

**COMMUNICATION TECHNIQUES
(AEIE 3131)**

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) What is the modulation index in AM?
(a) It is a measure of the depth of modulation in an AM signal.
(b) It is equal to the ratio of the peak amplitude of the modulating signal to the peak amplitude of the carrier signal.
(c) A higher modulation index results in a broader bandwidth.
(d) All of these.
- (ii) Which of the following analog modulation scheme requires the minimum transmitted power and minimum channel bandwidth?
(a) VSB (b) DSB-SC (c) SSB (d) DSB with carrier.
- (iii) Consider an angle modulation signal $x(t) = 6\cos[2\pi \times 103t + 2\sin(8000\pi t) + 4\cos(8000\pi t)]$. The average power of $x(t)$ is
(a) 10 W (b) 18 W (c) 20 W (d) 28 W.
- (iv) What are the three main elements of a communication system?
(a) Transmitter, receiver, and channel
(b) Encoder, decoder, and channel
(c) Modulator, demodulator, and channel
(d) All of these.
- (v) Calculate the minimum sampling rate to avoid aliasing when a continuous-time signal is given by $x(t) = 5 \cos 400\pi t$
(a) 100 Hz (b) 200 Hz (c) 400 Hz (d) 250 Hz
- (vi) In amplitude modulation
(a) sideband power is always constant
(b) total transmitted power is always constant
(c) carrier power is always constant
(d) bandwidth is infinite.

- (vii) In the envelop detector the charging time constant of the RC filter is
 (a) equal to the carrier period (b) greater than the carrier period
 (c) less than the carrier period (d) none of these.
- (viii) Square law modulator is used to generate
 (a) DSB-SC (b) SSB (c) DSB-FC (d) SSB-SC.
- (ix) The line code that has zero DC component for pulse transmission of random binary data is
 (a) non-return to zero (NRZ) (b) return to zero (RZ)
 (c) alternate mark inversion (AMI) (d) both (a) and (b).
- (x) An analog voltage in the range of 0 to 8 V is divided into 16 equal intervals for conversion to 4-bit digital output. The maximum quantization error (in V) is
 (a) 2 V (b) 0.5 V (c) 1 V (d) 0.25 V

Fill in the blanks with the correct word

- (xi) Frequency reuse factor for CDMA system is _____.
- (xii) In Differential Pulse Code Modulation decoding is performed by _____.
- (xiii) The Nyquist sampling interval, for the signal $\text{sinc}(700t) + \text{sinc}(500t)$ is _____.
- (xiv) When the bit rate of a QPSK communication system is 34 Mbps, then baud rate of the system is _____.
- (xv) In the physical layer modulation used by Bluetooth is _____.

Group - B

2. (a) Explain the principle of Amplitude Modulation. What is the Modulation index? [[CO3](Analyse/HOCQ)]
- (b) What is the total modulating index if a carrier is simultaneously modulated by two sine waves with modulating indices of 0.3 and 0.4? An AM transmitter produces 15 kW with 60% modulation. How much of it is carrier power? How much power is saved if SSB transmission takes place? [[CO2](Understand/LOCQ)]
(2 + 2) + (4 + 2 + 2) = 12
3. (a) Explain the scheme of the envelope detector and rectifier detector. What do you mean by diagonal peak clipping and negative peak clipping? [[CO1](Evaluate/HOCQ)]
- (b) Describe the principle of Angle Modulation. Define phase deviation, Modulation index, frequency deviation and percentage modulation. [[CO1](Evaluate/IOCQ)]
- (c) An angle-modulated wave with a carrier frequency $\omega_c = \pi \times 105 \text{ rad/s}$ is given as $f(t) = 5 \cos(\omega_c t + 3 \sin 2000t + 5 \sin 2000\pi t)$. Find (i) frequency deviation, (ii) deviation ratio, (iii) phase deviation and (iv) the bandwidth. [[CO1](Understand/LOCQ)]
(2 + 2) + (2 + 2) + 4 = 12

Group - C

4. (a) Describe a generalised digital communication system with a neat block diagram. Compare the various types of digital modulation techniques. [[CO3](Analyse/HOCQ)]
(b) Draw the block diagram of the BPSK demodulator and explain its operation. [[CO4](Remember/LOCQ)]
(c) An FSK signal with a mark frequency of 85 kHz and space frequency of 93 kHz, with an input rate of 5 kbps, find the peak frequency deviation, minimum bandwidth and baud rate. [[CO2](Apply/IOCQ)]
(2 + 2) + (2 + 2) + (2 + 1 + 1) = 12
5. (a) Why do we adopt spread spectrum modulation techniques in wireless communication? [[CO3](Analyse/HOCQ)]
(b) Write a short note on quadrature amplitude modulation. [[CO4](Remember/LOCQ)]
(c) State different types of spread spectrum modulation techniques. [[CO2](Apply/IOCQ)]
4 + 4 + 4 = 12

Group - D

6. (a) State sampling theorem. What is aliasing? [[CO4](Remember/LOCQ)]
(b) A signal $x(t) = 2 \sin 4000\pi t + 3 \sin 5000\pi t + 4 \sin 8000\pi t$ has to be truly represented by its samples. Determine the Nyquist rate for sampling. [[CO4](Evaluate/HOCQ)]
(c) Discuss the performance of Hamming code. [[CO4](Analyse/IOCQ)]
4 + 4 + 4 = 12
7. (a) What are slope overload distortion and granular noise in delta modulation? How are these avoided in adaptive delta modulation? [[CO4](Remember/LOCQ)]
(b) Given a sine wave of frequency f_m and amplitude A_m applied to a delta modulator having step size Δ and a sampling period of T_s . Verify that the slope overload distortion will occur if $A_m > \frac{\Delta}{2\pi f_m T_s}$. [[CO4](Evaluate/HOCQ)]
(c) Briefly explain the properties of Matched Filter. [[CO4](Analyse/IOCQ)]
4 + 6 + 2 = 12

Group - E

8. (a) Describe the Fixed Channel Assignment and Dynamic Channel Assignment. State the hand-off with its importance. [[CO5](Analyse/IOCQ)]
(b) Differentiate co-channel interference from adjacent channel interference. [[CO5](Analyse/IOCQ)]
(4 + 3 + 2) + 3 = 12
9. (a) Compare Wi-Fi and WLAN. List the applications of WLAN. [[CO6](Analyse/IOCQ)]/[[CO6](Remember/LOCQ)]
(b) Briefly describe the IEEE802.11 protocols. [[CO6](Understand/LOCQ)]
(4 + 2) + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	41.67	31.25	27.08

Course Outcome (CO):

After the completion of the course students will be able to:

1. Identify and apply detailed knowledge of analog modulation and demodulation techniques.
2. Examine the merits and short comings of the basic digital modulation techniques.
3. Compare the characteristics of standard multiplexing techniques and select the suitable one for specific requirement.
4. Evaluate the performance of coding techniques.
5. Analyze cellular concept and the strategies associated with cellular communication.
6. Explain the role of wireless local area networks in communication systems.

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