

**ANALOG AND DIGITAL COMMUNICATION
(ECEN 3223)**

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 Intermediate frequency used for AM in superheterodyne receiver is
(a) 10.7 MHz (b) 455 kHz (c) 900 kHz (d) 950 kHz.
 - (ii) A carrier is amplitude modulated simultaneously by two sine waves with modulation indices of 0.3 and 0.6. The effective modulation index is,
(a) 0.9 (b) 0.3 (c) 0.67 (d) 0.45.
 - (iii) The Nyquist rate for a signal $x(t) = 5 \cos(2\pi \cdot 500 t)$ is
(a) 1200 Hz (b) 1000 Hz (c) 2000 Hz (d) 500 Hz.
 - (iv) Spread spectrum modulation utilises
(a) wideband modulation (b) double modulation
(c) direct sequence modulation (d) pseudorandom sequence modulation.
 - (v) A superheterodyne receiver is tuned at 1000 kHz. If the Intermediate Frequency is 450 kHz, the image frequency is
(a) 1000 kHz (b) 1900 kHz (c) 550 kHz (d) 1450 kHz.
 - (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) In Delta modulation, the granular noise occurs when the
(a) modulating signal increases rapidly
(b) modulating signal remains constant
(c) pulse rate decreases
(d) pulse amplitude increases.

- (ix) 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.
- (x) The bit rate for a digital communication system is 28Mbps. The modulation scheme is QPSK. The baud rate of the system is
(a) 56 Mbps (b) 14 Mbps (c) 34 Mbps (d) 84 Mbps.

Group - B

2. (a) Draw the block diagram of communication system. [[CO1](Remember/LOCQ)]
(b) How phase modulated signal can be generated using frequency modulator circuit and vice versa? [[CO3](Analyse/IOCQ)]
(c) A 100 MHz carrier wave has a peak voltage of 5 volts. The carrier is frequency modulated by a sinusoidal modulating signal or waveform of frequency 2 kHz such that the frequency deviation is 75 kHz. The modulated waveform passes through zero and is increasing at $t=0$. Determine the expression for the modulated carrier waveform. [[CO3](Evaluate/HOCQ)]
2 + 4 + 6 = 12
3. (a) Define the following terms for FM wave:
(i) Frequency deviation
(ii) Modulation index
(iii) Narrowband FM. [[CO1](Remember/LOCQ)]
(b) What is the need for image rejection in Super heterodyne Receiver? [[CO2,CO3](Analyse/IOCQ)]
(c) A 100 MHz carrier wave has a peak voltage of 5 volts. The carrier is frequency modulated (FM) by a sinusoidal modulating signal or waveform of frequency 2 kHz such that the frequency deviation is 75 MHz. The modulated signal is passing through zero and is increasing at $t = 0$. Determine the expression for the modulated waveform. [[CO3](Apply/IOCQ)]
6 + 2 + 4 = 12

Group - C

4. (a) To transmit a bit sequence of 101001011010110, draw the resulting waveform using (i) Unipolar NRZ and RZ (ii) Polar-NRZ and RZ (iii) Bipolar NRZ or AMI (iv) Manchester Coding. [[CO4](Apply/IOCQ)]
(b) Consider the audio signal limited to frequency band of 300 Hz to 3.3 kHz. A PCM signal is generated with $f_s = 8000$ samples/sec. The reqd. O/P SNR is 30 dB. Determine M, n, Min Trans. BW. [[CO2](Evaluate/HOCQ)]
6 + 6 = 12
5. (a) What is quantization error and how can we reduce it? [[CO4](Apply/IOCQ)]

- (b) State the advantages of ADM over DM system? What is the condition for avoiding slope overload? [(CO4)(Apply/IOCQ)]
- (c) In a signal integration DM scheme, the voice signal is sampled at a rate of 64 kHz. The voice signal bandwidth is 3.5 kHz. The maximum signal amplitude is 1 volt. Determine the minimum value of step size to avoid slope overload. [(CO4)(Evaluate/HOCQ)]
- 4 + 4 + 4 = 12**

Group - D

6. (a) A binary data stream 1010110011 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) Draw and explain the geometric representation of 16-QAM system. [(CO5)(Analyze/IOCQ)]
- (b) Write down the advantages of MSK over QPSK. [(CO5)(Remember/LOCQ)]
- (c) Draw the block diagram of FHSS system and explain the working. [(CO5)(Analyze/IOCQ)]
- 4 + 4 + 4 = 12**

Group - E

8. (a) Draw and label the block diagram of a TDM system. [(CO5&CO6)(Remember/LOCQ)]
- (b) What are the key differences between FDM and TDM systems? What are the Features of FDMA? [(CO6)(Understanding/LOCQ)]
- 6 + (3 + 3) = 12**
9. (a) Explain the principle of CDMA with diagram. [(CO5&CO6)(Analysis/IOCQ)]
- (b) Differentiate between
- (i) Co channel interference and adjacent channel interference.
- (ii) Soft handoff and hard hand off. [(CO6)(Understanding/IOCQ)]
- (c) Microcell concept is applicable to urban and rural areas with different constrains and planning. Explain the statement. [(CO6)(Analysis/IOCQ)]
- 4 + 4 + 4 = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	31.25	52.08	16.67

Course Outcome (CO):

After the completion of the course students will be able to

1. Explain the necessity of communication, its history, evolution, the role of efficient communication in the present day.
2. Understand & apply the concepts of various types of signals, techniques for signal transmission and signal modulation from the knowledge gathered earlier.
3. Identify various parameters associated with Amplitude and frequency Modulation, time and frequency domain representations, side band frequencies etc and apply these knowledge to solve numerical problems.
4. Apply sampling theorem to sample analog signal properly and differentiate among pulse modulation & demodulation techniques and understand PCM, DPCM.
5. Analyze performance of various digital modulation & demodulation techniques and understand concept of OFDM and Spread Spectrum Modulationsystem.
6. Analyze various multiplexing and Multiple access techniques and compare modern multiple access schemes, explain the concept of frequency reuse, channel assignment strategies and make use of wireless communication tools.

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