

**DIGITAL COMMUNICATION  
(ECEN 3101)**

**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) The signal to quantization noise ratio in PCM system depends upon
    - (a) Sampling rate
    - (b) number of quantization levels
    - (c) message signal bandwidth
    - (d) none of these.
  - (ii) In a DM system, the granular noise occurs when the modulating signal
    - (a) increase rapidly
    - (b) remains constant
    - (c) decreases rapidly
    - (d) the nature of modulating signal has nothing to do with this noise.
  - (iii) Companding is used
    - (a) to overcome quantization noise in PCM
    - (b) in PCM transmitters, to allow amplitude limiting in the receiver
    - (c) to protect small signals in PCM from quantization distortion
    - (d) in a PCM receiver, to overcome impulse noise.
  - (iv) In vestigial spectrum the range of roll off factor is
    - (a)  $1 < r < 0$
    - (b)  $0 < r < 1$
    - (c)  $0 < r < \infty$
    - (d)  $-\infty < r < \infty$
  - (v) Spread spectrum modulation utilises
    - (a) wideband modulation
    - (b) double modulation
    - (c) direct sequence modulation
    - (d) pseudorandom sequence modulation.
  - (vi) If baud rate is 400 for a QPSK signal. The bit rate is
    - (a) 100
    - (b) 400
    - (c) 800
    - (d) 1600.
  - (vii) BW of MSK \_\_\_\_\_ that of QPSK
    - (a) higher than
    - (b) lower than
    - (c) equal to
    - (d) less than or equal to.

- (viii) Pulse shaping is done  
(a) by limiting the bandwidth of transmission  
(b) after line coding of the signal  
(c) to control ISI  
(d) all of the above.
- (ix) In eye pattern, as eye closes,  
(a) ISI increases (b) ISI decreases  
(c) timing jitter increases (d) timing jitter decrease.
- (x) The sensitivity of a system to timing error is determined by  
(a) width (b) opening  
(c) rate of eye closer of the eye diagram (d) none of these.

**Group – B**

2. (a) Draw the block diagram of digital Communication system.  
[(CO1) (Remember/LOCQ)]  
(b) Differentiate between Aliasing effect and Aperture effect.  
[(CO1) & (CO2)(Analyse/IOCQ)]  
(c) Estimate that in a PCM system, the output signal to quantization noise ratio (SNR)  $\text{dB} \leq 4.8 + 6n$ , where  $n$  is the number of bits of the quantizer.  
[(CO2) (Evaluate/HOCQ)]  
**3 + 2 + 7 = 12**
3. (a) How the step size of the uniform Quantizer decides the SNR of a PCM system?  
[(CO2)(Analyse/IOCQ)]  
(b) SNR at the output of a DPCM system is better than a PCM system: Justify the statement. [(CO2)(Analyse/IOCQ)]  
(c) For an analog input sinusoidal signal, decide the Quantizer and Encoder design parameters ( $L$  &  $n$ ) of a binary PCM system if the output SNR of that system is to be held to a min of 40 dB. [(CO2)(Evaluate/HOCQ)]  
**2 + 2 + 8 = 12**

**Group – C**

4. (a) To transmit a bit sequence of 011001011010110, draw the resulting waveform using (i) Unipolar NRZ and RZ (ii) Polar-NRZ and RZ (iii) Bipolar NRZ or AMI (iv) Manchester Coding. [(CO3)(Apply/IOCQ)]  
(b) How to differentiate between regenerative repeater and equalizer? What is the difference between line coding and source coding?  
[(CO3)(Analyse/IOCQ), (Remember/LOCQ)]  
**6 + (3 + 3) = 12**
5. (a) What is Nyquist 1st criterion for zero ISI. [(CO3)(Remember/LOCQ)]  
(b) What is the information obtained from eye pattern? [(CO3)(Understand/LOCQ)]

- (c) A message signal of 2 KHz bandwidth is transmitted using PCM. Quantization error is 1% of  $m_p$ . Roll off factor = 0.2, sampling rate is 25 % above Nyquist rate. Determine the transmission Bandwidth. [(CO2)(Evaluate/HOCQ)]

**2 + 4 + 6 = 12**

### **Group – D**

6. (a) A binary data stream 0010010011 is to be transmitted using DPSK. Show the encoding & decoding sequences. [(CO5) (Apply/IOCQ)]  
 (b) With suitable diagram, explain the working principle of QPSK transmitter and draw its signal space diagram. [(CO5) (Understand/LOCQ)]

**6 + (4 + 2) = 12**

7. (a) How M-ary Modulation technique ensures efficient utilization of transmission channel bandwidth? [(CO5) (Remember/IOCQ)]  
 (b) Draw BPSK & QPSK modulated waveform for the data stream 10010011. [(CO5) (Apply/IOCQ)]  
 (c) How spread spectrum technique ensures secure communication? [(CO5) (Understand/LOCQ)]

**4 + 4 + 4 = 12**

### **Group – E**

8. (a) Illustrate how the Integrate and Dump type filter enhances the signal relative to the noise in the receiver section of the Digital Communication System? [(CO4) & (CO6)(Analysis/IOCQ)]  
 (b) Design the Transfer Function of an Optimum filter. [(CO4) (Apply/IOCQ)]
9. (a) In a noisy channel which digital modulation technique (ASK/FSK/PSK) will ensure minimum value of BER? Justify your statement using signal space diagram. [(CO4),(CO5) & (CO6)(Evaluate/HOCQ)]  
 (b) How the decision about the received signal is made from the signal space diagram in QPSK modulation system? [(CO4) & (CO5)(Analysis/IOCQ)]

**9 + 3 = 12**

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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	23%	46%	31%

### **Course Outcome (CO):**

After the completion of the course students will be able to

1. Apply the concepts of various techniques for analog signal transmission and modulation from the knowledge gathered earlier.
2. Understand the functions of different components of a digital communication system and understand Pulse code Modulation System.

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3. Apply mathematical concepts to analyse the source coder and channel coder blocks of the digital communication system.
4. Analyze error performance of a baseband receiver in digital communication system in presence of noise and other interferences and apply this knowledge to design a receiver.
5. Compare performance of various digital modulation & demodulation techniques and understand concept of OFDM and Spread Spectrum Modulation system.
6. Design a digital communication system and evaluate the performance of the system in presence of noise.

\*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question

Department & Section	Submission Link
ECE - A	<a href="https://classroom.google.com/u/0/w/NDA0ODYxMDAwMTU1/tc/NDYzODQ3Mjk0OTQz">https://classroom.google.com/u/0/w/NDA0ODYxMDAwMTU1/tc/NDYzODQ3Mjk0OTQz</a>
ECE - B	<a href="https://classroom.google.com/w/NDA0NDcwODAyNzg5/tc/NDY0MDA3NTM3Nzc5">https://classroom.google.com/w/NDA0NDcwODAyNzg5/tc/NDY0MDA3NTM3Nzc5</a>
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