ANALOG AND DIGITAL COMMUNICATION
(ECEN 3223)

Time Allotted: 2½ hrs **Full Marks: 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

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

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) Which of the following desirable features are possessed by SSB in comparison to AM?
(a) More power is required (b) Bandwidth required is less
(c) Antenna size can be reduced (d) Low frequency can be used.

(ii) The Intermediate frequency used for AM in super heterodyne receiver is
(a) 10.7 MHz (b) 455 KHz
(c) 900 KHz (d) 950 KHZ

(iii) In commercial FM broadcasting, the maximum frequency deviation is normally
(a) 5kHz (b) 15kHz (c) 75kHz (d) 200kHz

(iv) If the modulation index of an AM wave is changed from 0 to 1, the transmitted power
(a) Increases by 50% (b) Increases by 75%
(c) Increases by 100% (d) Remains unaffected

(v) Which of the following system is called constant bandwidth system?
(a) AM (b) FM (c) PM (d) None of these

(vi) If baud rate is 400 for a QPSK signal. The bit rate is
(a) 100 (b) 400 (c) 800 (d) 1600.

(vii) In delta modulation, the slope overload distortion can be reduced by
(a) decreasing the step size (b) increasing the step size
(c) decreasing the granular noise (d) decreasing the sampling rate.

(viii) In FM, if the deviation is 10 kHz and modulating frequency is 1kHz and if the peak modulation voltage is 2V and carrier voltage is 4 V, then the modulating index is given by,
(a) 20 (b) 5 (c) 0.5 (d) 10

(ix) The BW of MSK is _____ the BW of QPSK

(a) higher than (b) lower than

(c) equals to (d) not comparable with

(x) The process of transmitting two or more information signals simultaneously over the same channel is called

(a) telemetry (b) multiplexing

(c) modulation (d) detection.

Fill in the blanks with the correct word

(xi) In FM, maximum deviation is 75 kHz and maximum modulating frequency is 15 kHz, In view if Carson's rule, the maximum required bandwidth is _____.

(xii) The Nyquist rate for a signal x(t)= 5 cos (2*pi* 500 t) is _____.

(xiii) The change in amplitude of carrier in accordance to the amplitude of the message signal is called _____.

(xiv) _____ encoding has a transition at the middle of each bit.

(xv) Quantization noise can be reduced by _____ the number of quantizer levels.

Group - B

2. (a) Draw the block diagram of communication system. *[(CO1)(Remember/LOCQ)]*

(b) Draw the spectrum of (i) AM (ii) DSB-SC signal (iii) SSB-SC modulated signal. *[(CO1,CO2)(Analyse/IOCQ)]*

(c) A modulating signal consisting of 1KHz, 2KHz and 4KHz amplitude modulates a carrier signal of 100KHz using DSB-SC modulation system. Determine (i) frequencies present in the modulated signal (ii) Transmission Bandwidth. *[(CO1,CO2)(Apply/IOCQ)]*

3 + 3 + 6 = 12

3. (a) Compare between wideband FM and narrowband FM. What is Carson's rule? *[(CO2,CO3)(Remember/LOCQ)]*

(b) What is the need for image rejection in super heterodyne Receiver? *[(CO3)(Analyse/IOCQ)]*

(c) A FM wave is represented by the following equation: V = 10 sin [5 x 10^8 t + 4 sin 1250t]. Find (i) carrier and modulating frequency (ii) modulation index and maximum deviation. *[(CO3)(Evaluate/HOCQ)]*

4 + 4 + 4 = 12

Group - C

4. (a) Estimate that in a PCM system, the output signal to quantization noise ratio (SNR) dB ≤ 4.8 + 6n, where n is the number of bits of the quantizer. *[(CO4)(Analyse/IOCQ)]*

(b) Describe the following line codes used for digital communication with the help of waveforms (i) Unipolar RZ (ii) Polar-NRZ (iii) Bipolar NRZ or AMI (iv) Manchester Coding. *[(CO4)(Remember/LOCQ)]*

(c) What is nyquist criteria? What is inter-symbol interference? *[(CO4)(Apply/IOCQ)]*

4 + 4 + (2 + 2) = 12

5. (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/HOCQ)]*

(b) Explain the limitations of DM. How such limitations are overcome? *[(CO4)(Analyse /LOCQ)]*

4 + (4 + 4) = 12

Group - D

6. (a) For a bit sequence of 10001101 draw the resulting waveform in time domain for (i) ASK, (ii) FSK (iii) PSK modulation scheme. *[(CO5)(Apply/IOCQ)]*

(b) With suitable diagram, explain the working principle of BASK transmitter and receiver. *[(CO5)(Understand/LOCQ)]*

6 + (3 + 3) = 12

7. (a) Explain the coherent detection of FSK signal with suitable diagram. *[(CO5)(Analyse/IOCQ)]*

(b) 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. *[(CO5)(Evaluate/HOCQ)]*

(c) What are the advantages of OFDM over FDM? *[(CO5)(Analyse/IOCQ)]*

4 + 4 + 4 = 12

Group - E

8. (a) Draw and label the block diagram of a TDM system. *[(CO6)(Remember/LOCQ)]*

(b) What are the key differences between FDM and TDM systems? *[(CO6)(Analyse/IOCQ)]*

(c) Identify the features of FDMA. *[(CO6)(Evaluate/IOCQ)]*

4 + 6 + 2 = 12

9. (a) What is the purpose of "handoff" in a cellular network? Design two cellular networks with "hard" & "soft" handoff and comments on the on the merits and demerits of both schemes. *[(CO1,CO6)(Create/HOCQ)]*

(b) Differentiate between fixed and dynamic channel assignment strategies in cellular network? *[(CO1,CO6)(Remember/LOCQ)]*

(c) Draw the block diagram to explain the design of GSM architecture. What is the significance of MSC in GSM architecture? *[(CO1,CO6)(Apply/IOCQ)]*

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

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	33.3	50	16.7

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.*