C.S.E. 3-2 Fall-18

Date of Examination: 07/05/2019

AHSANULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Department: Computer Science and Engineering

Program: Bachelor of Science in Computer Science and Engineering

Semester Final Examination: Fall 2018

Year: 3rd Semester: 2nd

Course Number: **CSE3211**

Course Name: **Data Communication**

Time: 3 (Three) hours Full Marks: 70

[Use separate scripts for PART A and PART B]

PART A

[Answer any **3 (Three)** questions out of **4 (Four)** from this part. Each question contains 14 marks. Marks are indicated in right side.]

1. a) Distinguish between analog and digital signal. [3]

   b) Assume that a channel has 2 MHz bandwidth. The Signal to Noise Ratio (SNR) for this channel is 63. What are the appropriate bit rate and signal level? [5]

   c) Mention the factors on which the data rate of a channel depends. [2]

   d) The performance of a telephone line is measured to be 4KHz of bandwidth. When the signal is 10V, the noise is 5 mV, what is the maximum data rate supported by this telephone line? [4]

2. a) What is the result of scrambling the sequence 1110000000000 using B8ZS scrambling technique? Assume that the last non-zero signal level has been positive. [2]

   b) What is Block Coding? How many unused code sequences can we have in 5B/6B encoding? [3]

   c) Write a short note on Bipolar Scheme. [4]

   d) Draw the graph of Differential Manchester Scheme for the data stream, 00110011; assuming that the last signal level has been positive. Specify all other necessary assumptions if needed. [5]

3. a) What is the ideal sampling rate for Pulse Code Modulation (PCM)? [1]

   b) Explain the effect of oversampling and undersampling a simple sine wave in PCM. [3]

   c) In Synchronous Time Division Multiplexing, the data rate for each of the three input connections is 1 Kbps. If 1 bit is multiplexed at a time, what is the duration of (a) each input slot, (b) each output slot and (c) each frame? [6]

   d) Using Multiple Slots Time Division Multiplexing Technique, multiplex four channels, two with a bit rate of 200 Kbps and two with a bit rate of 150 Kbps. [4]

4. a) Briefly describe the working principle of data communication using fiber optic cable. Also describe its different propagation modes. [6]

   b) Explain how Direct Sequence Spread Spectrum (DSSS) achieves bandwidth spreading. [3]

c) Assume that a voice channel occupies a bandwidth of 5 KHz. You are required to combine four voice channels into a link with a bandwidth of 20 KHz, from 20 to 40 KHz. Show the configuration using the frequency domain. Assume there are no guard bands. [5]

PART B

[Answer any **2 (Two)** questions out of **3 (Three)** from this part. Each question contains 14 marks. Marks are indicated in right side.]

5. a) In this summer, you are trying to alert people about global warming. So, you take the Celsius reading of the temperature outside every day at 12:30 P.M. You have done this for 15 days straight. Definitely you are trying to signal us about global warming but what are its types: Continuous or Discrete? Analog or Digital? Justify your answer. [2]

b) A signal $g(t) = e^{-2t}$ is given, which is periodic and defined as a single period in $t = [0, 2\pi]$. Find out its exponential Fourier series expansion. [5]

c) Write a short note on Pulse Amplitude Modulation. [3]

d) A periodic signal $g(t)$ is defined as $g(t) = t^3$ in a single period $t = [-2, 2]$. Find out its power. [4]

6. a) Define Baseband and Carrier communications. [2]

b) Find the Fourier transformation of $\Pi(t)$ using the definition of Fourier transformation. Then using linearity, time scaling and time shifting properties on the resultant expression- find the Fourier transformation of $\Pi(2t) + \Pi\left(t - \frac{1}{2}\right)$. [6]

c) Define the multiplication property of the unit impulse function. [2]

d) A signal **01111000** is being sent via a wireless channel. To save the energy, **QPSK** modulation will be used. The carrier signal is a sine wave, whose full cycle period equals to the same amount of time needed for sending one dibit (dual bit). Draw the signal graph and the modulated signal graph. The phase changes for corresponding dibits(dual bits) are shown in table 1. [4]

Table 1: Phase changes for dual bits in QPSK

Dibits	Phase Change
00	0
01	90
10	180
11	270

7. a) What are the two properties of LTI systems? Describe them in short. [3]

b) A signal **101101** is being sent. The carrier signals are (i) for bit "0", a sine wave whose full cycle period equals to the same amount of time needed for sending one bit (ii) for bit "1", a sine wave whose two cycle periods equals to the same amount of time needed for sending one bit. Which modulation scheme are you going to use if [5]

you want less noise susceptibility? Draw the signal graph, carrier signal graphs and modulated signal graph.

c) Why is Vestigial Sideband Modulation used? [2]

d) Draw the Phase modulation graph (approximate) for the periodic modulating signal shown below in Figure 1. Here, the constants are: $k_p = 6\pi$, $f_c = 200MHz$, period of the wave: $2 \times 10^{-5}s$. Show the calculations for f_i(min) and f_i(max). [4]

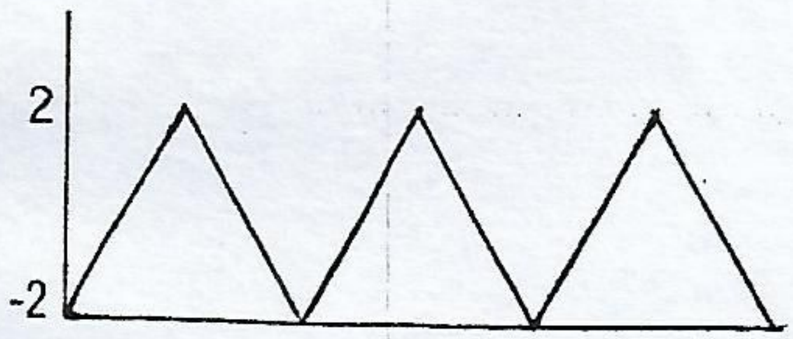


Figure 1: Message Signal

Date of Examination: 11/09/18

AHSANULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Department: Computer Science and Engineering

Program: Bachelor of Science in Computer Science and Engineering

Semester Final Examination: Spring 2018

Year: 3rd Semester: 2nd

Course Number: CSE3211

Course Name: Data Communications

Time: 3 (Three) hours | Full Marks: 70

[There are seven questions carrying a total of 14 marks each. Answer any five questions.
Marks allotted are indicated in the right margin.]

1. a) Distinguish between broadband and baseband transmission. We send a digital signal from one station of LAN to another station of LAN. Is it baseband or broadband? 4

   b) What is the phase shift for the following? 3

      i) A sine wave with the maximum amplitude at time zero.

      ii) A sine wave with maximum amplitude after ¼ cycle.

      iii) A sine wave with zero amplitude after ¾ cycle and increasing.

   c) We measure the performance of a telephone line (4KHz of bandwidth). When the signal is 20V the noise is 8 mV. What is the maximum data rate supported by this telephone line? 4

   d) Can we say if a signal is periodic or non-periodic by just looking at its frequency domain plot? How? 3

2. a) In a digital transmission, the sender clock is 0.2 percent faster than the receiver clock. How many extra bits per second does the sender send if the data rate is 1 Mbps?. 2

   b) We need to send data at a 1-Mbps rate. We have two options- i) a combination of 4B/5B and NRZ-I and ii) Manchester encoding. Compare and contrast the two options in terms of required bandwidth and dc component. 4

   c) How do scrambling techniques overcome the baseline wandering problem of AMI encoding? 2

   d) We have sampled low-pass signal with a bandwidth of 300 KHz using 1024 levels of quantization. Answer the following questions. 6

      i) Calculate the bit rate of the digitized signal.

      ii) Calculate the SNR_{dB} for this signal.

      iii) Calculate the PCM bandwidth of this signal.

3. a) Define carrier signal and describe its role in analog transmission. 2

   b) i) What is the motivation of QPSK? 1

      ii) How many carriers are there in QPSK? Are all the carriers in phase? 2

      iii) Draw the constellation diagram of QPSK. 1

   c) A cable company uses one of the cable TV channels (with a bandwidth of 6 MHz) to provide digital communication for each resident. What is the available data rate for each resident if the company uses a 64-QAM technique? 2

d) Find the bandwidth for the following situations if we need to modulate a 5-KHz voice. 3
i) AM, ii) FM (β=5) and iii) FM (β=1)

e) What is the range of frequency for AM radio recommended by FCC? How much bandwidth is allocated for each station by FCC? Calculate the total number of AM radio stations if 10 KHz is used as guard band. 3

4. a) Compare and contrast among twisted pair, coaxial cable and optical fiber. 4

c) i) Mention the basic principle of propagation of signal through optical fiber. 1
ii) Distinguish between step index and graded index optical fiber. 2
iii) Describe multimode and single mode propagation of optical fiber. 2

c) i) Describe the different types of propagation method of unguided media. 3
ii) Distinguish between unidirectional and omnidirectional antenna. 2

5. a) Distinguish between Synchronous Time Division Multiplexing and Statistical Time Division Multiplexing. 3

b) Two channels, one with a bit rate of 190 kbps and another with a bit rate of 180 kbps, are to be multiplexed using pulse-stuffing TDM with no synchronization bits. Answer the following questions:
i) What is the size of a frame in bits? 1+1
ii) What is the frame rate? 190
iii) What is the duration of a frame?
iv) What is the data rate? 2

c) i) Distinguish between a DSL modem and a DSLAM. 2
ii) Distinguish between CM and CMTS 2

6. a) Distinguish between forward error correction and backward error correction. 2

b) Design a codeword of length 7 for [illegible] of length 2 where minimum Hamming distance is 4. 3

c) Consider the following generating polynomial. 1

$$x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^8 + x^7 + x^5 + x^4 + x^2 + x + 1$$

i) Determine the number of X-OR gates and Shift registers are required to implement it. 2
ii) Does it detect a single error? Defend your answer. 2
iii) Does it detect a burst error of size 16? Defend your answer. 2
iv) What is the probability of detecting a burst error of size 33? 2
v) What is the probability of detecting a burst error of size 55?

7. a) Why is it useful to have more than one possible path through a network for each pair of stations? 2

b) Consider a switched communication network having 4 hops between two given end systems. Assume that the message length is 2200 bits, data rate on all links is 9600 bps, fixed packet size is 1024,ove head bits per packet is 16, call setup delay is 0.2 seconds and propagation delay is 0.001 second/hop. Also assume that there is no acknowledgement and no processing delay at each node. Compute the end-to-end delay for
i) Circuit switching 4
ii) Datagram packet switching 4
iii) Virtual-circuit switching 2

c) Can routing table in a datagram network have two entries with the same destination address? Explain. 2

Date: 13.09.17

Ahsanullah University of Science and Technology

Department of Computer Science and Engineering

Year: 3rd, Semester: 2nd, Final Examination (Spring 2017)

Course Title: Data Communications

Course No: CSE 3211 Time: 3 Hours

Full Marks: 70

[There are seven (7) questions. Answer any five (5) questions.]

[Marks allotted are indicated in the margin]

Q1. a) What is the phase shift for the following? 3

i) A sine wave with the maximum amplitude at time zero

ii) A sine wave with maximum amplitude after 1/4 cycle

iii) A sine wave with zero amplitude after 3/4 cycle and increasing

b) What is the bandwidth of a signal that can be decomposed into five sine waves with frequencies at 0, 20, 50, 100, and 200 Hz? All peak amplitudes are the same. Draw the bandwidth. 2

c) A computer monitor has a resolution of 1200 by 1000 pixels. If each pixel uses 1024 colors, how many bits are needed to send the complete contents of a screen? 2

d) We need to upgrade a channel to a higher bandwidth. Answer the following questions: 4

i) How is the rate improved if we double the bandwidth?

ii) How is the rate improved if we double the SNR?

e) i) What does the Nyquist theorem have to do with communications? 3

ii) What does the Shannon capacity have to do with communications?

Q2. a) In a digital transmission, the sender clock is 0.2 percent faster than the receiver clock. How many extra bits per second does the sender send if the data rate is 1 Mbps?. 2

b) We need to send data at a 1-Mbps rate. We have two options- i) a combination of 4B/5B and NRZ-I and ii) Manchester encoding. Compare and contrast the two options in terms of required bandwidth and dc component. 4

c) How do scrambling techniques overcome the baseline wandering problem of AMI encoding? 2

d) We have sampled a low-pass signal with a bandwidth of 200 KHz using 1024 levels of quantization. 6

i) Calculate the bit rate of the digitized signal.

ii) Calculate the SNR_{dB} for this signal.

iii) Calculate the PCM bandwidth of this signal.

$C = B(1+d)^{1/P}$

N = Bandwidth

$4000 \log_2(1+$

$SNR = 10^{SNR_{dB}/10}$

$C = B(SNR_{dB}/3)$

$SNR_{dB} = 6.07nB+$

Q3. a) Which characteristics of an analog signal are changed to represent the low pass analog signal in each of the following analog-to-analog conversions? 3

p) AM q) FM r) PM

b) Which of the three analog-to-analog conversion techniques (AM, FM, or PM) is the most susceptible to noise? Defend your answer. 3

c) A corporation has a medium with a 1-MHz bandwidth (lowpass). The corporation needs to create 10 separate independent channels each capable of sending at least 10 Mbps. The company has decided to use QAM technology. What is the minimum number of bits per baud for each channel? What is the number of points in the constellation diagram for each channel? Let d = 0. 4

d) Draw the constellation diagram for the following:

i) ASK, with peak amplitude values of 1 and 3
ii) BPSK, with a peak amplitude value of 2
iii) QPSK, with a peak amplitude value of 3
iv) 8-QAM with two different peak amplitude values, 1 and 3, and four different phases

Q4. a) Four channels, two with a bit rate of 200 kbps and two with a bit rate of 150 kbps, are to be multiplexed using multiple-slot TDM with no synchronization bits. Answer the following questions: 6

i) What is the size of a frame in bits?
ii) What is the frame rate?
iii) What is the duration of a frame?
iv) What is the data rate?

b) An FHSS system uses a 4-bit PN sequence. If the bit rate of the PN is 64 bits per second, answer the following questions:

i) What is the total number of possible channels? 1
ii) What is the time needed to finish a complete cycle of PN? 1

c) i) Show the band allocation (data and video) in CATV. 2
ii) Determine the upstream and downstream data rate. 2
iii) How do the downstream bands are shared among the subscribers? 2

Q5. a) i) What is Hamming distance? 1
ii) How does error detection take place in forward error detection? 2
iii) How does error correction take place in forward error correction? 2
iv) Make comments on overhead in forward error corrections. 1

b) i) In CRC, which of the following generators (divisors) guarantees the detection of a single bit error? 2

p) 101 q) 100 r) 1

ii) In CRC, which of the following generators (divisors) guarantees the detection of an odd number of errors? 3

p) 10111 q) 101101 r) 111

iii) In CRC, we have chosen the generator 1100101. What is the probability of detecting a burst error of length 3

p) 5? q) 7 r) 10?

Q6. a) Define a frame format in bit-oriented protocol. Show the bit stuffing and unstuffing for the data - 000111111110001111110011 3

b) How do flow control and error control are achieved in the following protocols? 5

i) Stop and Wait ARQ
ii) Go-Back-N ARQ

c) Using 4-bit sequence numbers, what is the maximum size of the send and receive windows for each of the following protocols? 6

i) Stop-and-Wait ARQ
ii) Go-Back-N ARQ
iii) Selective-Repeat ARQ

Defend your answer.

Q7. a) i) Why does a circuit-switched network need end-to-end addressing during the setup and teardown phases? Why are no addresses needed during the data transfer phase for this type of network? 2

ii) Why does a datagram network need only end-to-end addressing during the data transfer phase? 1

iii) Why does a virtual-circuit network need addresses during all three phases (setup, data transfer and teardown)? 1

b) We need a three-stage space-division switch with $N = 100$. Answer the following questions using Clos criteria.

i) Draw the configuration diagram. 2

ii) Calculate the total number of crosspoints. 2

iii) Find the possible number of simultaneous connections. 1

iv) Find the possible number of simultaneous connections if we use a single crossbar (100 × 100). 1

v) Find the blocking factor, the ratio of the number of connections in part iii) and in part iv). 1

c) What is TSI and what is its role in time-division switching? 3

10(10x4)+4(10x10)
+10(4x10)

Date: 25/09/16

Ahsanullah University of Science and Technology

Department of Computer Science and Engineering

Year: 3rd, Semester: 2nd, Final Examination (Spring 2016)

Course No: CSE 3211 Course Title: Data Communications

Full Marks: 70 Time: 3 Hours

[There are seven (7) questions. Answer any five (5) questions.]

[Marks allotted are indicated in the margin]

Q1. a) i) Distinguish between time domain representation and frequency domain representation. 5

ii) Distinguish between baseband transmission and broadband transmission

b) The attenuation of a signal is -12 dB. What is the final signal power if it was originally 4 W? 3

c) i) Mention the factors on which data rate of a channel depends. 2

ii) We measure the performance of a telephone line (4 kHz of bandwidth). When the signal is 20 V, the noise is 6 mV. What is the maximum data rate supported by the telephone line. 4

Q2. a) Describe the four cases of ratio (r) between data element and signal element. 4

b) i) Briefly describe the common characteristics of line coding. 4

ii) How do Manchester scheme overcome baseline wandering?. 2

c) Deduce the relation $B_{min} = n_b \times B_{analog}$ where B_{min} is the minimum bandwidth of digital signal, n_b is the number of bits per sample and B_{analog} is the bandwidth of analog signal. Assume that analog signal is converted into digital signal using pulse code modulation. 4

Q3. a) Briefly describe quadrature phase shift keying. 5

b) Mention the motivation of Quadrature Amplitude Modulation (QAM). Draw the constellation diagram of the following. 5

i) Amplitude Shift Keying (ASK), ii) 4-QAM

c) What is the number of bits per baud for the following techniques? 2

i) ASK with 8 different amplitude

ii) FSK with 16 different frequencies

d) What is the baud rate for the following given bit rate and type of modulation? 2

i) 6000 bps, ASK, ii) 72000 bps, 64-QAM

Q4. a) i) Mention the motivation of spread spectrum. How do you avoid jamming from intruder in Frequency Hopping Spread Spectrum? 4

ii) We have a digital medium with a data rate of 12 Mbps. How many 64-kbps voice channels can be carried by this medium if we use Direct Sequence Spread Spectrum?

b) i) Give an example of frame of a Statistical Time Division Multiplexing and a Synchronous Time Division multiplexing. 3

ii) Describe slot size in context of Statistical Time Division Multiplexing.

c) Determine the upstream data rate and downstream data rate in case of data transfer using ADSL technology. 3

d) Ten sources, seven with a bit rate of 250 kbps and three with a bit rate of 400 kbps are to be combined using multilevel Time Division Multiplexing with no synchronization bits. Answer the following questions. 4

i) What is the size of a frame in bits? ii) What is the frame rate?

iii) What is the duration of a frame? iv) What is the data rate?

Q5. a) What kind of error is undetectable by the following error detection techniques? 5

i) Single bit parity (even), ii) Two dimensional parity (even), and iii) Checksum

Provide example with proper reasoning.

b) Consider the following CRC generator polynomial 6

$$x^{16} + x^{12} + x^5 + 1$$

i) Does it detect a single bit error? Defend your answer.
ii) Does it detect a burst error of size 8? Defend your answer.
iii) What is the probability of detecting a burst error of size 17?
iv) What is the probability of detecting a burst error of size 25?

c) Answer the following questions. 3

i) What is the polynomial representation of 101100?
ii) What is the result of shifting 101010 three bits to the left?
iii) Distinguish between forward error correction and backward error correction.

Q6. a) Define a frame format in bit-oriented protocol. Show the bit stuffing and unstuffing for the data - 000111111110001111110011 3

c) How do flow control and error control are achieved in the following protocols? 5

i) Stop and Wait ARQ

ii) Go-Back-N ARQ

d) Using 3-bit sequence numbers, what is the maximum size of the send and receive windows for each of the following protocols? 6

i) Stop-and-Wait ARQ

ii) Go-Back-N ARQ

iii) Selective-Repeat ARQ

Defend your answer.

Q7. a) Mention the name of the layer at which following switching takes place. 3

i) Circuit-switching

ii) Datagram switching

iii) Virtual circuit-switching

b) In virtual circuit-switching, global and local addressing are involved. Briefly describe the role and scope of global and local addressing 3

c) A path in a digital circuit-switched network has a data rate of 1 Mbps. The exchange of 1000 bits is required for the setup and tear down phase. The distance between two parties is 8000 Km. Answer the following question if the propagation speed is $2 \times 10^8 m$. 4

i) What is the total delay if 2000 bits of data are exchanged during the data transfer phase.

ii) What is the total delay if 50000 bits of data are exchanged during the data transfer phase.

iii) What is the total delay if 200000 bits of data are exchanged during the data transfer phase.

iv) Find the delay per 1000 bits of data for each of the above case.

d) i) Crossbar switch is inefficient since only 25% cross points are used simultaneously. Multistage switching is the solution of this limitation. Mention the limitation of multistage switching 4

ii) What is TSI? Describe it's role in time-division switching. .

3, 6, 9, 10 | extra 11

(8)

Date: 23/03/16

Ahsanullah University of Science and Technology

Department of Computer Science and Engineering

Year: 3rd, Semester: 2nd, Final Examination (Fall 2015)

Course No: CSE3211 Course Title: Data Communication

Full Marks: 70 Time: 3 Hours

[Use separate scripts for Part A and Part B.]

Part A

[There are four (4) questions. Answer any three (3). Marks allotted are indicated in the right margin.]

Q1. a) Distinguish between broadband and baseband transmission. We send a digital signal from one station of LAN to another station of LAN. Is it baseband or broadband? 3

b) What is the phase shift for the following? 6

i) A sine wave with the maximum amplitude at time zero

ii) A sine wave with maximum amplitude after ¼ cycle

iii) A sine wave with zero amplitude after ¾ cycle and increasing

c) We measure the performance of a telephone line (4KHz of bandwidth). When the signal is 20V, the noise is 6 mV. What is the maximum data rate supported by this telephone line? 5

d) Can we say if a signal is periodic or non-periodic by just looking at its frequency domain plot? How? 2

Q2. a) Show the division of coaxial cable band by cable TV. 2

b) Determine the downstream and upstream data rate of CATV. 5

c) Describe the downstream band and upstream band sharing of CATV by the subscribers. 5

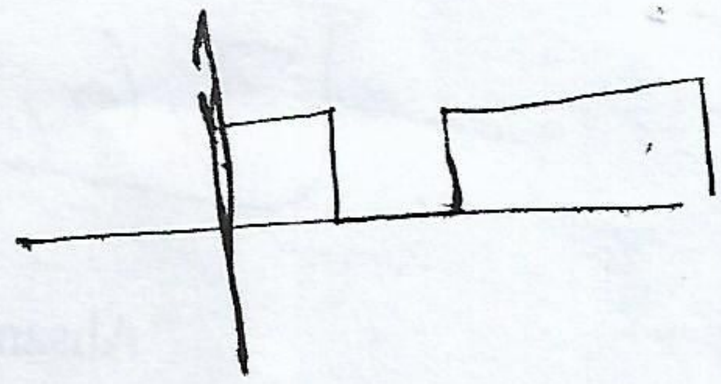
d) Distinguish between CM and CMTS. 4

Q3. a) i) Mention the limitation and overhead of two dimensional parity bit. 4
ii) Mention the limitation and overhead of checksum.

b) The given generator polynomial is $x^4 + x^2 + x + 1$. Draw the circuitry to implement the generator polynomial and calculate the CRC for a data word 101001. 9

c) Determine the capability to detect single bit error for the following generator polynomials. 3

i)$x + 1$, ii)x^3 and iii) 1



Q4 a) Define frame format in byte-oriented protocol. How does byte stuffing help us to resolve the problem of flag byte pattern occurrences in data? 3

b) Compare and contrast flow control and error control. 2

c) Briefly describe sliding window protocol. How is error control achieved in this protocol? 5

d) How is duplicate frame reception handled in Stop-and-Wait protocol? 2

e) For n-bit sequence number, prove that the window size of Go-Back-N ARQ is 2^n-1. 4

Part B

[There are three (3) questions. Answer any two (2). Marks allotted are indicated in the right margin.]

1 a) Write down the rules of HDB3 Scrambling. Scramble the following bit stream using HDB3 scrambling. Consider the base encoding is AMI. 7

1101001000011000011

b) Consider you have a sampled signal with amplitudes between -40V and +40V. If there are six levels, what is the value of Δ in PCM? 2

c) Write down the advantages of Serial Transmission over Parallel Transmission. 2

2. a) Explain the implementation method of QPSK. 7

b) An Analog signal has a bit rate of 8Kbps and baud rate of 1Kbaud. How many signal elements are needed to carry the data? 2

c) What is the only mathematical difference between Frequency Modulation and Phase Modulation? 2

3. a) Explain the propagation modes of Fiber Optic Cable. 7

b) Briefly discuss different Antennas for Microwave propagation. 2

c) Mention the name and data transmission rate of the standard Infrared port. 2

Date:
05/10/15

Ahsanullah University of Science and Technology

Department of Computer Science and Engineering

Year: 3rd, Semester: 2nd, Final Examination (Spring 2015)

Course No: CSE 3211 Course Title: Data Communications

Full Marks: 70 Time: 3 Hours

[There are seven (7) questions. Answer any five (5) questions.]

[Marks allotted are indicated in the margin]

Q1. a) Distinguish between baseband transmission and broadband transmission. 4

b) i) We send a voice signal from a microphone to a recorder. Is this baseband or broadband transmission? 3

ii) We modulate several voice signals and send them through the air. Is this baseband or broadband transmission?

c) i) Mention the factors on which data rate of a channel depends. 2

ii) We measure the performance of a telephone line (4 KHz of bandwidth). 5
When the signal is 20 V, the noise is 6 mV. What is the maximum data rate supported by this telephone line.

Q2. a) Briefly describe the following characteristics of line coding. 5

i) Signal element versus data element,

ii) Data rate versus signal rate

iii) Base line wandering

iv) DC components

v) Self-synchronization

b) i) Mention the limitations of bipolar AMI encoding. 2

ii) Briefly describe scrambling technique to overcome the limitations of bipolar AMI encoding. 4

c) In analog-digital conversion, answer the following questions. Consider that the frequency of input analog signal is f_a and number of bit per sample is 8. 3

i) Sampling rate

ii) Bit rate of encoded output

iii) Bandwidth of encoded output

Q3. a) Define carrier signal. Describe its role in analog transmission. 3

b) Define constellation diagram. Draw the constellation diagram of ASK, BPSK, QPSK and QAM 5

c) Which of the digital-to-analog conversion techniques (ASK, FSK, PSK and QAM) is most susceptible to noise? Defend your answer. 3

d) The telephone line has 4kHz bandwidth. What is the maximum number of bits we can send using the following techniques? Let d=0. 3

i) ASK

ii) QPSK

iii) 64-QAM

Q4. a) Briefly describe Time-division multiplexing (TDM). 4

b) We have four sources, each creating 250 characters per second. If the interleaved unit is a character and 1 synchronization bit is added to each frame, answer the following questions: 6

i) What is the data rate of each source?

ii) What is the duration of each character in each source?

iii) What is the frame rate?

iv) What is the duration of an output frame?

v) What is the number of bits in each frame ?

vi) What is the output data rate?

c) i) Mention the principles through which spread spectrum achieves its goal. 1

ii) We have a digital medium with a data rate of 10 Mbps. How many 64-kbps voice channels can be carried by this medium if we use DSSS with the Barker sequence. 3

Q5. a) Distinguish between forward error correction and error correction by retransmission. 2

b) What is Hamming distance? Find the minimum Hamming distance for the following cases: 4

i) Detection of two errors.

ii) Correction of two errors.

iii) Detection of 6 errors or correction of 2 errors.

c) A bit stream 10011101 is transmitted using the standard CRC method. The generator polynomial is $x^3 + 1$. 8

i) Show the actual bit string transmitted.

ii) Suppose that the third bit from the left is inverted during transmission. Show that this error is detected at the receiver's end.

iii) Give an example of bit errors in the bit string transmitted that will not be detected by the receiver.

Q6. a) The following data fragment occurs in the middle of a data stream for which the byte stuffing algorithm is used: A B ESC C ESC FLAG FLAG D. What is the output after stuffing? 3

b) Compare and contrast flow control and error control. 2

c) A sender sends a series of packets to the same destination using 5-bit sequence numbers. If the sequence number starts with 0, what is the sequence number after sending 100 packets? 3

d) A system uses the Go-back-N ARQ Protocol with a window size of 7. If each packet carries 1000 bits of data, how long does it take to send 1 million bits of data if the distance between the sender and receiver is 500Km and the propagation speed is 22×10^8 m? We assume no data or control frame is lost or damaged. 6

Q7. a) Briefly describe the working principle of data communication using fiber optic cable. Also describe its different propagation modes. 5

b) i) Draw the diagram of different types of propagation modes in unguided media. 2

ii) Compare and contrast microwaves and infrared waves. 2

c) Compare and contrast among twisted pair, coaxial cable and optical fiber 3

d) Compare and contrast between unidirectional and omnidirecational antenna. 2

Date: 30.03.14

Ahsanullah University of Science and Technology

Department of Computer Science and Engineering

Year: 3rd, Semester: 2nd, Final Examination (Fall 2013)

Course No: CSE 311 Course Title: Data Communications

Full Marks: 70 Time: 3 Hours

[Use separate script for Section A and Section B.]

[Marks allotted are indicated in the margin.]

SECTION A

[There are six (6) questions in this section. Answer any four (4) questions.]

Q1. a) i) What is meant by a periodic signal? Give an example of a periodic signal and define it's parameters. 3

ii) Show the output of a composite periodic signal and a composite non-periodic signal after decomposition. 2

b) i) Define Shanon capacity. 2

ii) Assume that a channel has bandwidth 1-MHz. The SNR for this channel is 63. What are the approximate bit rate and signal level? 3

Q2. a) Draw the graph of Manchester, Differential Manchester and AMI scheme for the data stream: 0 1 0 1 0 1 0 1 0 1 0 5

b) i) Define the processes of pulse code modulation. 2

ii) Assume that a sampling is made of a low pass signal with bandwidth 300kHz using 1024 levels of quantization. Calculate the bit rate of the digitized signal and PCM bandwidth of the signal.

Q3. a) i) Briefly explain quadrature PSK. 2

ii) Draw the constellation diagram of ASK, BPSK and QPSK. 3

b) i) Define carrier signal and its role in analog transmission. 2

ii) Find the bandwidth for the following cases if we need to modulate a 8-kHz voice. 3

AM, FM (set $\beta=5$) and PM (set $\beta=1$)

Q4. a) Distinguish between synchronous time-division multiplexing and statistical time-division multiplexing. 3

b) We need to use synchronous TDM and combine 25 digital sources, each of 100 kbps. Each output slot carries 1 bit from each digital source, but one extra bit is added to each frame for synchronization. Answer the following questions. 4

i) What is the size of an output frame in bits?

ii) What is the output frame rate?

iii) What is the duration of an output frame?

iv) What is the output data rate?

c) Define direct sequence spread spectrum and explain how it achieves bandwidth spreading. 3

Q5. a) Draw the diagram of discrete multitone technique. 2

b) Determine the upstream and downstream data rate in ADSL technology. 4

c) Determine downstream data rate and sharing in cable TV network. 4

Q6 Write short notes on the following: 10

a) Scrambling, b) Quadrature amplitude modulation and c) Frequency hopping spread spectrum.

Section: B

[There are five (5) questions in this section, answer any three (3) of them.]

Q1. a) Why unguided media is named as unguided? 2

b) Compare and contrast twisted pair, coaxial cable and fiber optic cable. 3

c) Briefly describe the working procedure of fiber optic cable. 5

Q2. a) Why does a circuit-switched network need end-to-end addressing during the setup and teardown phases? Why are no addresses needed during the data transfer phase for this type of network? 4

b) In the circuit switching technique, we use multistage switch to reduce the number of crosspoints. Fig. 1 shows a three stage switch, 6

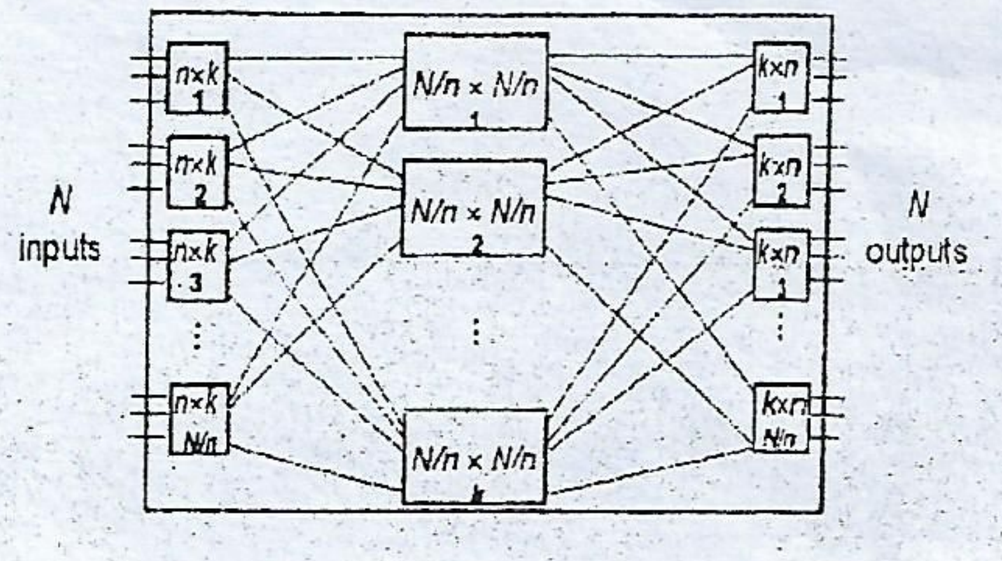


Fig. 1

Here, the n inputs to a first-stage switch share k paths through intermediate crossbar switches.

i. Calculate the number of crosspoints in the three stage switch.
ii. How many intermediate switches are required to make the switch nonblocking?

Q3. a) i. Determine the hamming distance of the code word d(101101, 110010) 2

ii. What is the polynomial representation of 1001101?

b) In CRC error correction scheme, we choose the generator polynomial $g(x) = x^3+x+1$ 8

i. Using shift register design a circuit to implement CRC check
ii. If message polynomial is $m(x) = x^7+x^3$, find the message codeword and encodes the massage codeword (m) to the transmitted codeword (c).

Q4. a) How is the simple parity check (single parity) related to the two-dimensional parity check? 2

b) What is the difference between single bit error and burst error? 2

c) What is the result of $(x^4+x^2+x)/(x^3+x+1)$. 2

d) A sender needs to sendsix decimal the data items 7 11 12 0 6 and 0, then 4

i. Find the checksum at the sender site.
ii. Find the checksum at the receiver site if there is no error.

Q5. a) Write algorithms of Stop-and-Wait ARQ Protocol for both Sender and Receiversites. 5

b) Draw the sender and receiver windows for a system using go-back-N ARQ given the following: (Window size is 7, frame sequence number is used from 0 to 7) 5

- Frame 0 is sent; frame 0 is acknowledged
- Frames 1 and 2 are sent; frames 1 and 2 are acknowledged
- Frames 3, 4 and 5 are sent; NAK 4 received
- Frames 4, 5, 6 and 7 are sent; frames 4 through 7 are acknowledged

Date: 01.05.13

Ahsanullah University of Science and Technology

Department of Computer Science and Engineering

Year: 3rd. Semester: 2nd, Final Examination (Spring 2013)

Course No: CSE 311 Course Title: Data Communications

Full Marks: 70 Time: 3 Hours

[There are seven (7) questions. Answer any five (5) questions.]

[Marks allotted are indicated in the margin]

Q1. a) Briefly describe different propagation modes of unguided signals. 3

b) Distinguish between omnidirectional and unidirectional antenna. 2

c) Describe the working principle of data communication in fiber optic cable. 4

d) Compare and contrast twisted pair, coaxial cable and fiber optic. 5

Q2. a) Distinguish between Manchester encoding and Alternate Mark Inversion (AMI). 2

b) We have sampled a low-pass signal with a bandwidth of 300 kHz using 1024 levels of quantization. 4

i) Calculate the bit rate of the digitized signal

ii) Calculate the PCM bandwidth of this signal

c) Define scrambling and mention it's purpose. What is the result of scrambling the sequence 11100000000000 using HDB3. Assume that the last non-zero signal level has been positive 4

d) Compare and contrast PCM and DM. 4

Q3. a) Mention the motivations of analog modulation. 3

b) Describe carrier signal's role in analog transmission. 3

c) Calculate the bit rate for a given baud rate and the type of modulation. 2

i) 2000 baud, FSK

ii) 2000 baud, BPSK

d) Draw the constellation diagram for the following: 6

i) ASK, with peak amplitude values of 2 and 4

ii) BPSK, with a peak amplitude value of 3

iii) QPSK, with a peak amplitude value of 4.

Q4. a) Mention the applications of multiplexing. 2

b) Briefly describe the Wavelength Division Multiplexing (WDM). 4

c) Mention the motivation of spread spectrum. Describe Direct Sequence Spread Spectrum (DSSS) with a suitable example. 4

d) We need to use synchronous TDM and combine 25 digital sources, each of 100 Kbps. Each output slot carries 1 bit from each digital source, but one extra bit is added to each frame for synchronization. Answer the following questions: 4

i) What is the size of an output frame in bits?

ii) What is the output frame rate?

iii) What is the duration of an output frame?

iv) What is the output data rate?

Q5. a) What is meant by single bit error and burst error? 2

b) A CRC is constructed to generate 4-bit FCS. The generator polynomial is X^4+X^3+1 and the data bit sequence is 10011011011. Draw the Shift register circuit that would perform the task and determine the CRC. 10

c) i) Determine the hamming distance of the code words10101 and 10010. 2

ii) What is the polynomial representation of 101100?

Q6. a) What is meant by flow control and backward error control? 2

b) Briefly describe the selective repeat ARQ. 5

c) Describe piggy backing. 4

d) Using 5-bit sequence numbers, what is the maximum size of the send and receive windows for each of the following protocols? 3

i) Stop-and-Wait ARQ

ii) Go-Back-N ARQ

iii) Selective-Repeat ARQ

Q7. a) Define switched communication network. Mention the types of switching techniques. 2

b) Briefly describe the working principle of datagram packet switching technique. 4

c) Draw a flow diagram of circuit switching technique. 2

d) Compare and contrast circuit switching technique, datagram switching technique and virtual circuit switching. 6

Date: 01/10/13

Ahsanullah University of Science and Technology

Department of Computer Science and Engineering

Year: 3rd, Semester: 2nd, Clearance/Improvement/Carry Over Examination (Spring 2013)

Course No: CSE 311 Course Title: Data Communications

Full Marks: 70 Time: 3 Hours

[There are seven (7) questions. Answer any five (5) questions.]

[Marks allotted are indicated in the margin]

Q1. a) What is the phase shift for the following? 4

i) A sine wave with the maximum amplitude at time zero

ii) A sine wave with maximum amplitude after ¼ cycle

b) i) Define the Shannon capacity. 5

ii) A telephone line is a noisy channel whose bandwidth for data transmission is 3000 Hz. The signal to noise ratio is 3162. Calculate the capacity of telephone line.

c) i) Define bandwidth. 5

ii) What is the relationship between period and frequency?

iii) If the bandwidth of a channel is 8 Kbps, how long does it take to send a frame of 200,000 bits out of this device?

Q2. a) Distinguish between data rate and signal rate. Write down the expression showing relation between data rate and signal rate. 3

b) What is the DC component? 2

c) Draw the graph of NRZI, bipolar-AMI and Differential Manchester scheme for the data stream: 0 1 0 1 1 1 0 0 1 6

d) How many invalid (unused) code sequences can we have in 5B/6B encoding? How many in 3B/4B encoding? 3

Q3. a) Mention the motivations of analog modulation. 3

b) Briefly describe phase shift keying with example. 5

c) Calculate the bit rate for a given baud rate and the type of modulation. 3

i) 2000 baud, FSK

ii) 2000 baud, BPSK

d) Calculate the baud rate for a given bit rate and the type of modulation. 3

i) 4000 bps, ASK

ii) 8000 bps, QPSK

Q4. a) Describe the goals of multiplexing. 2

b) Distinguish between synchronous and statistical Time Division Multiplexing (TDM). 3

c) Briefly describe the data communication in DSL technology. 5

d) Four 1-kbps connections are multiplexed together. The frame is created by taking 1 bit from each connection. Answer the following questions: 4

i) What is the size of an output frame in bits?

ii) What is the output frame rate?

iii) What is the duration of an output frame?

iv) What is the output data rate?

Q5. a) How do guided media differ from unguided media? 3

b) Compare and contrast among twisted pair, coaxial cable and fiber optic. 5

c) What is the significance of twisting in twisted pair cable? 3

d) How does the sky propagation differ from line-of-sight propagation? 3

Q6. a) What is meant by single bit error and burst error? 2

b) Compare the performance of the checksum and two dimensional parity. 3

c) A CRC is constructed to generate 3-bit FCS. The generator polynomial is X^3+X+1 and the data bit sequence is 1001. Draw the Shift register circuit that would perform the task and determine the CRC. 9

Q7. a) Define switched communication network. Mention the types of switching techniques. 3

b) Briefly describe the working principle of circuit switching technique. 5

c) Compare and contrast among circuit switching, virtual circuit switching, and datagram switching. 6

Datacom

fall:11
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Date: 20/2/12

Ahsanullah University of Science and Technology

Department of Computer Science and Engineering

Year: 3rd, Semester: 2nd, Final Examination (Fall 2011)

Datacom (fall-11)

Course No: CSE 311 Course Title: Data Communications

Full Marks: 70 Time: 3 Hours

[There are seven (7) questions. Answer any five (5) questions.]

[Marks allotted are indicated in the margin]

Q1. a) What is meant by a periodic signal? Give an example of a periodic signal and define it's parameters. 4

b) i) Define the Nyquist bit rate. 5

ii) Consider a case where requirement is to send 265 kbps over a noiseless channel with a bandwidth 20 khz. How many signal levelsdo we need?

c) i) Define Shannon capacity. 5

ii) Assusme that signal to noise ratio of a channel is 36 db and the bandwidth is 2 MHz. What is the channel capacity?

Q2. a) Distinguish between data element and signal element. What is meant by baud rate? 3

b) Define the characteristics of self-synchronization signal. 2

c) Draw the graph of NRZ-L, Manchester and Differential Manchester scheme for the data stream: 0 1 0 0 1 1 0 0 0 1 1 6

d) We have a baseband channel with a 2-MHz bandwidth. Determine the data rate of the channel if we use i) Manchester encoding, and ii) 2B1Q encoding. 3

Q3. a) Mention the motivations of analog modulation. 3

b) Briefly describe phase shift keying with example. 5

c) Calculate the bit rate for a given baud rate and the type of modulation. 3

i) 2000 baud, FSK

ii) 2000 baud, BPSK

d) Calculate the baud rate for a given bit rate and the type of modulation. 3

i) 4000 bps, ASK

ii) 8000 bps, QPSK

Q4. a) Describe the goals of multiplexing. 2

b) Distinguish between synchronous and statistical Time Division Multiplexing (TDM). 3

c) Define the frequency hopping spread spectrum (FHSS) and explain how it achieves bandwidth spreading.

d) We need to use synchronous TDM and combine 25 digital source, each of 100 Kbps. Each output slot carries 1 bit from each digital source, but one extra bit is added to each frame for synchronization. Answer the following questions: 4

i) What is the size of an output frame in bits?

ii) What is the output frame rate?

iii) What is the duration of an output frame?

iv) What is the output data rate?

Q5. a) What is meant by single bit error and burst error? 2

b) Compare the performances of two dimensional parity bit with checksum error detection technique. 3

c) Describe Cyclic Redundancy Check (CRC) with suitable example. 6

d) i) Determine the hamming distance of the code word d(10101, 10010) 3

ii) What is the polynomial representation of 101100?

iii) What is the result of shifting 101010 three bits to the left.

Q6. a) What is meant by flow control and backward error control? 2

b) Briefly describe the sliding window protocol. 5

c) Compare the Go-Back-N ARQ protocol with Selective-Repeat ARQ. 4

d) Using 5-bit sequence numbers, what is the maximum size of the send and receive windows for each of the following protocols? 3

i) Stop-and-Wait ARQ

ii) Go-Back-N ARQ

iii) Selective-Repeat ARQ

Q7. a) Define switched communication network. Mention the types of switching techniques. 2

b) Briefly describe the working principle of Circuit Switching Technique. 4

c) What is TSI and it's role in a time-division switching? How it can be implemented? 3

d) Draw a flow diagram of virtual circuit switching. 2

e) Compare circuit switching technique, datagram switching technique and virtual circuit switching. 3

Date: 17.08.11

Datacom
Sp-11

Ahsanullah University of Science and Technology
Department of Computer Science and Engineering

3rd year 2nd semester, Final Examination (Spring 2011)

Course No. CSE 311 Course Title: Data Communication
Time : 3 Hours Full Marks : 70

There are seven (7) questions. Answer any five (5).
Marks allotted are indicated in the margin.

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1. a) Define the following terms: i. Frequency domain, ii. Shannon Capacity, iii. Bandwidth-Delay product. 3

b) What is signal attenuation? How can it be tackled? 3

c) Consider a noiseless channel that carries frequencies between 300 Hz and 3300 Hz. If it can transmit using 4 signal levels, calculate its maximum bit rate. 3

d) What are the four components that create latency in a data communication system? Discuss them. 5

2. a) What are meant by Signal element and Data element? Show with examples. 4

b) Explain the working principles of Manchester and differential Manchester coding. In what ways are they better than NRZ coding? 4

c) What are the differences between Synchronous and Asynchronous serial transmission? 3

d) State and explain Nyquist's theorem. 3

3. a) What is the motivation behind using Block coding? Mention the names of some Block coding schemes. 3

b) With the help of proper diagram, briefly explain the working principle of ASK. What are its drawbacks? 6

What does a constellation diagram represent? Draw constellation diagrams for Binary ASK, Quadrature PSK and 4-QAM. 5

B: 2×BW
C = B × (C')2
-(1+S/R)

1/2

(4) a) Assume that a voice channel occupies a bandwid[illegible]4 kHz. We need to combine three voice channels into a link with a bandwidth of 12 kHz from 20 to 32 kHz. With the help of a diagram, show how this can be done using FDM. 5

b) Describe the relative advantages and disadvantages of Synchronous and Statistical TDM. 4

c) Briefly describe the procedure of FHSS. Why is it used? 5

5. a) What is the significance of twisting in a twisted pair cable? 3

b) Differentiate between Step-index and Graded-index modes of fiber optic cables. 3

c) Briefly discuss the characteristics and applications of Radio waves in data communication. 5

d) Telephone companies typically use circuit-switched communication. Why? 3

6. a) What are the things that happen during the Setup phase of circuit-switching? Show with an example. 5

b) What kind of delay occurs in a datagram network? Show with the help of a diagram. What are the relative advantages of datagram networks over circuit-switched networks? 5

c) Justify the following statement – "A Virtual Circuit Network is a cross between a circuit-switched network and a datagram network." 4

(7) a) What is Hamming distance? Find the Minimum Hamming distance for a system with the following codewords: 4

00000 01011 10101 11110

b) Briefly discuss the working principle of CRC. 5

c) Suppose you are to send the following values in a Checksum system. 5

10 7 14 1 9

Calculate the Sum, Wrapped sum and Checksum of these values on the [illegible]. Then the [illegible] receiver site will calculate these values assuming that no error occurred during transmission.

AHSANULLAH UNIVERSITY OF SCIENCE & TECHNOLOGY
Department of Computer Science and Engineering
Year: 3rd, Semester: 2nd, Final Examination (Spring 2010)

Course No. CSE 311 Course Title: Data Communication
Full Marks: 70 Times: 3 Hours

Datacom (Sp-10)

[There are Seven (7) Questions. Answer any Five (5) Questions.]
[Marks allotted are indicated in the margin.]

Q1. a) What are the directions of flows of data communication? Describe each mode in brief. [6]

b) Write down the differences between logical address and physical address. [4]

c) A sine wave is off-set one sixth of a cycle with respect to time zero. What is the phase in degree and radians? [4]

Q2. a) Define – i) Wavelength ii) Baseband Transmission iii) Bit Rate [5]

b) A periodic composite signal has a bandwidth of 200 Hz with a middle frequency of 250 kHz and peak amplitude of 20 V. What is the value of lowest and highest frequencies? If the two extreme frequencies have amplitude of 0 V, draw the frequency domain of the signal. [5]

c) Draw the pulse of the time domain function, f(t), defined as:

$$f(t) = \begin{cases} 1 & -T/2 \le t \le T/2 \\ 0 & \text{else.} \end{cases}$$

And also find the Fourier Transform of f(t). [4]

Q3. a) Briefly describe different types of noise. [5]

b) Draw the graph of the Manchester and Differential Manchester scheme using the following data streams, [5]

0 1 0 0 1 1 0 0 0 1

c) Television channels are 2 MHz wide. The signal-to-noise ratio is given in decibels, $SNR_{dB} = 36$. Assume a noisy channel, calculate the channel capacity. [4]

Q4. a) Describe Amplitude Modulation along with its bandwidth allocation. [4]

b) Draw constellation diagram for 4-QAM and 16-QAM. [4]

c) Assume that we have a sampled signal and the sample amplitudes are -6.1, 7.5, 16.2, 19.7, 11.0, -5.5, -11.3, which are between -20 and 20 V. We decide to have eight level (L = 8). Find the Normalized error, Quantization code and Encoded words. [6]

Q5. a) Describe with diagram of Frequency Division Multiplexing process. [3]

b) Four – 1 kbps connections are multiplexed together. Each bit of the sequence of bits on each connection is a unit. Find (a) the duration of 1 bit before multiplexing, (b) the transmission rate of the link, (c) the duration of a frame. [3]

c) What is Antenna? Describe different types of Antenna. [4]

d) For a parabolic reflective antenna with a diameter of 2m, operating at 12 GHz, what is the effective area and the antenna gain in dB? (Parabolic antenna, face area A, effective area $A_e = 0.56A$, power gain relative to isotropic $G = 7A/\lambda^2$) [4]

Q6. a) Write down different types of wireless propagation modes and their spectrum range. [3]

b) What is Free Space Loss? How can you express it? [3]

c) Determine the isotropic free space loss at 4 GHz for the shortest path to a synchronous satellite from earth (35,863 km). [4]

d) Find the codeword for the cyclic redundancy check (CRC) with C (7, 4), if the dataword is 1001 and the divisor is 1101. Where C (n, k) = C (7, 4). [4]

Q7. a) Define Time Division Multiple Access. What is the difference between TDM and TDMA? [3]

b) Write down the three phases of circuit switching. [3]

c) You are trying to design a cellular network that will cover an area of at least 2800 km2. There are K=300 available voice channels. Your design is required to support at least 100 concurrent calls in each cell. If the co-channel cell centre distance is required to be 9 km, how many base stations will you need in this network? [4]

d) Write down the steps to design a three stage switch and also the equation of number of crosspoints. [4]