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) The maximum power efficiency of an AM modulator is
(a) 25% (b) 50%
(c) 33% (d) 100%.

(ii) Consider an angle modulation signal $(t)=6cos[2\pi\times10^3+2\sin(8000\pi t)+4\cos(8000\pi t)]V$. The average power of (t) is
(a) 10 W (b) 18 W
(c) 20 W (d) 28 W.

(iii) For a bit-rate of 8 kbps, the best possible values of the transmitted frequencies in a coherent binary FSK system are
(a) 16 KHz and 20 KHz (b) 20 KHz and 32 KHz
(c) 20 KHz and 40 KHz (d) 32 KHz and 40 KHz.

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

(v) Calculate the minimum sampling rate to avoid aliasing when a continuous time signal is given by x(t) = 5 cos 400πt
(a) 100 Hz (b) 200 Hz
(c) 400 Hz (d) 250 Hz.

(vi) The Nyquist sampling interval, for the signal $\sin(700\ t)+ \sin c\ (500\ t)$ is
(a) $1/350\ sec$ (b) $\pi/350\ sec$
(c) $1/700\ sec$ (d) $\pi/175\ sec$.

(vii) A signal has frequency components from 300 Hz to 1.8 KHz. The minimum possible rate at which the signal has to be sampled is
(a) 600 Hz (b) 1200 Hz
(c) 1800 Hz (d) 3600 Hz.

(viii) An analog voltage in the range 0 to 8 V is divided in 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.

(ix) Co-channel interference in cellular system can be reduced by

(a) microcells (b) dynamic channel allocation
(c) sectoring (d) guard band.

(x) Co-channel reuse ratio (Q) is

(a) $3\sqrt{N}$ (b) $\sqrt{3N}$
(c) $\sqrt{3/N}$ (d) $\sqrt{N/3}$

Fill in the blanks with the correct word

(xi) A carrier is amplitude modulated simultaneously by two sine waves with modulation indices of 0.3 and 0.6. The effective modulation index is _____.

(xii) For a given data rate, the bandwidth of a BPSK signal is _____ the bandwidth of the QPSK signal.

(xiii) Frequency reuse factor for CDMA system is _____.

(xiv) The no of cells in cluster when i = 3 and j = 5 is _____.

(xv) When we divide band of Orthogonal Frequency Division Multiplexing (OFDM) into sub bands, it diminishes effects of _____.

Group - B

2. (a) Explain the functionality of each block of phase locked loop. *[(CO1)(Understand/LOCQ)]*

(b) A 107.76MHz carrier signal is frequency modulated by a 7kHz sine wave. The resultant FM signal has a frequency deviation of 50kHz. Determine carrier swing, highest & lowest frequencies of frequency modulated signal, and modulation index of FM wave. *[(CO1)(Analyse/IOCQ)]*

6 + 6 = 12

3. (a) An AM transmitter radiates 9kW of power when the carrier is un-modulated and 10.125kW of power when the carrier is sinusoidal modulated. Find the modulation index & Percentage modulation. Now if another sine wave corresponding to 40% modulation is transmitted simultaneously. Calculate total radiated power. *[(CO1)(Analyse/IOCQ)]*

(b) Discuss about different sources of noise. *[(CO1)(Remember/LOCQ)]*

6 + 6 = 12

Group - C

4. (a) Draw the constellation diagram for BPSK, QPSK, 8PSK, 16 QAM and 64 QAM systems. *[(CO2)(Apply/IOCQ)]*

(b) Compare between DSSS and FHSS techniques. *[(CO2)(Analyse/IOCQ)]*

(c) Define chip rate and processing gain for spread spectrum modulation techniques. *[(CO2)(Remember/LOCQ)]*

7 + 3 + 2 = 12

5. (a) For an FSK signal with a mark frequency of 85 kHz and space frequency of 93 kHz, with an input rate of 5kbps, determine the peak frequency deviation and baud rate. *[(CO2)(Analyse/IOCQ)]*

(b) Explain with block diagram the operation of BPSK modulator and demodulator. *[(CO2)(Understand/LOCQ)]*

(c) A 16PSK system has baud rate of 2000/s. Examine the bit rate of this system. Identify the baud rate of a QPSK system having the same bit rate. *[(CO2)(Analyse/IOCQ)]*

(d) An FSK transmitter, using a carrier frequency of 750 kHz, is sending 10 kbps and a frequency deviation of 200 kHz. Calculate the amount of transmission bandwidth needed for this purpose. *[(CO2)(Analyse/IOCQ)]*

2 + 5 + 3 + 2 = 12

Group - D

6. (a) What are slope overload distortion & 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)(Analyze/IOCQ)]*

4 + 6 + 2 = 12

7. (a) A delta modulator system is designed to operate at five times the Nyquist rate for a signal having a bandwidth equal to 3 kHz. Verify that the maximum amplitude of a 2 kHz input sinusoidal signal will be 596.83 mV to avoid slope overload, if the quantizing step size is 250 mV. *[(CO4)(Evaluate/HOCQ)]*

(b) Compare between ARQ and Hamming Code. *[(CO4)(Analyse/IOCQ)]*

(c) What is hamming distance? *[(CO4)(Remember/LOCQ)]*

(d) A TDM link has 24 signals & each channel is sampled 8000times/s. Each sample is represented by 8 binary bits and an additional bit for synchronization. Validate that the total bit rate made from the TDM link is more than 1600kbps. *[(CO3)(Evaluate/HOCQ)]*

4 + 3 + 1 + 4 = 12

Group - E

8. (a) Examine hand-off process in different generations of cellular communications. *[(CO5)(Analyse/IOCQ)]*

(b) Explain the factors that influence the hand-off process. *[(CO5)(Analyse/IOCQ)]*

(c) Evaluate the role of 'frequency reuse' in cellular communication. *[(CO5)(Evaluate/HOCQ)]*

3 + 4 + 5 = 12

9. (a) Compare Wi-Fi and WLAN. *[(CO6)(Analyse/IOCQ)]*

(b) List the applications of WLAN. *[(CO6)(Remember/LOCQ)]*

(c) Briefly describe the IEEE802.11 protocols. *[(CO6)(Understand/LOCQ)]*

4 + 2 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	33.33	46.87	19.79