

**COMMUNICATION TECHNIQUES
(AEI3203)**

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 $(t)=6\cos[2\pi\times10^3+2\sin(8000\pi t)+4\cos(8000\pi t)]V$. The average power of (t) is
 - (a) 10 W
 - (b) 18 W
 - (c) 20 W
 - (d) 28 W
- (iii) Comparison of FDM and TDM system shows that
 - (a) FDM requires lower bandwidth, but TDM has greater noise immunity
 - (b) FDM requires bandwidth as well as noise immunity is greater than TDM
 - (c) FDM requires channel synchronization while TDM has greater noise immunity
 - (d) none of these are correct
- (iv) 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
- (v) The baud rate is 400 for a QPSK signal. The bit rate is
 - (a) 100
 - (b) 400
 - (c) 800
 - (d) 1600
- (vi) QPSK is a composite of
 - (a) Two BPSK
 - (b) Three BPSK
 - (c) Two FSK
 - (d) Two M-ary PSK
- (vii) The Nyquist sampling interval, for the signal $\sin(700 t)+\text{sinc}(500 t)$ is
 - (a) $1/350 \text{ sec}$
 - (b) $\pi/350 \text{ sec}$
 - (c) $1/700 \text{ sec}$
 - (d) $\pi/175 \text{ sec}$

- (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) Determine no of cells in cluster when $i = 2$ and $j = 4$
 (a) 7 (b) 14
 (c) 28 (d) 35
- (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) If frequency deviation is 75 kHz and modulating frequency is 15 kHz, the bandwidth of a commercial FM transmission is _____.
- (xiii) The process of transmitting two or more information signals simultaneously over the same channel is called _____.
- (xiv) The line code that has zero dc components for pulse transmission of random binary data is _____.
- (xv) Frequency reuse factor for CDMA system is _____.

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) Explain the concept of Instantaneous frequency. [[CO1](Understand/LOCQ)]
 (b) A 20 MHz carrier is frequency modulated by a sinusoidal signal such that the peak frequency deviation is 100 kHz. Determine the modulation index and the approximate bandwidth of the FM signal if the frequency of the modulating signal is: (i) 1 kHz (ii) 15 kHz. [[CO1](Analyse/IOCQ)]
5 + 7 = 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) 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) List the advantages of spread spectrum modulation techniques.
 [[CO2] (Remember/LOCQ)]
4 + 3 + 1 + 4 = 12
7. (a) Draw waveforms using: (i) AMI, (ii) NRZ Technique, (iii) RZ Technique, (iv) Manchester Coding with the message signal (10011011).
 [[CO4] (Apply/IOCQ)]
- (b) Describe the use of spread spectrum modulation techniques in wireless communication.
 [[CO6] (Apply/IOCQ)]
- (c) Discuss the importance of quantization process in digital transmission of information signal.
 [[CO4] (Evaluate/HOCQ)]
4 + 2 + 6 = 12

Group - E

8. (a) Explain location management in cellular systems. Describe location update and paging process.
 [[CO5] (Analyse/IOCQ)]
- (b) Classify different types of handoff (hard, soft, horizontal, vertical) and explain each with suitable examples.
 [[CO5] (Understand/LOCQ)]
- (c) Explain trunking and Grade of Service (GoS). How does trunking improve system efficiency?
 [[CO6] (Analyse/HOCQ)]
4 + 4 + 4 = 12

9. (a) From the concept of frequency reuse, analyze channel capacity and cluster. [[CO5](Analyse/IOCQ)]
- (b) Prove that for a hexagonal geometry, the co-channel reuse ratio is given by $Q = \sqrt{3N}$, where $N = i^2 + ij + j^2$. [[CO5](Evaluate/HOCQ)]
- (c) A total of 33 MHz bandwidth is allocated to a FDD cellular system with two 25 KHz simplex channels to provide full duplex voice and control channels. Compute the number of channels available per cell if the system uses (i) 4-cell and (ii) 7-cell reuse technique. Assume 1 MHz of spectrum is allocated to control channels. Give a distribution of voice and control channels. [[CO5](Analyse/IOCQ)]
- 3 + 5 + 4 = 12**
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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	28.1	52.1	19.8