

**Chittagong University of Engineering and Technology  
Department of Computer Science and Engineering  
B. Sc. Engineering Level-3, Term-II, Exam. 2017**

Course No.: CSE-313  
Course Title: Data Communication  
Marks: 210  
Time: 3 Hours

The figure in the right margin indicates full marks. The questions are of equal value.  
Answer any three questions from each section. Use separate script for each section.

**SECTION-A**

- |                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <span style="font-size: 2em; color: yellow;">✓</span> Q.1(a) Define information. How information can be measured? 08                                                                                                                                                                                                                                                                                                      |
| <span style="font-size: 2em; color: yellow;">✓</span> Q.1(b) Draw the block diagram of a general communication and explain its components briefly. 12                                                                                                                                                                                                                                                                     |
| <span style="font-size: 2em; color: yellow;">✓</span> Q.1(c) How data is represented as a signal? Distinguish between base-band and pass-band signals. 08                                                                                                                                                                                                                                                                 |
| <span style="font-size: 2em; color: yellow;">✓</span> Q.1(d) Distinguish between line code and channel code. 07                                                                                                                                                                                                                                                                                                           |
| <span style="font-size: 2em; color: yellow;">✓</span> Q.2(a) Define the following terms: 06 <ul style="list-style-type: none"> <li><span style="color: green;">✓</span> i) Continuous time signal and discrete time signal</li> <li><span style="color: green;">✓</span> ii) Periodic signal and aperiodic signal</li> <li><span style="color: green;">✓</span> iii) Exponential signal and sinusoidal signal.</li> </ul> |
| <span style="font-size: 2em; color: yellow;">✓</span> Q.2(b) What is the frequency spectrum of a signal? When it becomes discrete and continuous? Justify your answer with necessary example. 16                                                                                                                                                                                                                          |
| <span style="font-size: 2em; color: yellow;">✓</span> Q.2(c) Derive the continuous time Fourier transform (CTFT) pair (Analysis and synthesis equation). 13                                                                                                                                                                                                                                                               |
| <span style="font-size: 2em; color: yellow;">✓</span> Q.3(a) Consider the discrete time periodic square wave shown in Fig. 3(a). Calculate the Fourier series coefficients of this signal for $N = 10, 20, 40$ and finally sketch the spectrum. 15                                                                                                                                                                        |

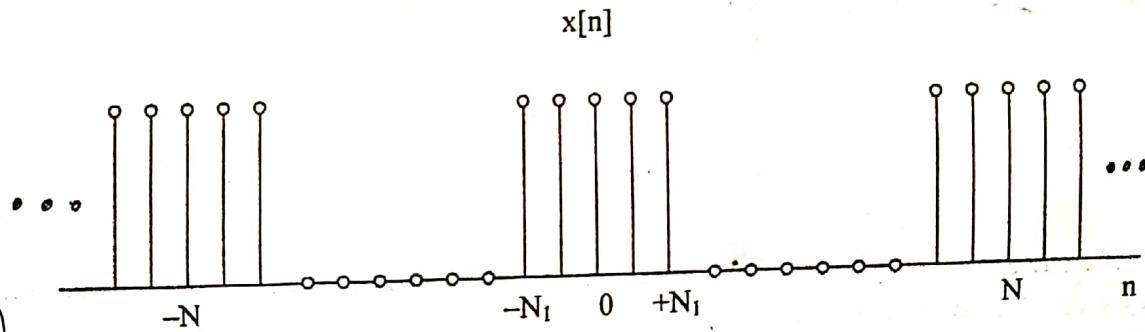


Fig. 3(a)

- |                                                                                                                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <span style="font-size: 2em; color: yellow;">✓</span> Q.3(b) Discuss the operation of a switching modulator for DSB-SC. 13                                                                                               |
| <span style="font-size: 2em; color: yellow;">✓</span> Q.3(c) Write down the advantages and disadvantages of single side band (SSB) modulation over double side band (DSB) modulation. 07                                 |
| <span style="font-size: 2em; color: yellow;">✓</span> Q.4(a) How AM signal can be demodulated using envelop detection? Explain with necessary diagram. 13                                                                |
| <span style="font-size: 2em; color: yellow;">✓</span> Q.4(b) What is vestigial side band (VSB) modulation? What are the advantages of VSB over DSB and SSB? Derive the equation of output filter for VSB demodulator. 14 |
| <span style="font-size: 2em; color: yellow;">✓</span> Q.4(c) "Phase and frequency modulation are inseparable" – justify the statement. 08                                                                                |

P.T.O.

CSE-313

## SECTION-B

- Q.5(a)* State and proof sampling theorem. 08
- Q.5(b)* Briefly explain Pulse Code Modulation with necessary diagram. 14
- Q.5(c)* Explain the phenomenon of Inter-symbol Interference (ISI). Identify the causes of ISI in digital communication systems. Describe a method that can reduce the ISI effect. 13
- 3rd. C* *Q.6(a)* Show that the spectrum of a flat-top PAM signal is  $W_s(f) = \frac{1}{T_s} H(f) \sum_{K=-\infty}^{\infty} W(f - Kf_s)$ , where the symbols have their usual meanings. Hence sketch its spectrum. 15
- 3rd. C* *Q.6(b)* Write short note on  $\mu$ -law and A-law companding. 08
- 3rd. C* *Q.6(c)* Show that the signal-to-quantization noise ratio (SQNR) of a PCM system is given by  $SQNR = 1.76 + 6.02n$  dB, where the symbols have their usual meaning. 12
- 3rd. C* *Q.7(a)* Why channel coding is used in communication system? Distinguish between Forward Error Correction (FEC) and Automatic-Repeat Request (ARQ). 08
- 3rd. C* *Q.7(b)* For binary sequence "10010110" sketch the following line code signals: 10
  - i) Unipolar NRZ
  - ii) Bipolar NRZ
  - iii) Polar RZ
  - iv) Manchester NRZ
  - v) Differential Manchester NRZ.
- 3rd. C* *Q.7(c)* Design a time division multiplexer that will accommodate the following sources. 10
  - Source 1 and 2: Analog 2 KHz Bandwidth
  - Source 3: Analog 4 KHz Bandwidth
  - Source 4-11: Digital, synchronous at 7,400 bit/s.
- 2nd. A.P.* *Q.7(d)* "A communication system is generally considered as a linear time invariant (LTI) system" – justify. 07
- 3rd. C* *Q.8(a)* What is the purpose of using regenerative repeater? Explain with necessary diagram. 11
- Q.8(b)* Differentiate between TDM and FDM. 07
- 3rd. C* *Q.8(c)* Discuss the detection of PWM and PPM signals with necessary diagram. 12
- Q.8(d)* What is noise? What are the various sources of noise? 05

END

CSE'14

**Chittagong University of Engineering and Technology  
Department of Computer Science and Engineering  
B. Sc. Engineering Level-3, Term-II, Exam. 2016**

**Course No: CSE-313**

**Course Title: Data Communication**

**Marks: 210**

**Time: 3 Hours**

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Answer any three questions from each section. Use separate script for each section.

**SECTION-A**

**Q.1(a)** What is communication system? Distinguish between analog and digital communication system. Justify the use of digital communication system in data communication networks. 10

**Q.1(b)** Define information. How information can be measured? Hence, relate the term entropy and information. 10

**Q.1(c)** Assume that a computer terminal has 110 characters and each character is sent by using binary words. 15

- i) What are the minimum number of bits needed to represent each character?
- ii) How fast can the characters be sent (character/sec) over an internet line having bandwidth of 3.2 KHz and SNR of 10 dB?
- iii) What is the information content of each character if each is equally likely to be sent?

**Q.2(a)** The figure below shows the Fourier spectrum of a signal  $g(t)$ . 10

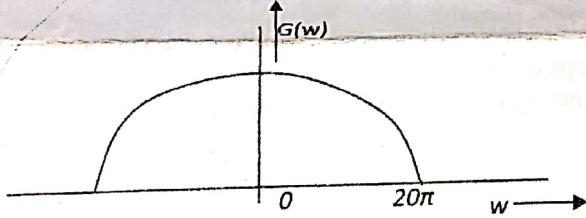


Fig. 2(a)

Sketch the spectrum of the signal  $2g(t)\cos^2(100\pi t)$ . Show all values on the sketch. Also, show all the required steps.

**Q.2(b)** 100KHz carrier  $2\cos(2\pi \cdot 10^5 t)$  is amplitude modulated (DSB-SC) by a signal  $s(t)$  given as 15

$$s(t) = 10\cos(2\pi \cdot 10^3 t) + 8\cos(4\pi \cdot 10^3 t) + 6\cos(10\pi \cdot 10^3 t)$$

- i) What frequencies are contained in the resultant modulated signal?
- ii) Sketch the frequency spectrum of the modulated signal.

**Q.2(c)** We know there are three analog-to-analog modulation techniques named AM, FM and PM. Among these three which one is the best and why? Show relevant logic to your answer. 10

**Q.3(a)** Sketch FM and PM waves for the modulating signal  $m(t)$  shown in Fig. 3(a). The constants  $K_f$  and  $K_p$  are  $2\pi \cdot 10^5$  and  $10\pi$  respectively and the carrier  $f_c$  is 100MHz. 10

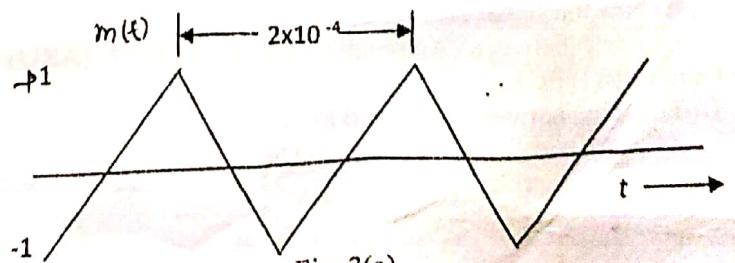


Fig. 3(a)

**Q.3(b)** Distinguish between coherent and non-coherent detection. Briefly explain a non-coherent detection technique of AM signal. 15

**Q.3(c)** Find the bandwidth of a 4-PSK signal transmitting at 2000bps. Transmission is in half duplex mode. 10

Q.4(a) "The number of variation in phase is always larger than the number of variation in amplitude in case of quadrature amplitude modulation." – why? Explain with appropriate diagram. 10

- ~~Q.4(b)~~ Define the following terms 12
- Data element, signal element
  - Periodic and non-periodic signal
  - Digital signal, analog signal
  - Signal to noise ratio
  - Bandwidth

~~Q.4(c)~~ Why constellation diagram is important? Draw the constellation diagram for a 16-QAM. Ensure that your diagram is the best one. Also explain the reason. 7

~~Q.4(d)~~ Compare among ASK, PSK, FSK and QAM. 6

### SECTION-B

Q.5(a) Why do we need line coding? Mention the considerations for line coding. What are the ways of synchronization between a sender and a receiver? 10

Q.5(b) Sketch the transmitter sequence 1001100111 for the following line coding techniques 17

- Unipolar NRZ
- Polar RZ
- Manchester NRZ
- Differential Manchester NRZ
- Bipolar NRZ
- Bipolar Mark Insertion

Also, compare between (iii) and (vi) in all aspects.

Q.5(c) Define Eye diagram. Explain the formation of Eye diagram with appropriate figure. 8

Q.6(a) What is Inter-Symbol Interference (ISI)? Predict the effect of it in data communication system? 10

Q.6(b) Sketch the block diagram of a practical PCM transmission system. Explain different steps of PCM. 15

Q.6(c) Show that the signal to quantization noise ratio of a PCM system is given by 10

$$\left( \frac{S}{N} \right)_{dB} = 6.02n + \alpha \quad V_s = 1.11 V_{av}$$

where  $n$  is the number of bits in PCM word,  $\alpha = 4.77$  for the peak SNR and  $\alpha = 0$  for the average SNR.

Q.7(a) What are the advantages and disadvantages of M-array modulation technique? 10

Q.7(b) What is pulse stuffing? Design a time division multiplexer that will accommodate 7 sources. Assume that the sources have the following specification

Source 1-4: digital, synchronous at 5.5 Kbit/sec

Source-5: Analog, 2KHz bandwidth

Source-6: Analog, 4KHz bandwidth

Source-7: Analog, 8KHz bandwidth

Q.7(c) What is the key reason for using optical fiber in communication? Draw and explain the function of each element of a block diagram of an optical fiber communication system. List the losses in optical fiber. 13

Q.8(a) What is noise? List few sources of noise in data communication system. Why noise in communication system is considered as a White Noise? 10

Q.8(b) Show the CDMA encoding and decoding method for the bit sequence +1, 0, -1. Also show the signal created by CDMA. 10

Q.8(c) Distinguish between Automatic Repeat Request (ARQ) and Forward Error Correction (FEC). 7

Q.8(d) Differentiate between TDM and FDM. 8

-The End-

CSB

## Chittagong University of Engineering and Technology

Department of Computer Science and Engineering

B. Sc. Engineering Level-3, Term-II, Exam. 2015

Course No: CSE-313

Course Title: Data Communication

Marks: 210

Time: 3 Hours

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 Answer any three questions from each section. Use separate script for each section.

## SECTION-A

~~Q.1(a)~~ Write down some importance of studying data communication in the discipline of computer programming. 08

~~Q.1(b)~~ Define information and entropy. Find the information and entropy of a 12 digit message in which each digit may take on one of four possible levels. The probability of sending any of the four levels is assumed to be equal, and the level in any digit does not depend on the value taken on previous digits. 10

~~Q.1(c)~~ What is channel coding? Why channel coding is necessary in communication systems? 10

~~Q.1(d)~~ Evaluate the channel capacity for a channel that has 1 KHz bandwidth and a SNR of 20 dB. 07

~~Q.2(a)~~ Define signal and system with example. 05

~~Q.2(b)~~ Write short notes on the followings:  
 (i) Automatic repeat request  
 (ii) Forward error controller 08

~~Q.2(c)~~ A continuous line signal  $x(t)$  is shown in Fig.1. Carefully sketch the signal  $x(2 - t)$ . 10

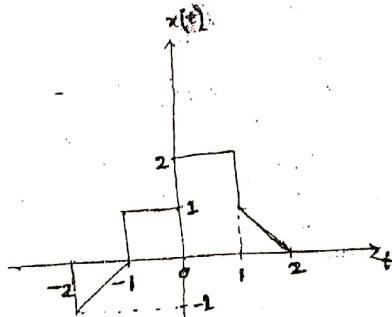


Fig. 1

~~Q.2(d)~~ Determine which of these properties (memoryless, time invariant, linear, causal, stable) hold and which do not hold for the following system: 12

$$y(t) = x\left(\frac{t}{3}\right)$$

~~Q.3(a)~~ What is frequency spectrum of a signal? When it becomes discrete and continuous? Justify your answer with necessary examples. 14

~~Q.3(b)~~ Derive the discrete time Fourier transform pair equations (Analysis and Synthesis equations). 14

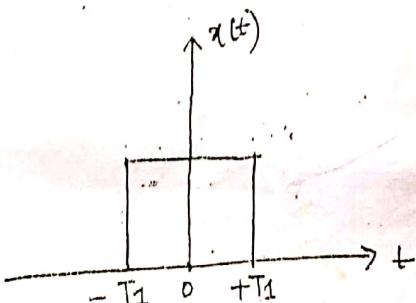


Fig.2

A Q.3(c) Consider a rectangular pulse signal defined by the equation shown in Fig.2 07

$$x(t) = \begin{cases} 1, & |t| < T_1 \\ 0, & |t| > T_1 \end{cases}$$

Find the Fourier transform of this signal, and draw the spectrum.

- Q.4(a) What is amplitude modulation? Discuss the operation of a ring modulator for BSD-SC signal with proper diagram. 12
- Q.4(b) What is demodulation? Briefly explain the operation of a rectifier detector for AM signal with proper diagram. 10
- Q.4(c) Show that a general SSB signal  $\phi_{SSB}(t)$  can be expressed as  $\phi_{SSB}(t) = m(t) \cos wct \pm mn(t) \sin wct$ , where the symbols have their usual meaning. 13

### SECTION-B

- Q.5(a) What are the advantage of vestigial side band modulation over double side band and single side band modulation? 07
- Q.5(b) Define modulation index for frequency modulation. 03
- Q.5(c) Show that the narrowband FM signal  $s(t)$  can be expressed as  $s(t) \cong A_c \cos 2\pi f_c t + \frac{1}{2} BA_c \{\cos[2\pi(f_c + f_m)t] - \cos[2\pi(f_c - f_m)t]\}$ , the symbols have their usual meaning. 15
- Q.5(d) "Frequency and phase modulation are inseparable"—Justify the statement. 10
- Q.6(a) Define the terms Throughput, Delay, Latency and Jitter. 08
- Q.6(b) For the bit sequence '1010011011' draw the modulated signal of type i) ASK, ii) QPSK, iii) PSK and iv) FSK 08
- Q.6(c) What are the advantages of M-array modulation? Briefly explain MPSK with necessary diagram. 11
- Q.6(d) What is the main source of noise in communication system? Why data communication systems deal only with white Gaussian noise? 08
- Q.7(a) Discuss  $\mu$ -law and A-law companding with proper diagram. 10
- Q.7(b) Discuss the operation of a regenerative repeater with proper diagram. 10
- Q.7(c) What is pulse stuffing? Why pulse stuffing is used in digital communication? 10
- Q.7(d) Define noise. Briefly explain the various sources of noise. 05
- Q.8(a) Why multiple access techniques are used in communication system? Briefly explain Time division multiplexing (TDM) technique. ✓ 10
- Q.8(b) State and prove Nyquist Sampling Theorem. 08
- Q.8(c) What is bit error rate? Derive the probability of bit error for BPSK modulation in AWGN channel. 12
- Q.8(d) Write short note on minimum shift keying. 05

End

**Chittagong University of Engineering and Technology  
Department of Computer Science and Engineering  
B. Sc. Engineering Level-3, Term-II, Exam. 2014**

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Marks: 210  
Time: 3 Hours

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**Section-A**

- Q.1(a)** Discuss qualitatively the basic role of bandwidth and SNR in limiting the communication performance. 12
- Q.1(b)** What are the basic components of a communication system? Why digital communication is superior over analog communication? 12
- Q.1(c)** What is modulation index? Distinguish among AM, FM and PM. 11
- Q.2(a)** Why carrier signal is used in modulation-demodulation process? Explain double sideband suppress carrier (DSB-SC) signal demodulation process. 12
- Q.2(b)** Why communication signals are processed in both time and frequency domains? 10
- Q.2(c)** Sketch and explain how envelope detection works? 13
- Q.3(a)** State Shannon's capacity theorem and explain its significance. Also, describe how this theorem is related to the information measure. 14
- Q.3(b)** Define the terms (i) Throughput (ii) Latency (iii) Propagation time 09
- Q.3(c)** What is Quadrature Amplitude Modulation (QAM)? Show the constellation diagram of BPSK and 16QAM. 12
- Q.4(a)** Define noise, thermal noise, noise figure and signal-to-noise ratio. 12
- Q.4(b)** Why multiple access techniques are used in data communication? 08  
Distinguish between TDM and FDM?
- Q.4(c)** What is inter-symbol interference? What are the sources of inter-symbol interference? Briefly explain a method to mitigate this effect. 15

**Section-B**

- Q.5(a)** What are the differences between bit rate and baud rate? Explain two different errors in delta modulation. 12
- Q.5(b)** What is companding? Explain  $M$  and  $A$  law companding. 12
- Q.5(c)** What is delta modulation? Draw the block diagram of a delta modulation transmitter and receiver. 11
- Q.6(a)** Explain adaptive delta modulation. What are the advantages and disadvantages of adaptive delta modulation over delta modulation? 14
- Q.6(b)** What is pulse code modulation (PCM)? Explain three basic steps of PCM and hence show that PCM is a special type of analog-to-digital conversion process. 13

Q.6(b) Mention some properties of line coding techniques.

Q.6(c) Mention some properties of line coding techniques.

Q.7(a) How do you differentiate digital modulation from analog modulation? For a given bit sequence 0100101101, draw the modulated signal of type- (i) ASK (ii) OOK (iii) FSK and (iv) PSK

Q.7(b) What is Quaternary Phase Shift Keying (QPSK)? Draw and explain the block diagram of a typical QPSK modulator. Hence, explain the significance of I and Q channels.

Q.7(c) For an input signal with data rate equal to 10 MHz and a carrier frequency of 70 MHz; determine the minimum double-side Nyquist bandwidth and the baud for (i) QPSK modulator (ii) BPSK modulator

Q.8(a) Define slope overload and granular noise.

Q.8(b) What are the advantages of fiber optic cables over metallic cables?

Q.8(c) Explain single and multimode propagation of optical fiber cable.

Q.8(d) We have an available bandwidth of 100 KHz, which spans from 200 to 300 KHz. What should be the carrier frequency and bit rate if we modulate our data by using FSK with  $d = 1$ .

### -The End-

### Ques)

Q.1. Define the term 'line coding' and explain its importance in digital communication.

Q.2. Explain the working principle of Manchester Coding.

Q.3. Explain the working principle of Bi-Polar Coding.

Q.4. Explain the working principle of Gray Coding.

Q.5. Explain the working principle of Manchester Coding.

Q.6. Explain the working principle of Bi-Polar Coding.

Q.7. Explain the working principle of Gray Coding.

Q.8. Explain the working principle of Manchester Coding.

Q.9. Explain the working principle of Bi-Polar Coding.

Q.10. Explain the working principle of Gray Coding.

**Chittagong University of Engineering and Technology**  
**Department of Computer Science and Engineering**  
**B. Sc. Engineering Level-3, Term-II, Exam. 2013**

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Course Title: Data Communication

Marks: 210

Time: 3 Hours

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**SECTION-A**

Q.1(a) What are the basic elements of a digital communication system? Draw the block diagram of a digital communication system. 13

Q.1(b) Distinguish between broadcast and point-to-point communication. 07

Q.1(c) What do you mean by data communication standards? Why are they needed? 08

Q.1(d) What is information? Briefly explain how information can be measured. 07

Q.2(a) Explain the significance of signal-to-noise ratio (SNR) and bandwidth in data communication system. 08

Q.2(b) Why modulation is necessary in communication system? Distinguish among AM, FM and PM. 12

Q.2(c) What is inter-symbol interference? Explain the demodulation process of SSB-SC (Single sideband suppressed carrier) signal by using phase shift method. 15

Q.3(a) What is modulation index? Why communication signals are processed in both time and frequency domains? (FG5) 07

Q.3(b) Explain the relationship between frequency and phase modulation. Why they are inseparable. 12

Q.3(c) Describe what is meant by error control. Hence, distinguish between error detection and error corrections. (FG6) 10

Q.3(d) Distinguish between bit rate and baud rate. What are the advantages of digital transmission? 06

Q.4(a) Explain the following terms: 10

- i. Throughput
- ii. Latency
- iii. Propagation time
- iv. Transmission time
- v. Jitter (with respect to bandwidth and propagation)

Q.4(b) State sampling theorem. Distinguish between baseband and broadband transmission. 07

Q.4(c) A convolution encoder has a single shift register with two stages (i.e. K=3), two modulo-2 adders and an output multiplexer. The generator sequences of the encoder are as follows:

$$g^{(1)} = (1, 1, 1)$$

$$g^{(2)} = (1, 0, 1)$$

draw the encoder block diagram and determine encoder output produced by the message sequence. (10)

Q.4(d) Describe Shannon's capacity formula. If the SNR of the channel is 16 dB and bandwidth is 2MHz. What is the channel capacity? 08

**SECTION-B**

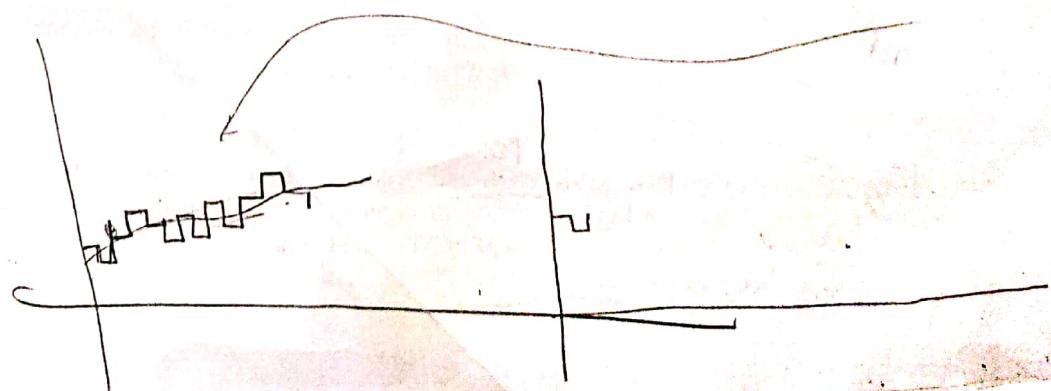
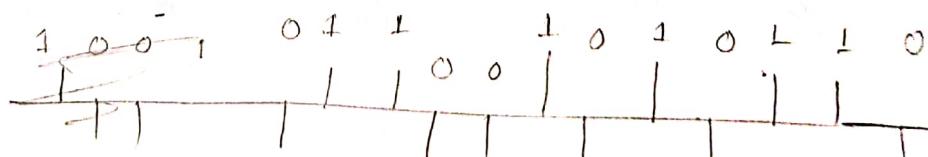
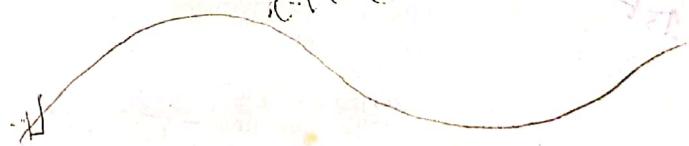
Q.5(a) Explain PSK, MSK, OOK and QPSK with necessary waveforms. 12

Q.5(b) "PCM is a kind of analog to digital converter"-justify the statement. Also briefly explain the steps of PCM with diagram. 15

Q.5(c) Contrast between TDM and FDM in terms of applications. 08

- Q.6(a) Explain ASK, FSK, [16QAM] with necessary waveforms. Show the constellation diagram of ASK, 8PSK and 16 QAM. 12
- Q.6(b) Explain the operation of delta modulation system. A binary sequence '011001010110' is transmitted by a delta modulator. Sketch the resulting analog waveform. 13
- Q.6(c) Why channel coding is used? Explain how errors are detected by two dimensional parity check system. 10
- Q.7(a) For a transmitted data sequence '100110011' sketch the following line codes 09
  - i. Unipolar NRZ
  - ii. Polar NRZ
  - iii. Manchester code
- Coch (11) Q.7(b) Sketch and prove sampling theorem. Differentiate between natural sampling and flat-top sampling. 13
- Q.7(c) Find the Fourier transform of a square pulse with unit amplitude and width. Plot the transformed web and describe the frequency domain behavior of pulse systems. 13
- Q.8(a) What are the advantages of fiber optic cables over metallic cables? Explain single and multimode propagation of fiber optic cables. 10
- Q.8(b) Explain the importance of Fourier transform in communication system analysis. Explain two different errors in delta modulation. 13
- Q.8(c) Distinguish between narrowband and wideband FM. Explain  $\mu$  law and A law companding with necessary diagrams. 12

The End



Chittagong University of Engineering and Technology  
 Department of Computer Science and Engineering  
 B. Sc. Engineering Level-3, Term-II, Exam. 2012<sup>1</sup>

*SUGAR*  
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Course Title: Data Communication

Marks: 210

Time: 3 Hours

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SECTION-A

- ~~Q.1(a)~~ What do you mean by Communication System? Why digital communication is superior over analog communication? 09
- ~~Q.1(b)~~ What is information? Explain how information can be measured by using entropy. 10
- ~~(Q.1(c))~~ What is modulation index? Differentiate between wideband FM and narrowband FM. 08
- ~~Q.1(d)~~ Discuss qualitatively the basic role of B (Bandwidth) and SNR in limiting the communication performance. 08
- ~~Q.2(a)~~ Why modulation is necessary in communication system? Explain DSB-SC signal modulation and demodulation process. 15
- ~~Q.2(b)~~ Distinguish among AM, FM, and PM. Sketches and explain envelope detector. 10
- ~~Q.2(c)~~ What do you mean by time domain and frequency domain? Why communication signals are processed in both time and frequency domains. (frozen - 65) 10
- ~~Q.3(a)~~ What is the transmission impairment? Distinguish between baseband and broadband transmission. 12
- ~~Q.3(b)~~ Define Latency, Propagation delay, and Jitter. 06
- ~~Q.3(c)~~ What is quadrature amplitude modulation (QAM)? Show the constellation diagram of 8-QAM and 16-QAM. 07
- ~~Q.3(d)~~ State sampling theorem. 12
- ~~Q.4(a)~~ A convolution encoder has a single shift register with two stages (i.e.,  $k=2$ ), two modulo-2 adder and an output multiplexer. The generator sequences of the encoder are as follows:  

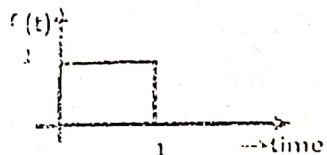
$$g^{(1)} = (1, 0, 1)$$

$$g^{(2)} = (1, 1, 1)$$
- Draw the encoder block diagram and determine encoder output produced by the message sequence 110101. 06
- ~~Q.4(b)~~ State the characteristics of band pass filter (BPF) and low pass filter (LPF) in the communication. 10
- ~~Q.4(c)~~ Describe Shannon's capacity formula. If the SNR of the channel is 36 dB and bandwidth is 2 MHz. What is the channel capacity? 07
- ~~Q.4(d)~~ Explain ASK, OOK, FSK, and PSK with necessary wave forms. 07

$$GPR = \frac{10^{-3} \times 2^8}{10^3 \times 1} \text{ contig.} \\ = 0.02 \times 6.02 \text{ m}$$

## SECTION-B

- ~~Q.5(a)~~ What are the differences between *Bit Rate* and *Baud Rate*? Explain two different errors in delta modulation. 10
- ~~Q.5(b)~~ Explain the different steps of pulse code modulation (PCM) with necessary diagram. 10
- ~~Q.5(c)~~ Why differential modulation is used? Explain the differences between DPCM and PCM. 10
- ~~Q.5(d)~~ What is Hamming distance? Explain its significance in channel coding. 05
- ~~Q.6(a)~~ What is *Companding*? Explain  *$\mu$ -law* and *A-law Companding*. 12
- ~~Q.6(b)~~ Prove that the signal to quantization error ratio  $SQR = 1.76 + 6.02n$  Where  $n$  is the number of bits used to encode a quantization level. 13
- ~~Q.6(c)~~ Explain adaptive delta modulation. What are the advantages and disadvantages of adaptive delta modulation over conventional delta modulation? 10
- ~~Q.7(a)~~ What is inter-symbol interference? How we can reduce inter-symbol interference? 07
- ~~Q.7(b)~~ Explain the importance of Fourier transform in communication system analysis. 07
- ~~Q.7(c)~~ Find the Fourier transform of the following square pulse. 15



- ~~Q.7(d)~~ Also draw the transform function.  
Define signal and systems. Lathi 06
- ~~Q.8(a)~~ Distinguish between synchronous and asynchronous transmission. 05
- ~~Q.8(b)~~ What are the advantages of fiber optic cables over metallic cables? Explain single and multi-mode propagation of optical fiber cable. 15
- ~~Q.8(c)~~ We have an available bandwidth of 100 KHz which spans from 200 to 300 KHz. What should be the carrier frequency and bit rate if we modulate our data by using FSK with  $d = 1$ .  $2\Delta f = 50$  Hz 07
- ~~Q.8(d)~~ Given the data stream 1001110111, sketch the transmitted sequence of pulses for each of the following line codes:  
(i) Unipolar NRZ (ii) Polar NRZ (iii) BRZ (iv) Manchester code 08

The End.

multi grade index  
multi step index.

$$\rightarrow f(t) = \begin{cases} 1; & 0 \leq t < 1 \\ 0; & t \geq 1 \end{cases}$$

$$\begin{aligned} F\{f(t)\} &= \int_{-\infty}^{\infty} f(t) e^{-j2\pi ft} dt \\ &= \int_0^1 f(t) e^{-j2\pi ft} dt \\ &\Rightarrow \int_0^1 1 e^{-j2\pi ft} dt = (1)^1 = 1 \\ &\Rightarrow \left[ \frac{e^{-j2\pi ft}}{-j2\pi f} \right]_0^1 = 1 \quad (\text{Ans}). \end{aligned}$$

Chittagong University of Engineering and Technology  
Department of Computer Science and Engineering  
B. Sc. Engineering Level 3, Term II, Exam, 2011

Course No: CSE 313  
Course Title: Data Communication  
Marks: 210  
Time: 3 Hours

The figure in the right margin indicates full marks. The questions are of equal value.  
Answer any three questions from each section. Use separate script for each section.

SECTION A

~~Q.1(a)~~ What is bandwidth? Distinguish between baseband transmission and Broadband transmission. 10

~~Q.1(b)~~ What are the significances of Nyquist bit rate? 08

~~Q.1(c)~~ We need to send 265 kbps over a noiseless channel with a bandwidth of 20 KHz. How many signal levels do we need? 10

~~Q.1(d)~~ What are the differences between bit rate and band rate? 07

~~Q.2(a)~~ Describe Shannon's capacity formula. 08

~~Q.2(b)~~ If the SNR of the channel is 36 dB and bandwidth is 2 MHz. What is the channel capacity?  $C = B \left( 1 + \frac{N}{S} \right)$  07

~~Q.2(c)~~ Define the following terms. 20

(i) Throughput 10

(ii) Latency 10

(iii) Transmission time 10

(iv) Propagation time 10

~~Q.3(a)~~ State the characteristics of the band pass filter (BPF) and low pass filter (LPF) in the communication. 10

~~Q.3(b)~~ A signal is carrying data in which one data element is encoded as one symbol element ( $t=1$ ). If the bit rate is 100 kbps. What is the average value of the baud rate if  $C$  is between 0 and 1? 10

~~Q.3(c)~~ Define the following line coding. 06

(i) Non return to zero 06

(ii) Return to zero 06

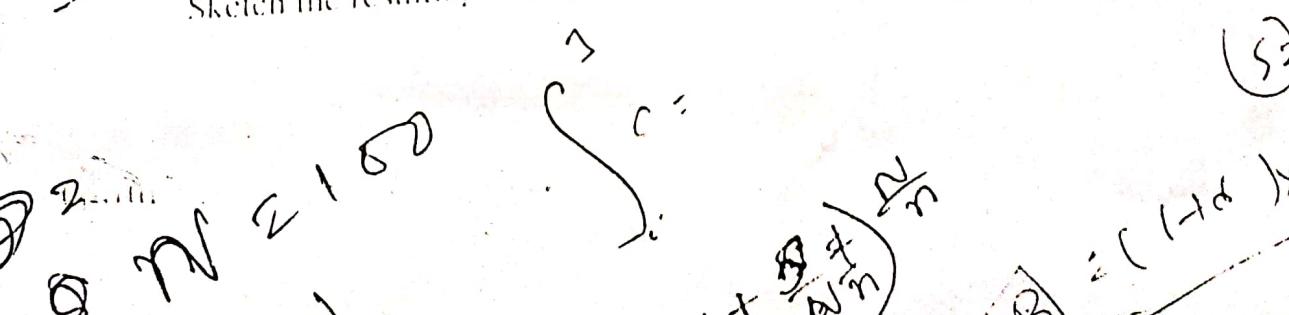
(iii) Manchester coding 06

~~Q.3(d)~~ What are the significances of Fourier transformation? 13

~~Q.4(a)~~ Explain the different steps of Pulse Code Modulation with necessary diagram. 08

~~Q.4(b)~~ What are the differences between PWM and PAM? 12

~~Q.4(c)~~ A binary sequence '0110011010' is transmitted by a delta modulator. Sketch the resulting analog waveform. 20



## SECTION B

~~Q.5(a)~~ Describe the followings with appropriate diagrams:

- ASK
- QPSK
- Constellation diagram.

~~Q.5(b)~~ Find the BCS for the following data and CRC generating polynomials:

$$\text{Data, } G(x) = x^7 + x^6 + x^5 + x^4 + x^3$$

$$\text{CRC, } P(x) = x^5 + x^4 + x^3 + x^2 + x^1$$

~~Q.5(c)~~ Determine the output spectrum for the SPSK signal when  $I=0$ ,  $Q=0$  and  $C=0$ .

~~Q.6(a)~~ Write short note on :

- (i) FEC, (ii) TDM, and (iii) ARQ.

~~Q.6(b)~~ Explain QAM. What are the advantages of QAM over ASK and PSK?

~~Q.7(a)~~ Define the following:

- BER
- Noise
- Inter-symbol Interference
- Burst error.

~~Q.7(b)~~ What are the significances of channel coding?

~~Q.7(c)~~ State and prove the integration property of Fourier transform.

~~Q.8(a)~~ What is the significance of hamming distance?

~~Q.8(b)~~ What are the differences between simple parity check code and two dimensional parity check code?

~~Q.8(c)~~ Describe two dimensional parity check code with an appropriate example.

The End

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~~(Q.4(b), c)~~ ~~Q.5(d)~~ What are the advantages of QAM over ASK and PSK?

Course No: CSE-313  
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### SECTION-A

- |                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                      |                |
|------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <u>Q.1(a)</u><br><u>Q.1(b)</u><br><u>Q.1(c)</u><br><u>Q.1(d)</u> | What is information? Give mathematical interpretation of information in terms of communication theory.<br>The capacity of a communication channel increases logarithmically with signal-to-noise ratio - justify this statement with Shannon's capacity theorem.<br>What is entropy? How entropy can be used to measure information?<br>Evaluate the channel capacity of a FM radio channel that has a 500 MHz bandwidth and an SNR of 25 dB. | 05<br>08<br>10<br>07                                                                                                                                                                                                                                                                                                                                                                 |                |
| <u>Q.2(a)</u><br><u>Q.2(b)</u><br><u>Q.2(c)</u>                  |                                                                                                                                                                                                                                                                                                                                                                                                                                               | Determine which of the properties (memory less, time invariant, linear, causal, stable) hold and which do not hold for each of the following system.<br>(i) $y(t) = x(t-2) + x(2-t)$<br>(ii) $y[n] = x[n+1]$<br>Let $x[n] = \delta[n] + 2\delta[n-1] \quad [n \geq 3]$ and $b[n] = 2\delta[n+1] + 2\delta[n-1]$ . Compute and plot $y[n]$ graphically where $y[n] = x[n+2] * b[n]$ . | 20<br>05<br>05 |
| <u>Q.3(a)</u><br><u>Q.3(b)</u><br><u>Q.3(c)</u>                  |                                                                                                                                                                                                                                                                                                                                                                                                                                               | Derive the Discrete Time Fourier Series (DTFS) pair.<br>Calculate the Fourier transform of the signal $x(t) = e^{at} u(t)$ where $a > 0$ . Also draw the magnitude and phase spectrum of the given signal.<br>State and prove the integration property of Fourier transform.                                                                                                         | 12<br>10<br>05 |
| <u>Q.4(a)</u><br><u>Q.4(b)</u><br><u>Q.4(c)</u>                  |                                                                                                                                                                                                                                                                                                                                                                                                                                               | Draw the block diagram of a diode-bridge modulator and explain its operation.<br>Explain the operation of a rectifier detector with necessary diagram.<br>Explain the demodulation process of SSB-SC (single side band suppressed carrier) signal by using phase-shift method.                                                                                                       | 12<br>10<br>13 |

## SECTION-B

- ~~Q.5(a)~~ Distinguish between Narrowband and Wideband frequency modulation. 08 2
- ~~Q.5(b)~~ Explain the following terms with their waveforms. 10 3
- (i) QPSK
  - (ii) BPSK
  - (iii) 2-FSK
- Q.5(c) Explain QAM technique. What is the advantages of QAM over ASK and PSK. 10 3
- ~~Q.6(a)~~ Explain the different steps of pulse code modulation with necessary diagram. 12 12
- Q.6(b) Explain  $\mu$ -law and A-law companding with necessary diagrams. 12 15
- ~~Q.6(c)~~ Mention some properties of line coding. 09 5
- ~~Q.7(a)~~ Draw the block diagram of a differential coding system and explain its operation with example. 13 10
- ~~Q.7(b)~~ Why is transversal filter used in differential pulse code modulation (DPCM)? Explain. 13 5
- Q.7(c) Explain the operation of adaptive delta modulation system with necessary diagram. 14 12
- ~~Q.8(a)~~ Write short note on the following. 04 4
- (i) Time division multiplexing
  - (ii) Synchronous and asynchronous communication.
- Q.8(b) A binary sequence '011001010110' is transmitted by a delta modulator. Sketch the resulting analog waveform. 08 11
- Q.8(c) Why channel coding is used? Explain how errors are corrected by a linear block code. 11 11

**Chittagong University of Engineering and Technology  
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B. Sc. Engineering L-3, Term-II, Exam. 2018**

**Course No: CSE-313**

**Course Title: Data Communication**

**Marks: 210**

**Time: 3 Hours**

The figure in the right margin indicates full marks. The questions are of equal value. Answer any three questions from each section. Use separate script for each section.

**Section-A**

**Q.1(a)** Write down the advantages and disadvantages of digital communication system over analog communication system. 09

**Q.1(b)** Discuss the various propagation characteristics of electromagnetic waves used in wireless channel with proper diagram. 12

**Q.1(c)** Write short note on 08

- (i) Automatic repeat request
- (ii) Forward error correction

**Q.1(d)** Define signal and system with example. 06

**Q.2(a)** Determine which of these properties (memory less, time invariant, linear, causal, and stable) hold and which do not hold for the following system. Justify your answer. 15

$$y(t) = [\cos(3t)]x(t)$$

**Q.2(b)** Derive the discrete time Fourier transform (DTFT) pair (analysis and synthesis equations) 12

**Q.2(c)** A periodic impulse train is given by 08

$$x(t) = \sum_{K=-\infty}^{+\infty} \delta(t - KT)$$

Calculate the Fourier transform of this signal and draw its spectrum. 13

**Q.3(a)** Derive the Analysis and Synthesis equations of the continuous time Fourier transform (CTFT) pair. 09

**Q.3(b)** Compare AM, FM and PM. 13

**Q.3(c)** Discuss the operation of a switching modulator for DSB-SC. 13

**Q.4(a)** What is VSB modulation? Show that the output low-pass filter of VSB demodulator can be expressed as 13

$$H_o(\omega) = \frac{1}{H_l(\omega + \omega_c) + H_l(\omega - \omega_c)}, |\omega| \leq 2\pi B,$$

where the symbols have their usual meaning.

**Q.4(b)** Discuss the rectifier detector of an AM signal with proper diagram. 12

**Q.4(c)** Find  $\varphi_{SSB}(t)$  for a simple case of a tone modulation, when the modulating signal is a sinusoid  $m(t) = \cos \omega_m t$ . 10

### Section-B

**Q.5(a)** Show that a narrow-band FM signal can be represented by

$$S(t) \approx A_c \cos(2\pi f_c t) + \frac{1}{2} \beta A_c \{ \cos[2\pi(f_c + f_m)t] - \cos[2\pi(f_c - f_m)t] \} \quad 14$$

**Q.5(b)** where the symbols have their usual meaning.

Prove that the spectrum of a wide-band FM signal is given by

$$S(f) = \frac{A_c}{2} \sum_{n=-\infty}^{+\infty} J_n(\beta) [\delta(f - f_c - nf_m) + \delta(f + f_c + nf_m)] \quad 15$$

**Q.5(c)** where the symbols have their usual meaning.

Define bit rate and baud rate with example.

**Q.6(a)** Explain in detail about error detection and correction. 06

**Q.6(b)** Define noise and what are its sources? Explain signal to quantization noise. 10

**Q.6(c)** Show that the spectrum of a flat-top PAM signal is 10

$$W_s(f) = \frac{1}{T_s} H(f) \sum_{K=-\infty}^{\infty} W(f - Kf_s)$$

where the symbols have their usual meanings.

**Q.7(a)** Explain the phenomenon of Inter-symbol interference (ISI). Identify the causes of ISI in digital communication systems. Describe a method that can reduce the ISI effect. 13

**Q.7(b)** Discuss the detection of PWM and PPM signals with necessary diagram. 12

**Q.7(c)** Describe the operation of Foster-Seeley detector in FM receiver. 10

**Q.8(a)** Discuss the frequency division multiplexing (FDM) technique with proper diagram. 13

**Q.8(b)** Explain ASK, FSK and PSK with proper example. 12

**Q.8(c)** State and explain Shannon's capacity theorem. 10

**END**