, ISPs and internet backbones, Delay and loss in packet-switched networks, Protocol layers and their service models.	4
2	Transport Layer: Transport layer services, Multiplexing and demultiplexing, Connectionless transport and UDP, Principles of reliable data transfer, Connection oriented transport and TCP, Principles of congestion control, Congestion and flow controls with TCP.	5
3	Network Layer: Network topology, Network layer services, Routing principles, Hierarchical routing, Internet Protocol: IP4 addressing, IPv6, ICMP.	6, 7, 8
4	Link Layer and Local Area Networks: Link layer services, Error detection and correction techniques, Multiple access protocols, CSMA, CSMA/CD, Slotted ALOHA, LAN address and ARP, Ethernet, Hub, Bridge and switch, Wireless links, Wi-Fi and WLAN architecture, Bluetooth, PPP, ATM, Frame relay.	8, 9
5	Security in Computer Networks: Security issues in computer networks, Principles of cryptography: Symmetric key cryptography and public key encryption, Message integrity and digital signatures, End-point authentication, Operational security, Firewalls and intrusion detection systems.	9

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CSE 22 Batch

Course Teacher: Dr. SK Alamgir Hossain (Hira Sir)

CT Questions :

CT 1

1. What is a protocol stack? Discuss its potential benefits and drawbacks. (6)
2. What are the OSI and TCP/IP models? How do these two models differ? (6)
3. What is a communication satellite? Discuss GEO, MEO, and LEO satellites. (6)
4. What is Time Division Multiplexing (TDM)? Explain with an appropriate diagram. (6)
5. Discuss the internal structure of a UTP with appropriate figure. (6)

Computer Network

CT 2

1. What is IP address? Why IP address is necessary in networking? (4)
2. Why traffic shaping is important? Discuss with appropriate figure the token bucket algorithm. (6)
3. What is distance vector routing? Explain the "count-to-infinity" problem with an example network. (10)
4. Given the following network: (10)
   A is connected to B (cost 1) and C (cost 5)
   B is connected to C (cost 2) and D (cost 4)
   C is connected to D (cost 1)
   (a) Construct the distance vector table for each node.
   (b) Find the shortest path from A to D.

Computer Network

CT 3, Marks-30

1. What is class full IP addressing? Discuss different types if IP classes. (5)
2. Define the following terms (12)
   a. ICANN
   b. Domain Name
   c. HTTP & HTTPS
   d. Loop Back Address
   e. URL
   f. TLDs
3. What is the main purpose of the transport layer in the OSI model? What is a port number, and why is it important in the transport layer? (5)
4. Explain the difference between TCP and UDP in terms of reliability and use cases. (8)

Computer Network

CT 4, Marks-30

1. Explain the steps involved in RSA encryption system and how RSA ensures secure communication between two parties. Discuss with appropriate figure.

Term Final :

Date: 18/06/2025

Khulna University, Khulna

Computer Science and Engineering Discipline

3rd Year, Term I, Examination 2025

Session: 2023-2024

Course No: 071402 CSE 3101

Full Title of Course: Data Communication and Computer Networks

Full Marks: 60 Time: 03 Hours

- The figures in the margin indicate full marks. The questions are of equal value.
- Use separate sheet for each section.

Section A

There are **FOUR** questions in this section. Answer any **THREE** questions

1	a)	What is the difference between LAN, MAN, and WAN?	02
	b)	Define IP address. What are the classes of IP addresses?	02
	c)	Explain the role of a router in a network.	02
	d)	For a network with n devices, determine the number of cable links (assuming full-duplex links) required for the following topologies: Mesh, Star, Bus, and Ring. (Note: You may ignore drop lines in the bus topology and the connectors between devices and repeaters in the ring topology.)	04
2	a)	Differentiate between TCP and UDP.	02
	b)	Write definitions for the following terms: i) Network ii) internet (with a lowercase i) iii) Internet (with an uppercase I)	03
	c)	What is the difference between HTTP and HTTPS?	02
	d)	Define MAC address. How is it different from an IP address?	03
3	a)	Define error control. What is the advantage of selective-reject automatic repeat request (ARQ) compared to Go-Back-N automatic repeat request (ARQ)?	03
	b)	Describe how a firewall secures a computer network.	02
	c)	Explain how wireless networks differ from wired networks. Discuss the internal structure of a UTP cable with appropriate figure.	05
4	a)	Given a host address of 172.16.45.0 and a subnet mask of 255.255.224.0, determine the network address.	03
	b)	What is the use of encryption and decryption?	02
	c)	Given the following network: A is connected to B (cost 1) and C (cost 5) B is connected to C (cost 2) and D (cost 4) C is connected to D (cost 1) (i) Construct the distance vector table for each node. (ii) Find the shortest path from A to D.	05

Section B

There are **FOUR** questions in this section. Answer any **THREE** questions

5	a)	Why are the wires twisted in a twisted pair cable?	03
	b)	What is ARPANET? Do you think opening the ARPANET to all was a good decision? Why or why not- Explain.	02
	c)	What are MAC addresses?	02
	d)	Create a network diagram showing how different devices connect using switches and routers.	03
6	a)	Define flow control. What is the advantage of sliding-window flow control compared to stop-and-wait flow control?	03
	b)	Discuss different Multiplexing techniques with appropriate figure.	04
	c)	What is the main purpose of the transport layer in the OSI model? What is a port number, and why is it important in the transport layer?	03
7	a)	What is hamming code? Demonstrate how an (11, 7) Hamming code correcting a single-bit error with appropriate diagrams.	03
	b)	What is the difference between a frame and a packet?	01
	c)	Discuss the working process of Selective Repeat ARQ protocol.	04
	d)	Which type of light source is good for optical fiber communication? –Discuss.	02
8	a)	What is DoS?	02
	b)	What is distance vector routing? How does a router in distance vector routing determine the best path? Describe how distance vector routing works with an example.	05
	c)	What is communication satellite? Discuss GEO, MEO, and LEO.	03

KHULNA UNIVERSITY, KHULNA

Computer Science and Engineering Discipline Date: 04/06/2017

3rd Year, Term II, Examination 2017

Session: 2015-2016

Course No: ECE 3251

Full Title of Course: **Data Communication**

Full Marks: 60 Time: 03 Hours

- The figures in the margin indicate full marks. The questions are of equal value.
- Use separate sheet for each section.

Section A

There are **FOUR** questions in this section. Answer any **THREE** questions.

1. (a) Define Data. Explain how data is transmitted with the help of a data communication model including specific function of each block of this model. 03
   (b) Derive the standard equation of Pulse Amplitude Modulated (PAM) wave using the concept of flat-top sampling. 03
   (c) Draw a modulator to generate a Pulse width Modulated (PWM) wave and explain its operation. Also show the corresponding waveforms after each block. 04

2. (a) Why is multiplexing of signals necessary? Name the common forms of multiplexing techniques. 02
   (b) Describe FDM system. From here, show the spectrum of the composite baseband signal and the FDM signal. 05
   (c) Three information signals are to be sent using time-division multiplexed PAM. Suppose that the maximum frequency of each of the first two signals is 5kHz and the maximum frequency of the third signal is 10kHz. Draw the block diagram of the system. 03

3. (a) A sinusoidal carrier has a peak value of 3V and frequency of 100Mhz. It is modulated with a binary digital message 101101. Draw the modulated waveforms for (i) ASK, (ii) BFSK and (iii) BPSK. 03
   (b) Explain the generation of a QPSK wave along with the modulator states. 04
   (c) Which of the four digital-to-analog conversion techniques (ASK, FSK, PSK or QAM) is most susceptible to noise? Defend your answer. 03

4. (a) What is quantizing? What is its effect? Explain the types of a quantizer with transfer characteristic of each type. 04
   (b) What is the need of sample and hold circuit? How does it help in quantization? 03
   (c) Show that, "under the assumption of no slope-overload distortion, the maximum output signal to-noise ratio of a delta modulator is proportional to the sampling rate cubed" 03

Section B

There are **FOUR** questions in this section. Answer any **THREE** questions.

5. (a) What is meant by intersymbol interference (ISI) in data communication? 02
   (b) Bipolar binary pulses are received with peak amplitude $A_p = 0.0015$ volt. The channel noise rms amplitude is 0.3 millivolt. Threshold detection is used, and 1 and 0 are equally likely. Find the detection-error probability. Given that $Q(x) \cong \frac{1}{x\sqrt{2\pi}}\left(1 - \frac{0.7}{x^2}\right)e^{\frac{-x^2}{2}}$. 03
   (c) A binary PSK system transmits the following two signals: 05
   $S_0(t) = 0.01\cos(2\pi \times 1000t)$
   $S_1(t) = 0.01\cos(2\pi \times 1000t + \Theta_1)$
   $T_b = 10$ msec and $N_o = 2 \times 10^{-7}$
   Plot the probability of bit error of a coherent detector as a function of Θ_1

6. (a) State channel coding theorem. 02
   (b) Prove that, "the channel capacity, C varies with the probability of error, P". 03

(c) Consider a message bit be 100100 and Divisor be 1101. Find the message bit polynomial and Divisor Polynomial. What will be the polynomial of sending data after adding CRC? 05

(a) A code scheme has a minimum hamming distance of 4. What is the error detection and correction capability of this scheme? 02

(b) Show the structure of the encoder and decoder for a hamming code and explain its operation. 03

(c) Consider the (7,4) Hamming Code, whose parity check matrix is given by H in figure 7(c) 05

$$H = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 & 1 \end{bmatrix}$$

Fig. 7(c) : Matrix H

(i) Find the minimum distance of the Hamming Code.

(ii) Determine the syndrome 's' of the Hamming Code for single and double error patterns. From this, show that single errors are correctable and double errors are at least detectable.

8. (a) What is line coding? List some important factors that can be used in evaluating the various line coding techniques. 02

(b) Given the bit pattern 00110011, draw the waveform for this sequence using (i) NRZ-I (ii) Manchester and (iii) MLT-3 scheme. 03

(c) What is the result of scrambling the sequence 111000000000000 using the following scrambling techniques? Assume that the last non-zero signal level has been positive. 02

(i) B8ZS

(ii) HDB3 (the number of non-zero pulses is odd after the last substitution)

(d) We have a baseband channel with a 1-Mhz bandwidth. What is the data rate for this channel if we use the following line coding schemes? 03

(i) NRZ-L (ii) MLT-3 (iii) 2B1Q

CSE Discipline

ECE 3251, Class Test : 1

Marks: 30, Time: 20 min

Q1. Describe Data Communication system with its block diagram. Also show the input-output waveforms of the corresponding blocks. 10

Q2. How does a data communication system differ from the basic communication system? 04

Q3. Make a comparison among PAM, PWD and PPM. 06

Q4. Convert a PWM wave into a PPM wave. 10

Date: 09-05-2019

Khulna University Khulna

Computer Science and Engineering Discipline

Second Year, Term I

Session: 2018-2019.

CSE Discipline

Course No.: ECE 3151 / ECE-3251

Full Title of Course: Data Communication

Full Marks: 60 **Time:** 3 **Hours**

- The Figures in the margin indicate full marks. The questions are of equal value.
- Use separate sheet for each section.
- Special instructions (if any).

N.B In case of questions and extracts, please, give at the bottom of the paper full reference to the text books or other books from which they are taken, indicating the edition used and the page in which they occur.

Section A

Marks

There are **FOUR** questions in this section. Answer any **THREE** questions

1.a What do you understand by Modulation index m_a. Describe the situation for the following cases — 04

i) $m_a > 1$
ii) $m_a = 1$
iii) $m_a < 1$

1.b Let a single tone modulation signal $x(t) = V_m \cos w_m t$ is modulated by a carrier signal $c(t) = A \cos w_c t$. Show that the desired expression for this sigle-tone modulated signal is — 03

$S(t) = A \cos w_c t \, [1 + m_a \cos w_m t]$

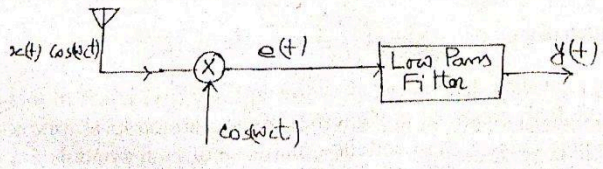
Where m_a is modulation index.

1.c A 400 watts carrier is modulated to depth of m%. If the total power in the amplitude – modulated wave is 512.5 watts, find the value of m. — 03

2.a Prove that total power P_t of a single tone Amplitude-Modulated (AM) signal can be expressed as — 04

$$P_t = P_c \left(1 + \frac{m_a^2}{2}\right)$$

2.b What will be the value of e(t) and y(t) of the following block diagram. — 03



Consider the low pass filter only allow the signal which contains the frequency loss than $2w_c$.

2.c What do you understand by the following terms? — 03

(i) DSB – FC
(ii) DSB – SC
(iii) SSB - SC

3.a What is line coding? What are the main divisions of line coding. 02

3.b For the following bit stram 04

0 1 0 0 1 1 1 0

Draw the line coding using following schemes

(i) NRZ - L
(ii) NRZ – I
(iii) RZ
(iv) Manchester
(v) Alternate Mark Inversion (AMI)
(vi) 2B1Q

3.c (i) Define Bit rate and Baud rate. (ii) Compute the Bit rate for a 1000-Baud 16 QAM signal. (iii) Compute the Baud rate for 72000 – bps, where 64 QAM is used. 04

4.a What is multiplexing? Distinguish between TDM and FDM. 03

4.b With necessary figures explain the working principle of delta modulation (DM). 03

4.c What is the major factor that makes PSK superior to ASK? Draw the constellation diagram of a 16-QAM signal having 3 amplitudes and 12 phases. 04

Section B Marks

There are **FOUR** questions in this section. Answer any **THREE** questions

5.a State and explain Shannon's channel capacity theorem. A communication channel with a bandwidth of 8 KHz has a signal power to noise ratio of 7. The bandwidth is reduced to 30%. How much should the signal power be increased to maintain the same channel capacity? 05

5.b Calculate the channel capacity and spectral efficiency of the following (Fig. 5.b) point-to-point communication link at 45 degree centigrade temperature assuming that the receiver is affected alone by white noise. How many signal levels will be needed to send data at the same rate over a noiseless channel? Also determine the P_s in dBm. 05

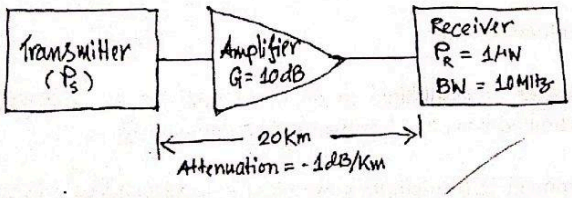


Fig. 5.b

6.a The input to a binary communication channel consists of 0's with a priori probability P0 = 0.2 and 1's with priori probability P1 = 0.8. If the received signal peak amplitude and r.m.s noise voltage are 1.35 V and 0.115 V respectively, compute the detection error probability for bipolar signaling if channel noise is Gaussian. Given that $Q(x) = \frac{1}{x\sqrt{2\pi}}(1-\frac{0.7}{x^2})e^{\frac{-x^2}{2}}$ for x >2. 03

6.b Noise having Laplacian distribution as shown in Fig. 6(b1) is added to a signal sequence of the form presented in Fig. 6(b2). If the decision level for one signal plus noise sample is set at zero and the occurrence of both symbols 1 and 0 is equally likely, Find the detection error probability. 05

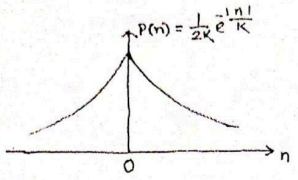


Fig. 6(b1)

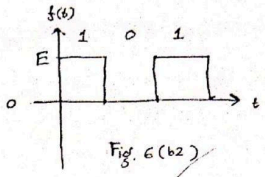


Fig. 6(b2)

6.c What is the difference between channel coding and source coding? Define coding gain. 02

7.a What is the significance of minimum Hamming distance in error control coding? 02

7.b Draw the possible structures of the encoder and decoder for a hamming code which can correct a single bit error. Explain its function for any arbitrary dataword. 06

7.c If we need a dataword of at least 8 bits, calculate values of k and n that satisfy this requirement in a Hamming code. 02

8.a What is the difference between even and odd parity? 01

8.b What does the CRC generator append to the data unit? What is the relationship between the size of the CRC remainder and the divisor? How does the CRC checker know that the received data unit is undamaged? 05

8.c What are the propagation modes supported by optical channels. 02

8.d Why cladding is necessary in optical fiber. 03

Khulna University, Khulna

Computer Science and Engineering Discipline

3rd Year, Term **I**, Examination **2021**

Session: **2019-2020**

Course No: **ECE 3151**

Full Title of Course: **Data Communication**

Full Marks: **36** Time: **1.5** Hours

- The Figures in the margin indicate full marks. The questions are of equal value.
- Use separate sheet for each section.

SECTION A

There are **FOUR** questions in this section. Answer any **THREE** questions.

1. a) Define Delta function. 01
   b) For n devices in a network, calculate the number of cable links required for a mesh, ring, bus, and star topology. 03
   c) Find out the Fourier transform of the following signal: $y(t)\ Sin\omega_c t$ 02

2. a) The tuned-circuit of the Oscillator in an AM transmitter uses a 50 μH coil and a 1 nF capacitor. Now if the Oscillator output is modulated by audio frequencies upto 16 KHz, then find the frequency range occupied by the side bands. 03
   b) What do you understand by modulation index, m. Describe the situation of the modulated signal for the following range of m 03
   (i) $m > 1$ (ii) $m = 1$ (iii) $m < 1$

3. a) A carrier is modulated to a depth of 75%. The total power of this amplitude modulated wave is 512 watts. Assume the modulating signal to be a sinusoidal one. Find the carrier power. 03
   b) What are some of the factors that determine whether a communication system is a LAN or WAN? Why are protocols needed? 03

4. a) State and prove sampling theorem. 03
   b) A single-tone FM is represented by the voltage equation as: $y(t) = 18\ cos\ (6.28 \times 10^8 + 9sin1200t)$. Determine the following terms (1) Carrier frequency (2) Modulating frequency (3) The modulation index (4) Maximum frequency deviation 03

SECTION B

There are **FOUR** questions in this section. Answer any **THREE** questions.

5. a) Describe frequency shift keying method. 02
   b) There is a signal travelling through a transmission medium from point 'A' to point 'B'. The distance between the two point is 20 Km. At the beginning the signal has the power of 3.9 mW and at the end it has the power of 1.5 mW. Find the loss in cable in dB/km. 04

6. a) Describe the effects of distortion on a composite signal. 02
   b) Why flow and error control required for an effective communication? Briefly describe the working principle of stop-and-wait flow control. 04

7. a) Suppose you send two code words of (i) 000 101 101 and (ii) 000 101 101 and the receiver receive two code words as (i) 010 101 101 and (ii) 111 010 101, respectively. What type of error occurs in these two code words? Justify your answer. 03
   b) Suppose a sender wants to send some data. The original data is given as: 1100111 1011101 0111001 0101001. Explain the sending and receiving procedure with two-dimensional parity check. 03

8. a) Compare the performance between the checksum and CRC error detection technique. 02
   b) How Hamming code is implemented? How Hamming code is used to detect error? Explain with example. 04

Course Title: **Computer Networks**, CT: **1**, Time: **30 minutes**, Marks: **30**

1.	Consider that you are transferring a file while watching a Youtube video. How connection oriented and connection less service will be applied in these applications? Mention the name of the protocols that will be used in each case.	10
2.	Which layers play the main role in case of same network communications and inter network communications for the TCP/IP protocol architecture? Explain.	10
3.	What are the two reasons for using layered protocols? What is one possible disadvantage of using layered protocols?	10

Course: **CSE 3203**, Course Title: **Computer Networks**
Class Test: **2**, Time: **40 minutes**, Marks: **30**

1.	Consider a setup, where a sender has 14 frames in the queue to be sent to the receiver while it can send up to 7 frames at a time. Draw the steps when sender-receiver are following **Go Back N error control** protocol for the scenarios, **a) a frame is received in out of order** in the receiver end, **b) an acknowledgement is lost** from receiver to the transmitter end.	15
2.	FM radio spectrum is 76MHz to 106MHz and each radio station can be assigned 400KHz with a guard band of 10 KHz. i. What is the maximum number of radio stations possible in FM band? If $SNR_{dB} = 12$, what is the capacity (bps) of each radio station? ii. Human audio spectrum is 20Hz to 20KHz. If the signal is modulated using M = 128 signaling levels, what is the capacity (bps) of human audio? iii. Discuss whether the audio of (ii) can be transmitted through the channel of (i)? If not how the parameters of (i) can be modified to allow the transmission? Show in detail.	15

Course Title: **Computer Networks**, Class Test: **3**, Time: **45 minutes**, Marks: **30**

1.	Your software company has assigned you to design an Intranet for them but they have limited budget. Authority has decided to buy networking devices such as HUB, BRIDGE and LEVEL-2 SWITCH if required. Their network has following requirements. • Connect eight offices which are in four different cities. Their internal network topologies are 2 offices use BUS, 2 offices use RING, 3 offices use STAR and the other one-use MESH. • You can only use above mentioned networking devices if required. Consider, each office has minimum 2 passive networking nodes. Draw the complete network diagram for your Intranet. Explicitly identify your networking device types.	15
2.	Replace your networking devices from the above designed diagram with ROUTERs. Create direct links between routers so that every router is directly connected with at least two other routers. If the organization has bought a Class C address 196.196.196.0, help the company to identify the sub-networks available in your designed network, by identifying the subnet mask, assigning addresses to each of the sub-networks, assigning needed IP addresses to the networking devices, respective interfaces and computers or printers. Assume that there is at least one computer and one networked printer on each of the offices.	15

Date: 13-11-2019

Khulna University, Khulna
CSE Discipline
Third Year Term II Examination 2019
Session: 2018-19
Course No.: CSE-3203
Full Title of Course: Computer Networks

Full Marks: 60 **Time:** 3 **Hours**

- The Figures in the margin indicate full marks. The questions are of equal value.
- Use separate sheet for each section.
- Special instructions (if any).

Section A

There are **FOUR** questions in this section. Answer any **THREE** questions

Marks

1.a Briefly describe client-server and peer-to-peer networks? 2
1.b Compare LAN, MAN, and WAN. 3
1.c Distinguish between OSI and TCP/IP architecture reference models. 3
1.d Briefly explain why we twist the twisted pairs? 2

2.a Briefly explain optical fiber data transmission approach. 2
2.b How does parabolic reflective antenna work? 2
2.c Draw the constellation diagram and signal table of an 8-QAM modulation model. Encode the following bit stream using your modulation technique, 0 0 0 1 1 0 1 0 0 0 0 1 0 1 1 1 0 0 1 1 0 1 0 1 1 3
2.d Draw any analog signal and take 11 PAM samples per second for it. If each of the PAM sample is quantized to any of 16 different levels, what would be the PCM code of the signal? 3

3.a For the **Sliding Window** based **flow control** protocol, a frame number is chosen using **K** bits. Theoretically, the window size can be maximum 2^K-1. Explain why? 2
3.b What is piggybacking? What is the advantage of it? 2
3.c Suppose, for the **Sliding Window** based **flow control** protocol, frame numbers follow **K=2** bits model. Show the **protocol behavior steps** of the following scenario, where the transmitter sends **9 frames** to the receiver, **a frame is lost** from transmitter to the receiver end. 3
3.d Use the above example to draw the steps for **Go Back Nerror control** protocol for the following scenario, **an acknowledgement is lost** from receiver to the transmitter end. 3

4.a The data link layer in the IEEE standard is divided into two sub-layers: LLC and MAC. Describe the functions performed by each sub-layer. 4
4.b Draw the flow diagram of the Carrier Sense Multiple Access/Collision Detection mechanism used by Ethernet (CSMA/CD) 3
4.c Explain how a network connection is established between a user and a server over the Internet using the TCP protocol 3

Section B

There are **FOUR** questions in this section. Answer any **THREE** questions

Marks

5.a Briefly explain the functionality of RING topology. 2
5.b Differentiate SWITCH, BRIDGE and ROUTER. 3
5.c Consider an organization has 7 subnets in its intranet. If it has bought a Class C address 199.198.199.0, help the company to identify the sub-networks available in your designed network, by identifying the subnet mask, assigning addresses to each of the sub-networks, assigning needed IP addresses to the networking devices and computers. Assume that there are two computers on each of the offices. 5

6.a Show the steps to find the shortest path from source router **J** to all other routers for the following network. Write down the link-state based routing table of router **J**. 4

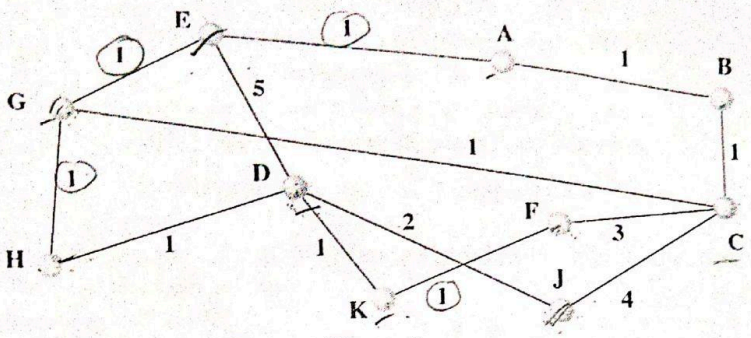


Figure 8.a

6.b Why would you choose OSPF over RIP protocol? Explain briefly. 2

6.c What is congestion? How can we control it? 2

6.d What is DNS and DHCP? 2

7.a Explain the concept of Hamming distance and how it is calculated. 4

7.b Explain the relationship between the Hamming distance and error occurring during transmission and calculate the Hamming distance between 01011 and 10101. 6

8.a Define the concept of virtual circuit. 2

8.b Indicate three main differences between link-state and distance-vector routing protocols. 5

8.c Explain the meaning of the term "residual error rate" in the context of error detection schemes. 3

Marks: 15 Data Communication Class Test: 01

1. Define modulation process. Write down the names of modulation techniques with an example. 03
2. Consider a sinusoidal AM wave, now derive its frequency spectrum equation where symbols have their usual meaning. 05
3. A carrier of 10 V peak and frequency 100 KHz is amplitude modulated by a sine wave of 4 V peak and frequency 1000 KHz. Determine the modulation index for the modulated wave and draw the amplitude spectrum. 05
4. Define PWM technique. 02

Khulna University

Computer Science and Engineering Discipline
3rd Year Term II Final Examination 2016
Session: 2014-2015
Course No: ECE 3251
Full Title of Course: Data Communication

Full Marks: 60 Time: 03 Hours

- The figures in the margin indicate full marks. The questions are of equal value.
- Use separate sheet for each section.

Section A

There are **FOUR** questions in this section. Answer any **THREE** questions

1. (a) Define the following terms: 03
Analog and Digital transmission system.
(b) Explain amplitude modulation technique with its standard equation. 03
(c) A carrier of 10V peak and frequency 100KHZ is amplitude modulated by a sine wave of 4V peak and frequency 1000HZ. Determine the modulation index for the modulated wave and draw the amplitude spectrum. 04

2. (a) Write down the sampling theorem and explain its significance on communication system. 03
(b) Prove the following statement: At 100% modulation, total power of a modulated signal is $P_T = (3/2)P_C$, where symbols have their usual meanings. 03
(c) Define PAM. Also draw the neat sketch of PAM with natural sampling. 03
(d) What do you mean by aperture effect? 01

3. (a) Define SNR. Show that, the product of two significant parameters for digital transmission system, R_b/B_T and E_b/N_0 is equal to SNR. [Symbols have their usual meanings]] 04
(b) Explain the technique of full-duplex FSK transmission system on a voice-grade line. 03
(c) A sinusoidal signal with a maximum peak input voltage of 5V is applied to a PCM channel using a 10-bit code word. Find: 03
i. The number of quantization levels used
ii. The maximum sinusoidal signal to quantization noise ratio in Decibels.

4. (a) Draw up a table, showing how the sequence d_k = 1011001 would be encoded and decoded using DPSK technique. 04
(b) Discuss the basic stages involved in the generation of PCM. Why is compressor added in the generation of PCM? 03
(c) Explain the fundamental concept of a constellation diagram with necessary figure. 03

5. (a) Define numerical aperture. Prove that – $NA = n_1(2\Delta)^{1/2}$, where symbols hold their usual meanings. 04

(b) In a fiber-optic cable, does the light energy from the source equal the light energy recovered at the destination?. Discuss this in terms of propagation mode. 03

(c) An optical fiber made of plastic with a refractive index of 1.53 and cladded with another plastic with a refractive index of 1.51. Launching takes place from air. Now calculate the following terms: 03

i. Relative refractive index difference between core and cladding.
ii. Numerical aperture.
iii. Acceptance and critical angle.

6. (a) Define multiplexing and demultiplexing process. Write down the classification of multiplexing technique. 03

(b) Consider the TDM technique with three input signals and explain the interleaving process with the help of a diagram. 04

(c) Five channels are to be multiplexed together shown in the following figure. Find the minimum bandwidth of the link. 03

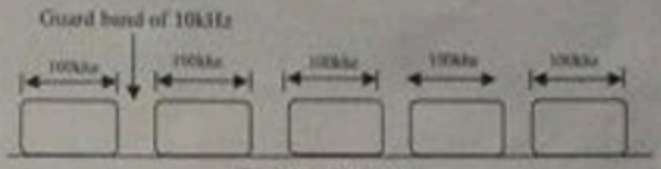


Figure Q.6 (c)

7. (a) Explain sliding-window flow control protocol with necessary diagram. 04

(b) Consider a message of 10 bits, M = 1101011011. Pattern of 5 bits, P = 10011. For CRC error-detecting code, find the reminder R and transmitted bits in a polynomial form. 04

(c) How is synchronization provided for synchronous transmission? 02

8. (a) Write down the Shannon capacity formula. What is the channel capacity for a teleprinter channel with a 300-Hz bandwidth and a signal-to-noise ratio of 3dB? 03

(b) A discrete memoryless source has an alphabet of five symbols with their probabilities for its output, as given here: 05

Symbol	S_0	S_1	S_2	S_3	S_4
Probability	0.4	0.2	0.2	0.1	0.1

Compute Huffman Code for this source and find:

i. The average code-word length
ii. Calculate the entropy of the source

(c) What do you mean by data link control protocol? 02

Khulna University, Khulna

Computer Science and Engineering Discipline

3rd Year, Term II, Examination 2015

Session: 2013-2014

Course No: ECE 3251

Full Title of Course: **Data Communication**

Full Marks: 60 Time: 03 Hours

- The Figures in the margin indicate full marks. The questions are of equal value.
- Use separate sheet for each section.

SECTION A

There are **FOUR** questions in this section. Answer any **THREE** questions.

Q1. a) Define data and signal. **02**

b) Explain how data is transmitted, with the help of a digital communication system. **03**

c) What is modulation? State the conditions to retain the shape of the envelop of the modulated signal same as the modulating signal. **02**

d) Classify modulation techniques for transforming digital data into analogue signals. Give one use of each technique. **03**

Q2. a) Describe the pulse width modulation technique with the variations of its modulating signals. **03**

b) A PCM system is to carry a 20-kHz music channel. It is to have a signal-to-noise ratio of 80 dB and the peak maximum signal is 15 dB over its rms value. **03**

i. What sampling rate should be used?

ii. How many bits should be used in the sample code word?

c) Explain with necessary figure how PPM wave can be generated from a PWM signal. **04**

Q3. a) For the situation of a maximum sized sinusoidal signal input, derive the equation $\left(\frac{S}{N}\right) q = 1.5L^2$. **03**

b) Describe binary frequency shift keying method. **03**

c) Given the bit pattern, 01100 encode this data using ASK, BFSK and BPSK. **03**

d) Why carrier recovery circuit is used? **01**

Q4. a) With the help of a block diagram, describe QPSK modulation and demodulation technique. **04**

b) Why should PCM be preferable to data modulation for encoding analogue signals that represent digital data? **03**

c) What do you mean by constellation diagram and draw a constellation diagram of 16 QAM system. **03**

SECTION B

There are **FOUR** questions in this section. Answer any **THREE** questions.

Q5. a) For the bit stream 01001100011, sketch the waveforms for this sequence using: (i) NRZ-L; (ii) Bipolar AMI; (iii) Pseudoternary. 03

b) State and prove the channel capacity theorem. 03

c) Given a channel with an intended capacity of 20 $Mbps$ and the bandwidth of the channel is 3 MHz. What signal-to-noise ratio is required to achieve this capacity? 03

d) What do you understand by the term mutual information? 01

Q6. a) A discrete memoryless source has an alphabet of five symbols with their probabilities for its output, as given here: 04

Symbol	S_0	S_1	S_2	S_3	S_4
Probability	0.55	0.15	0.15	0.10	0.05

Compute Huffman code for this source and find:

i. The average code-word length

ii. Calculate the entropy of the source.

b) With the help of a Synchronous frame format, explain the synchronous transmission system. 03

c) What is multiplexing? Discuss about the time division multiplexing process. 03

Q7. a) Consider the (7, 4) Hamming code, whose parity check matrix is given by H in Figure 7 (a). 05

i. Find the minimum distance of the Hamming code.

ii. Determine the syndrome 's' of the Hamming code for single and double error patterns. From this, show that single errors are correctable and double errors are at least detectable.

$$H = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 & 1 \end{bmatrix}$$

Figure 7(a): Matrix 'H'

b) Draw the state diagram of the convolution encoder given in Figure 7(b). Consider the input bit stream in 10011. Find the encoded bit sequence of the given data. Also draw the trellis diagram of this data sequence. 05

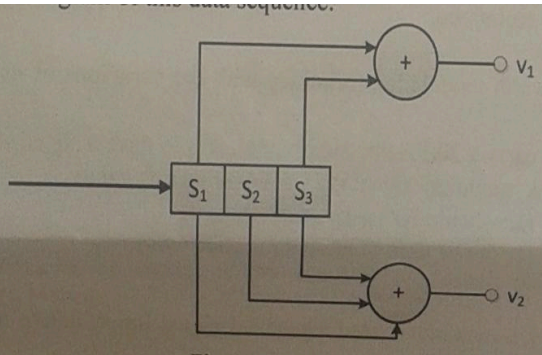


Figure 7(b): Convolution Encoder

Q8. a) How can you convert a general communication system into an optical fiber communication system? Explain with a block diagram. 03

b) A multimode step index fiber with a core diameter of 60 μm and a relative index difference of 1.5% is operating at a wavelength of 0.85μm. If the core refractive index is 1.48, then calculate: 03

i. The normalized frequency for the fiber.

ii. The number of guided modes.

c) Prove that, if the transmission times are to be the same, the bit energy for the coded signal must be reduced by a factor "r" compared to the uncoded signal. 04

Date: 22/11/2018

Khulna University, Khulna

Computer Science and Engineering Discipline
3rd Year, Term II, Examination 2018
Session: 2017-2018
Course No: ECE 3251
Full Title of Course: Data Communication

Full Marks: 60 Time: 03 Hours

- The figures in the margin indicate full marks. The questions are of equal value.
- Use separate sheet for each section.

Section A

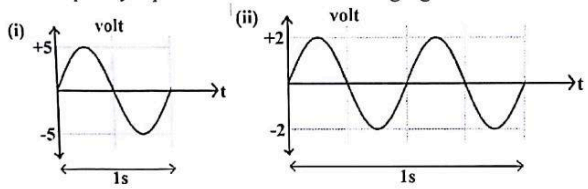
There are **FOUR** questions in this section. Answer any **THREE** questions

1 a) What do you understand by the term modulation? Why modulation is necessary in communication? 2+1

b) Calculate the antenna height for the frequency 3GHz 02

c) Consider the general expression for Amplitude-Modulated (AM) signal is $s(t) = [A + x(t)]\cos\omega_c t$; where $x(t) = V_m \cos\omega_m t$ is a single tone modulating signal. Show that the modulated signal will be $s(t) = A\cos\omega_c t\,[1 + m_a \cos\omega_m t]$. Here m_a represents the modulation index. 03

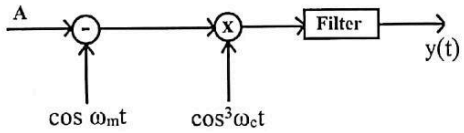
d) Draw the frequency representation of the following signals 02



ω

2 a) A 400 watts carrier is modulated to a depth of 75 percent. Find the total power in the amplitude-modulated wave. Assume the modulating signal to be a sinusoidal one. 03

b) Find out the output signal y(t) of the following system. Consider the filter allow to pass the frequency up-to $\left(2\pi f_c + \frac{2\pi f_m}{4}\right) Hz$. 03



Here, $\omega_c >> \omega_m$.

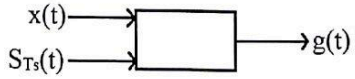
c) Why should you consider Double-Sideband-Suppressed Carrier (DSB-SC) Amplitude Modulation technique in place of Double-Side-Band-Full Carrier (DSBFC) Amplitude Modulation technique. 02

d) Do you think, for Amplitude Modulation, Upper Side Band (USB) and Lower Side Band (LSB) contain similar kind of message information? Justify your answer. 02

3 a) A single-tone Frequency Modulated (FM) signal is represented by the voltage equation as: $v(t) = A\cos(\omega_c t + m_f \sin\omega_m t)$. For this scenario find out the following terms. 4x1 =04

(i) Carrier frequency
(ii) Modulating frequency
(iii) Modulation index
(iv) Maximum frequency deviation

b) Consider a continuous time signal x(t) is multiplied by a continuous impulse train $S_{T_s}(t)$ of period T_s. This system is represented by the following figure: 04



Prove the frequency domain representation of the signal g(t) is

$$G(\omega) = \frac{1}{T_s} \sum_{n=-\infty}^{\infty} X(\omega - n\omega_s)$$

c) What do you understand by the following two terms 02
   (i) Mid-Rise Quantization
   (ii) Mid-Tread Quantization

4 a) An analog signal is expressed by the equation 03

$$x(t) = 4\cos 50\pi t + 18\cos 300\pi t - \cos 100\pi t$$

Calculate the Nyquist rate for the signal

b) What do you understand by 03
   (i) Binary Phase Shift Keying (BPSK)
   (ii) Binary Amplitude Shift Keying

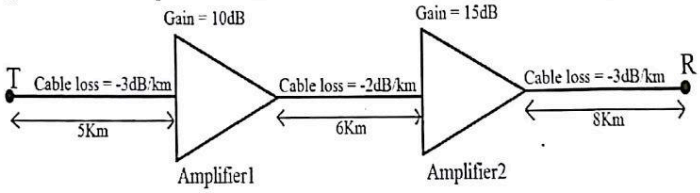
c) Describe the following terms 4x1 =04
   (i) Pulse Position Modulation (PPM)
   (ii) Pulse width Modulation (PWM)
   (iii) Pulse Amplitude Modulation (PAM)
   (iv) Quantization Noise

Section B

There are **FOUR** questions in this section. Answer any **THREE** questions

5 a) Explain Shannon's channel capacity theorem. Prove that for an infinite bandwidth of channel, the capacity is finite. 04

b) A signal with 5dBm power travels from T to R as shown in following figure. 06



   (i) Calculate the signal power at R
   (ii) At room temperature what is the signal to noise ratio at R if its bandwidth is 30 MHz? Take thermal noise alone into account whose noise power density is kT watt/Hz, k being the Boltzmann's constant and T is the absolute temperature.
   (iii) Determine the channel capacity of the link.
   (iv) How many signal levels are needed to achieve a data rate of half of the channel capacity?

6 a) Define Line Coding. 01

b) A signal has four data levels with a phase duration of 1ms. Calculate the Pulse Rate and Bit Rate. 2+2

c) Describe following terms 2+2
   (i) Frequency Division Multiplexing
   (ii) Time Division Multiplexing

d) What do you understand by Microwave? 01

7 a) What is the Hamming distance? A code scheme has a minimum Hamming distance of 5. What is the error detection and correction capability of this scheme? 02

b) Show the possible structure of the encoder and decoder for a Hamming code and explain its operation. How can this code be used to correct burst errors? 04

c) What are the advantages of the cyclic codes? What are the characteristics of a good polynomial generator? Given the dataword 1010011110 and the divisor 1011, show the generation of the codeword at the sender side using polynomials. 03

d) For a CRC-32 polynomial, what is the probability of detecting a burst error of size 55? 01

8 a) What are the major classes of guided media? What is the significance of the twisting in twisted pair cable? 02

b) What is meant by the numerical apertures (NA) of an optical fiber? Show that $NA = \sqrt{n_1^2 - n_2^2}$, *where* n_1 *and* n_2 are the refractive indexes of core and cladding layer of an optical fiber. 03

c) Draw the basic block diagram of an optical fiber transmission link. What is WDM? Explain with necessary figure. 05

Khulna University

Date: 09/12/2021

Computer Science and Engineering Discipline

3rd Year Term II, Examination 2021, Session 2019 - 2020

Course No.: CSE 3203 **Course Title:** Computer Networks

Full Marks: 60 Time: 3 Hours

- The figures in the margin indicate full marks. The questions are of equal value.
- Use separate sheet for each section.

Section A

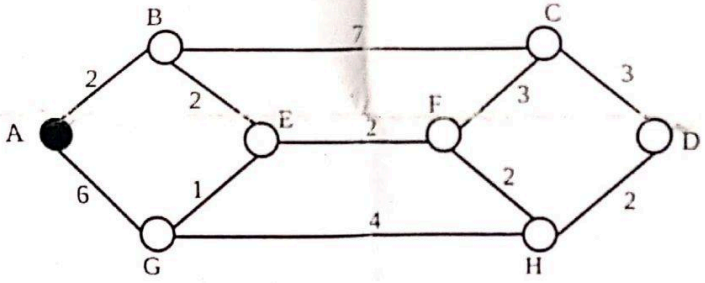
There are **four** questions in this section. Answer any **three** questions.

1(a) Classify Computer Networks based on geographical distance. 03

1(b) What is the difference between a Virtual Path and a Virtual Channel? 03

1(c) Describe what is meant by wave division multiplexing (WDM) and explain how it is used to deliver high rate data transmission over a fibre optic cable. 04

2(a) Calculate the shortest path for the following graph. 05



2(b) What do mean by IP Classes of Network? Write the IP ranges of all classes. 03

2(c) What are Private and Special IP addresses? What is meant by 127.0.0.1 and localhost? 02

3(a) What do you mean by Network Topology? Discuss the working process of RING topology. 03

3(b) What are the differences between HTTP and HTTPS? What happens when you enter google.com in the web browser? 01+ 02

3(c) What are the differences between the Internet, Intranet, and Extranet? 02

3(d) What are the differences between Firewall and Antivirus? 02

4(a) What is Count-to-Infinity Problem in distance vector routing? Explain with appropriate figure. 05

4(b) What is the use of encryption and decryption? How data in the networking can be protected from unwanted access? 03

4(c) In your own words Critique the OSI Model and its Protocols. 02

Section B

There are **four** questions in this section. Answer any **three** questions.

5(a) Explain the concept of Hamming distance and how it is calculated. 04

5(b) Explain the relationship between the Hamming distance and errors occurring during transmission and calculate the Hamming distance between 01011 and 10101. 06

6(a) What is the network address in a class A subnet with the IP address of one of the hosts as 25.34.12.56 and mark 255.255.0.0? 03

6(b) A company is granted the site address 181.56.0.0 (class B). The company needs 1000 subnets. Design the subnets. 02

6(c) What is ARPANET? Do you think opening the ARPANET to all was a good decision? Why or why not – Explain. 03

6(d) What are MAC addresses? 02

7(a) How Selective Repeat ARQ is better than Go-Back-N ARQ protocol? Discuss with appropriate example. 03

7(b) Discuss any one wireless transmission technique with necessary figure. 03

7(c) Discuss the working process of Selective Repeat ARQ protocol. 04

8(a) With an example explain the Dynamic routing algorithms used in computer Networks. 02+ 02

8(b) How hierarchical routing can simplify a complex network? Discuss with appropriate graph. 03

8(c) What is the importance of implementing a Fault Tolerance System? 02

8(d) What is DoS? 01

Khulna University, Khulna

Computer Science and Engineering Discipline
3rd Year Term I Examination 2022
Session: 2020-2021
Course No.: ECE-3151
Full Title of the Course: Data Communication

Full Marks: 60 **Time: 03 Hours** **Date: 22/05/2022**

- The figures in the right margin indicate the full marks.
- Use separate answer sheet for each section.

SECTION A

There are **FOUR** questions in this section. Answer any **THREE** questions.

Q1. (a) Suppose you are going to connect 20 computers in the academic building-1 where there are 5 computers in each floor. Which topology will you select to design the network? – Justify your answer.

(b) Four data channels (digital), which transmitting at 1 Mbps, use a satellite channel of 1 MHz. Design an appropriate configuration, using FDM.

(c) The loss in a cable is usually defined in decibels per kilometer (dB/km). If the signal at the beginning of a cable with -0.3 dB/km has a power of 2 mW, what is the power of signal at 5 km?

Q2. (a) What is pulse modulation? Give some examples of pulse analog modulation and pulse digital modulation.

(b) Suppose, in synchronous TDM, there are three digital channels are multiplexed and the data rate of each channel is 3kbps. If 1 bit at a time is multiplexed (a unit is 1 bit), what is the duration of (a) each input time slot, (b) each output slot and (c) each frame. Design an appropriate configuration using these specifications.

(c) Distinguish among multilevel TDM, multislot TDM, and pulse-stuffed TDM.

Q3. (a) Let's say, we have an available bandwidth of 100kHz which spans from 200 to 300 kHz. What should be the carrier frequency and the bit rate if we modulated our data by using: (i) FSK with d=1 and (ii) ASK with d=1?

(b) Compare the pulse width modulation and pulse position modulation with neat sketches.

(c) Show the digital encoding format for the sequence 1100011110 using 2B1Q and differential Manchester encoding.

Q4. (a) Define constellation diagram and its role in analog transmission.

(b) Draw the constellation diagram for: (i) ASK, with peak amplitude values of 1 and 3; (ii) QPSK, with peak amplitude value of 3; (iii) 8-QAM with two different peak amplitude values 1 and 3, and four different phases.

(c) Suppose you want to digitize human voice using PCM. What will be the bit rate, assuming 8 bit per sample? Also, calculate the SNR_{dB}. Repeat it by assuming 16 bit per sample? Comments on your answer.

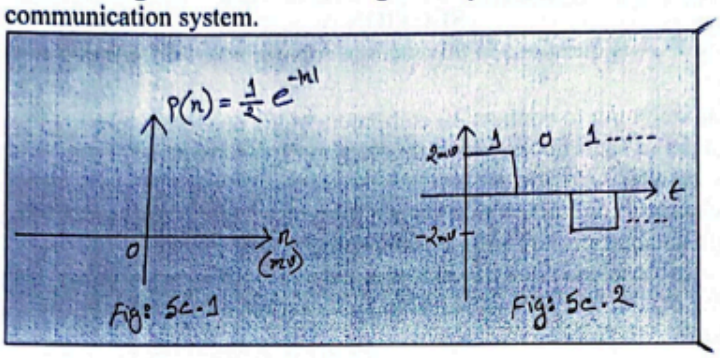
SECTION B

There are **FOUR** questions in this section. Answer any **THREE** questions.

Q5. (a) What do you mean by the detection-error probability in a binary communication system? 02

(b) The input to a binary communication channel consists of 0's and 1's with priori probabilities of 0.7 and 0.3 respectively. Polar binary pulses are received with peak amplitude of 0.5mV. If the rms amplitude of channel noise is 120 μV, determine the detection error probability assuming zero intersymbol interference and a Gaussian noise distribution. 03

(c) Noise with Laplacian distribution (Fig: 5c.1) is added to a signal sequence of the form shown in Fig: 5c.2. Find the average error probability of the received pulses in a binary communication system. 05



Q6. (a) What is transmission impairment? Briefly explain some major causes of transmission impairment. 03

(b) Why thermal noise is particularly significant for satellite communication? Given a receiver with an effective noise temperature of 17°C and a 12-MHz bandwidth, compute the thermal noise level at the receiver's output in decibel-watts. 03

(c) Define spectral efficiency of a digital transmission. Consider a channel with a 1 MHz capacity and an SNR of 63. What is the upper limit of the data rate that the channel can carry? How many signal levels are needed to achieve the half of this maximum data rate? 04

Q7. (a) Describe the working method of Sliding window flow Control. 03

(b) Find the minimum hamming distance of the coding scheme in Table 7b. Determine the error detection and correction capability of this scheme. 02

Table 7.b

Dataword	Codeword
00	00000
01	01011
10	10101
11	11110

(c) Given the dataword 1010011110 and the divisor 10111, show the generation of the codeword at the sender site using polynomials. Show also the checking of the codeword at the receiver site (assume no error). 05

Q8. (a) What are the three major classes of guided transmission media? Illustrate the significance of the twisting in twisted-pair cable with necessary diagrams. 03

(b) What is meant by propagation modes in optical fiber? What is the major limitation of a multimode fiber? Consider a step index fiber that has a core refractive index of 1.48, a cladding index of 1.476, and a core radius of 4μm. Determine the wavelength at which this fiber becomes single-mode. How many modes will propagate through this fiber if it operates at 850nm wavelengths? 05

(c) Describe how light propagates through optical fiber. 02

02-03-202

CT: 01

Data Communication

1	Draw the Waveform of 00100111 using QPSK through step-by-step procedure	5
2	Draw the line coding of 1100011110 using 2B1Q and Differential Manchester scheme.	5
3	Compare and contrast PCM and DM.	5
4	Describe the significance of constellation diagram in communication. Also draw the constellation diagram of 16-QAM.	5
5	Suppose you want to digitize human voice using PCM. What will be the bit rate, assuming 8 bit per sample? Also, calculate the SNR_{dB}. Repeat it by assuming 16 bit per sample? Comments on your answer.	10

20 04-20

CT 2

Data Communication

1	What are the differences between parallel and serial transmission?	5
2	Briefly describe the delta modulator with necessary figure.	5
3	Four data channels (digital), each transmitting at 1 Mbps, use a satellite channel of 1 MHz. Design an appropriate configuration, using FDM.	10
4	Suppose, in synchronous TDM, there are three digital channels are multiplexed and the data rate of each channel is 3 kbps. If 1 bit at a time is multiplexed (a unit is 1 bit), what is the duration of (a) each time slot, (b) each output slot and (c) each frame. Design an appropriate configuration using this.	10

Khulna University, Khulna

Computer Science and Engineering Discipline

3rd Year Term I Examination 2023

Session: **2021-2022**

Course No.: **ECE-3151**

Full Title of the Course: Data Communication

Full Marks: **60** Date: **15/05/2023** Time: **03 Hours**

- The figures in the right margin indicate the full marks.
- Use separate answer sheet for each section.

SECTION A

There are **FOUR** questions in this section. Answer any **THREE** questions.

Q1. (a) Why modulation is necessary for communication? 02

(b) Find the height of antenna for the following frequencies: 03

i. 3 KHz ii. 3MHz

(c) Derive the expression for the transmission efficiency of AM wave. 05

Q2. (a) Let consider a message signal 05

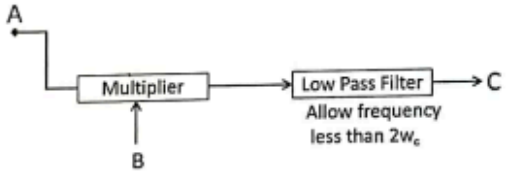
$$x(t) = v_1 cosw_1 t + v_2 cosw_2 t + v_3 cosw_3 t$$

is modulated by a carrier signal $Acosw_c t$. Prove that the relation between total power P_t and carrier power P_c will be

$$P_t = P_c(1 + \frac{m_1^2}{2} + \frac{m_2^2}{2} + \frac{m_3^2}{2})$$

(b) A 500 watts carrier is modulated to a depth of 80 percent. Find the total power in the amplitude-modulated wave. Assume the modulating signal to be a sinusoidal one. 03

(c) What will be the output C of the following block? 02



Here, $A = x(t)\cos w_c t$ and $B = \cos w_c t$

Q3. (a) State and prove the sampling theorem. 05

(b) An analog signal is expressed by the equation 04

$$x(t) = 3\cos 50\pi t + 10\sin 300\pi t - \cos 100\pi t$$

Calculate the Nyquist rate for this signal.

(c) What do you understand by line coding? 01

Q4. (a) What do you understand by circuit switching? 01

(b) A single-tone FM is represented by the voltage equation as $v(t) = 120\cos(8 \times 10^9 + 10\sin 1250t)$. Determine the following: 04

i. Carrier frequency
ii. Modulating frequency
iii. The modulation index
iv. Maximum deviation

(c) Explain the following terms: 05

i. Amplitude Shift Keying
ii. Frequency Shift Keying

SECTION B

There are **FOUR** questions in this section. Answer any **THREE** questions.

Q5. (a) Suppose that bipolar pulses are received with peak amplitude of 1000μV. Noise is added to the channel with rms amplitude of 0.2 millivolt. If threshold detection is used at the receiver and the probability of sending 0 and 1 are 0.25 and 0.75 respectively, compute the average detection-error probability. Given that, 04

$$Q(x) \cong \frac{1}{x\sqrt{2\pi}}\left(1-\frac{0.7}{x^2}\right)e^{-\frac{x^2}{2}}, x > 2$$

(b) What is the basic difference between attenuation and distortion of a signal? 02

(c) Define channel capacity. State and explain Shannon capacity formula. 04

Q6. (a) A telephone network has a bandwidth of 3.4 KHz. Calculate the minimum signal-to-noise ratio required for information transmission through the channel at the rate of 9600 bits/s. 04

(b) Describe what is meant by channel coding. How does it differ from source coding? 02

(c) Explain automatic repeat request (ARQ) technique with proper diagrams. 04

Q7. (a) Suppose you want to encode three datawords, 1111, 0101, and 1011 by adding an extra bit in such a manner that the resultant codewords have even number of 1. Write down the codewords and determine the minimum hamming distance (d_{min}) among them. Also, find out the minimum number of bits that can be corrected using this coding scheme. 04

(b) Mention few advantages and applications of the CRC coding. Show the calculation at the receiver for CRC codeword 1110001001 and polynomial generator $x^4 + x^3 + 1$. Does this codeword contain errors? 06

Q8. (a) What is transmission medium? Why the usage of electromagnetic spectrum needs to be regulated? Mention some applications of twisted pair cable and coaxial cable. 03

(b) Explain the meaning of numerical aperture of an optical fiber. A step index fiber has a normalized frequency V=26.6 at a 1300nm wavelength. If the core radius is 25μm, what is the numerical aperture? 03

(c) Draw a typical block diagram of an optical fiber transmission link and briefly describe the function of each block. 04

Khulna University, Khulna

Computer Science and Engineering Discipline

3rd Year 1st Term, Examination 2024, Session: 2022 – 2023

Course No.: ECE 3151, Course Title: Data Communication

Full Marks: 60 **Date: 06.06.2024** Time: 03 Hours

- The figures in the margin indicate full marks. The questions are of equal value.
- Use separate sheet for each section.

Section A

There are **FOUR** questions in this section. Answer any **THREE** questions.

1. (a) Why is modulation necessary in communication? 3
   (b) Define delta function. Explain its significance. 2
   (c) Draw a generalized block diagram of a transmitter and receiver of a communication system. Also, explain each block. 5

2. (a) What do you understand by Amplitude modulation index m? Explain the significance of the following cases: 5
      I. $m > 1$
      II. $m < 1$
      III. $m = 1$
   (b) Explain how you can create Double Side band suppress carrier signal. Then also explain how the message signal can be recovered from this double side band suppressed carrier signal. 5

3. (a) Prove that the equation for a single tone FM is 3
      $S(t) = A \cos [w_c t + m_f \sin w_m t]$.
   (b) State and prove sampling theorem. 5
   (c) Determine the Nyquist rate for the following continuous-time signal 2
      $X(t) = 6 \cos 50\pi t + 2\sin 300\pi t - 10 \cos 100\pi t$

4. (a) What do you understand by QPSK method? Explain QPSQ modulation and demodulation method. 6
   (b) Explain Amplitude shift keying method. 3
   (c) What is the modulation index of an FM signal having a carrier swing of 100KHz when the modulating signal has a frequency of 8kHz? 1

Section B

There are **FOUR** questions in this section. Answer any **THREE** questions.

5. (a) Write down the expression of average detection-error probability at the receiver for polar, on-off and bipolar pulses. Show that the increase in error probability for bipolar case can be compensated by just a little increase in signal power. 3=1+2

(b) Define effective bandwidth of a signal. What are the negative effects of limiting the signal bandwidth? 3=1+2

(c) What do you mean by noise and noise figure in a communication system? Given a receiver with an effective noise temperature of 294K and a 10 MHz bandwidth, compute the thermal noise level at the receiver's output. 4=2+2

6. (a) What is channel capacity? What key factors affect channel capacity? Show that as the bandwidth goes to infinity, the capacity of the channel goes to $1.44\frac{S}{N_0}$, where S and N_0 are the signal power and the noise spectral density respectively. 5=1+1 +3

(b) A communication channel with a bandwidth of 4KHz has a signal power to noise ratio of 8. The bandwidth is reduced by 20%. How much should the signal power be increased to maintain the same channel capacity? 3

(c) Given a channel with an intended capacity of 20 Mbps, the bandwidth of the channel is 3 MHz. Assuming white noise, what signal to noise ratio is required to achieve this capacity? 2

7. (a) What is channel coding? What are the major factors that determine the selection of a channel coding scheme for a particular application? 2

(b) A code scheme has the following codewords: 00000, 01011, 10101, 11110. Compute the minimum hamming distance of these codes and determine the error detection and correction of this scheme. 2

(c) With proper sketches explain the working principle of the encoder and decoder for a Hamming code. Also, explain how this coding scheme can be used to deal with burst error correction. 6

8. (a) Describe some of the major advantages of using an optical fiber as the transmission media over twisted pair and coaxial cable. 4

(b) Explain the meaning of numerical aperture of an optical fiber. Do you agree that the fiber with larger core diameter will also have higher values of numerical aperture? Why or why not? 3

(c) What is the main limiting factor of using multimode optical fiber in a long distance communication? 1

(d) Consider a multimode step index fiber with a 62.5 μm core diameter and a core-cladding index difference of 1.5%. If the refractive index is 1.480, how many modes? 2