COMMUNICATION TECHNIQUES
(AEIE 3101)

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) An AM signal is detected using an envelope detector. The carrier frequency and modulation signal frequency are 1 MHz and 2 KHz respectively. An appropriate value for the time constant of the envelope detector is
   (a) 600 μs (b) 100 μs (c) 0.5 μs (d) 0.1 μs.

   (ii) A 10 MHz carrier is frequency modulated by a sinusoidal signal of 500 Hz, the maximum frequency deviation being 50 KHz. The bandwidth required, as given by the Carson's rule is
   (a) 101 KHz (b) 10 MHz (c) 50 KHz (d) 500 Hz.

   (iii) In Differential Pulse Code Modulation technique, the decoding is performed by
   (a) Quantizer (b) Accumulator
   (c) Sampler (d) PLL.

   (iv) 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) 300 samples/sec (b) 600 samples/sec
   (c) 1800 samples/sec (d) 3600 samples/sec.

   (v) Bluetooth provides universal short-range wireless capabilities. It uses
   (a) 2.4 GHz (b) 2.9 GHz
   (c) 3.8 GHz (d) 1.5 MHz.

   (vi) In a double side-band (DSB) full carrier AM transmission system, if the modulation index is doubled, then the ratio of total sideband power to the carrier power increases by a factor of
   (a) 2 (b) 4 (c) 8 (d) 0.5.

   (vii) An FM signal with a modulation index 9 is applied to a frequency tripler. The modulation index in the output signal will be
   (a) 0 (b) 3 (c) 9 (d) 27.

   (viii) Flat top sampling of low pass signals
   (a) gives rise to aperture effect (b) implies oversampling
   (c) leads to aliasing (d) introduces delay distortion.

   (ix) 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) 0.25 (b) 0.5 (c) 2 (d) 4.

   (x) In a PCM system with uniform quantization, increasing the number of bits from 8 to 9 will reduce the quantization noise power by a factor of
   (a) 9 (b) 8 (c) 4 (d) 2.

Group – B

2. (a) Explain the principle of Amplitude Modulation. Compare between DSB and SSB modulation.

   (b) Determine the total modulating index if a carrier is simultaneously modulated by two sine waves with modulating indices of 0.3 and 0.4?

   (c) An AM transmitter produces 15 kW with 60% modulation. Estimate the amount of carrier power and the power saved, if SSB transmission takes place?

   (3 + 3) + (2 + 2) + (1 + 1) = 12

3. (a) Explain the scheme of envelope detector. Examine diagonal peak clipping and negative peak clipping?

   (b) The line parameters of a transmission line are: R = 15 Ω/kM, L = 2.5 mH/kM, C = 7500 μF/kM and G = 0.15×10^6 mhos/kM. Estimate the characteristic impedance and propagation constant.

   (4 + 1 + 1) + (3 + 3) = 12

Group – C

4. (a) An FSK transmitter, using a carrier frequency of 500 kHz, is sending 10 kbps and a frequency deviation of 100 kHz. Calculate the amount of transmission bandwidth needed for this purpose.

   (b) Develop the constellation diagram for BPSK, QPSK, 16 QAM and 64 QAM systems.

   (c) Assess the efficiency of the coding systems: (i) 4B3P, (ii) 11B4P, (iii) 2B1P, (iv) 26B5P.

   2 + 6 + 4 = 12

5. (a) Compare among DSSS, FHSS and THSS techniques. Examine the role of chip rate and processing gain in spread spectrum modulation techniques.

(b) Draw the block diagram of QPSK modulator and explain its operation.

(c) Explain the operation of a delta modulation encoder.

(3 + 2) + 4 + 3 = 12

Group – D

6. (a) What do you mean by quantization of signals? What is quantization error? How can the quantization error be reduced?

(b) Analyze the role of A-law companding and μ-law companding.

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

7. (a) Identify the use of source coding, line coding & channel coding in communication with suitable example of each coding.

(b) Discuss any coding technique for error detection and correction.

(5 + 3) + 4 = 12

Group – E

8. (a) List the multiple access techniques used in mobile communication systems? How near-far problem is addressed in these MA techniques?

(b) An earth station has a coordinate 42^0 North and 54^0 East. Measure the limit of visibility for an antenna elevation angle of 30^0.

(c) A satellite transmits 1000W. Determine the energy per bit E_b, if the transmission rate is 500Kbps.

(3 + 3) + 4 + 2 = 12

9. (a) Distinguish between Fixed Channel Assignment and Dynamic Channel Assignment. Analyze hand-off process in different generations of cellular communications. List the factors that influence the hand-off process.

(b) Compare among CDMA, TDMA and FDMA.

(4 + 3 + 2) + 3 = 12