DIGITAL COMMUNICATION
(ECEN 3105)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) In digital transmission, the modulation technique that usually requires minimum bandwidth is
(a) Delta modulation (b) PCM (c) DPCM (d) PAM

(ii) Use of non-uniform quantization leads to
(a) Reduction in transmission bandwidth
(b) Increase in maximum SNR
(c) Increase in SNR for low level signals
(d) Simplification in quantization process.

(iii) Which of the following digital modulation techniques is used for GSM mobile system?
(a) PSK (b) O-QPSK (c) MSK (d) GMSK.

(iv) PCM generation requires a LPF at the beginning to
(a) Eliminate quantization noise (b) Eliminate Aliasing effect
(c) Eliminate decoding noise (d) None of these.

(v) If the number of bits/per sample in a PCM system is increased from 5 to 7, the increase in signal to quantization noise ratio will be
(a) 8 (b) 16 (c) 32 (d) 64.

(vi) In a PCM system, numbers of quantization levels are 64 and the maximum signal frequency is 4 KHz, the minimum BW of the required transmission channel is
(a) 128 kbps (b) 256 kbps (c) 48 kbps (d) None of these.

(vii) A rectangular pulse of duration T is applied to a matched filter. The output of the filter is
(a) Rectangular pulse of duration T (b) Rectangular pulse of duration 2T
(c) Triangular pulse (d) Sine function.

(viii) The width of the main lobe of the PSD gives the bandwidth of MSK signal and given by -------- times the baseband frequency (f_b)
(a) 0.5 (b) 0.25 (c) 0.75 (d) 2.0.

(ix) SNR of a PCM system depends on
(a) Sampling rate (b) Number of quantization levels
(c) Message signal bandwidth (d) None of these.

(x) In eye-pattern, as eye closes
(a) ISI increases (b) ISI decreases
(c) Timing jitter increases (d) Timing jitter decreases.

Group – B

2. (a) State sampling theorem. [CO1, (Remember/LOCQ)]
(b) Describe Flat-top sampling. What is aperture effect? [CO1 , (Analyse/IOCQ)]
(c) What is Aliasing effect? How is it taken care of in PCM system?
The amplitude of a sinusoid signal is 8V. The signal is transmitted using PCM and the minimum SNR_q required in uniform quantization of the signal is 43.5 dB. Find the number of bits require to code the signal & estimate the step size. [CO1, (Apply/IOCQ)]

2 + (2 + 1 + 4) + 3 = 12

3. (a) Discuss the advantage of DPCM over PCM. [CO1, (Analyse/IOCQ)]
(b) Explain the limitations of DM. How such limitations can be overcome in ADM? [CO1, (Analyse/IOCQ)]
(c) A DM system is designed to operate at 8 times the Nyquist rate for a signal with 4 KHz bandwidth and Δ = 200 mV.
(i) Determine the maximum amplitude of 1 KHz input sinusoid for which the DM system does not show slope over load.
(ii) Estimate the output signal to quantization noise ratio.
[CO1, (Evaluate/HOCQ)]

2 + (3 + 2) + (3 + 2) = 12

Group – C

4. (a) What is inter-symbol interference? [CO2, (Remember/LOCQ)]
(b) What is Nyquist 1st criterion for zero ISI? [CO2, (Remember/LOCQ)]
(c) What are the limitations of the ideal solution and how this can be solved with Raised cosine pulse? [CO2, (Analyse/IOCQ)]
(d) In a baseband communication link of bandwidth 3500 KHz, data is transferred using raised cosine pulse with 75% excess bandwidth and no ISI, estimate the maximum signal rate. [CO2, (Apply/IOCQ)]

2 + 2 + 5 + 3 = 12

5. (a) What is line coding? Write down the desirable properties of a line code.
[CO2, (Remember/LOCQ)]

(b) To transmit a bit sequence of 11001, draw the resulting waveform using following line code format (i) Polar- RZ(ii) AMI (iii) Manchester Coding. [CO2, (Create/HOCQ)]

(c) Explain the operation of Regenerative Repeater in baseband data transmission. [CO2, (Analyse/IOCQ)]

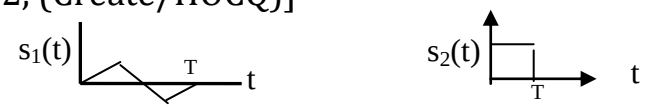
(1 + 3) + 3 + 5 = 12

Group – D

6. (a) What is the significance of the term 'Matched' in matched-filter? [CO3, (Remember/LOCQ)]

(b) Starting from $\eta_{max} = \frac{2}{N_0}\int_{-\infty}^{\infty}|G(f)|^2\,df$ show that maximum SNR of a matched filter is independent of signal shape but depends only on the signal energy. Symbols have their usual meaning. [CO3, (Analyse/IOCQ)]

(c) For the given signals, sketch the impulse responses of the filter matched to these signals. [CO2, (Create/HOCQ)]



(d) Describe the operation of an Integrate & Dump filter. [CO3, (Analyse/IOCQ)]

2 + 5 + 2 + 3 = 12

7. Write short notes on (Any *Three*) **(3 × 4) = 12**

(i) Eye-diagram (ii) Early – late gate synchronizer
(iii) MSK (iv) Companding. [CO3, (Remember/LOCQ)]

Group – E

8. (a) The bit rate for the digital system is 34 Mbps. For QPSK modulation scheme, what is the baud rate? [CO4, (Apply/IOCQ)]

(b) For a bit sequence of 100110, draw the resulting waveform for QPSK modulation scheme. [CO4, (Create/HOCQ)]

(c) With suitable diagram, explain the working principle of QPSK transmitter. Draw its signal space diagram. [CO4, (Analyse/IOCQ)]

(d) What are the advantages of OQPSK over QPSK. [CO4, (Analyse/IOCQ)]

1 + 2 + (5 + 1) + 3 = 12

9. (a) A binary data stream 0010010011 are to be transmitted using DPSK. Show the encoding & decoding sequences. [CO4, (Create/HOCQ)]

(b) Starting from the expression $P_e = Q\left(\sqrt{\frac{E_d}{2N_o}}\right)$ for binary signaling corrupted by white Gaussian Noise, find the expression for probability of error in case of OOK modulation. Symbols have their usual meanings. [CO3, (Analyse/IOCQ)]

(c) Determine the bandwidth for an FSK signal with two frequency offsets placed at 32 KHz & 24 KHz. Input bit rate is specified as 4 kbps. [CO4, (Apply/IOCQ)]

5 + 5 + 2 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	25%	57%	18%

Course Outcomes (CO):

1. To understand the functions of different components of a digital communication system and Pulse code Modulation System.
2. To understand some mathematical concepts like probability theory and random process necessary for the course and to analyse conduct of different coded digital baseband signals in time domain and in frequency domain.
3. To analyze error performance of a digital communication system in presence of noise and other interferences.
4. To analyze the performance of Digital modulation and demodulation techniques in various transmission environments and to understand concept of OFDM and Spread Spectrum Communication system.

Department & Section	**Submission Link**
ECE - BACKLOG	Join the Backlog classroom using the link: https://classroom.google.com/c/NDY0NDY3Mjk1NDI1?cjc=dzp3ice The assignment for Answer script submission is available in the class room.