KHULNA UNIVERSITY, KHULNA

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

3rd Year, Term II, Examination 2017

Session: 2015-2016

Course No: ECE 3251

Full Title of Course: **Data Communication**

Full Marks: 60 Time: 03 Hours

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

Section A

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

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

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

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

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

Section B

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

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

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

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

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

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

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

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

Fig. 7(c) : Matrix H

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

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

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

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

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

(i) B8ZS

(ii) HDB3 (the number of nonzero pulses is odd after the last substitution)

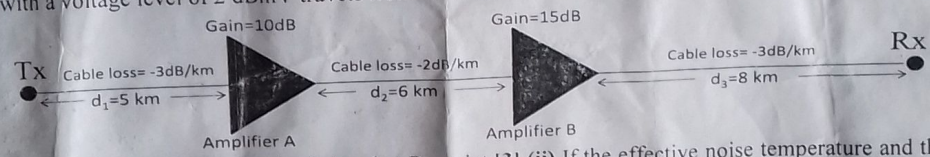
(d) We have a baseband channel with a 1-Mhz bandwidth. What is the data rate for this channel if we use the following line coding schemes? 03

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

CT-2,ECE 3251(B),FM:15, Time:30 min, Date:10-04-2017

(Q.1) What key factors affect channel capacity? Draw the spectrum of thermal noise. [1+1]

(Q.2.) A signal with a voltage level of 2 dBmV travels from Tx to Rx as shown in the following figure.



(i) Calculate the power(in dBm) of the received signal at Rx point.[3] (ii) If the effective noise temperature and the bandwidth o the receiver is 294K and 20 MHz respectively, calculate the signal to noise ratio(SNR) in dB at Rx point, taking thermal nois alone into account.[3] (iii) Determine the channel capacity of the link.[3] (iv) How many signal levels are needed to achieve a dat rate of half of the channel capacity?[2] (v) Which amplifier, A or B, will improve the SNR better and why? [1+1]

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PAM with natural sampling. 03
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Date: 10-04-2017

CSE Discipline

ECE 3251, Class Test : 1

Marks: 30, Time: 20 min

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

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

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

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

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Hours

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ECE 3251(B), FM:15, Time:30 min, Date:10-04-2017

CSE Discipline, ECE 3251, Class Test : 2, Marks: 15, Time: 20 min

Q1. A sinusoidal carrier has a peak value of 3V and frequency of 100MHz. It is modulated with a binary digital message 101101. Draw the modulated waveform for (a) ASK, (b) BFSK and (c) BPSK. 06

Q2. Draw the block diagram of a QPSK modulator. Also draw the corresponding inphase component, quadrature phase component and the output waveforms of this block if the input is 101001. 07

Q3. What is Delta Modulation? 02

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