WEST BENGAL UNIVERSITY OF TECHNOLOGY

EC-601

DIGITAL COMMUNICATIONS

Time Allotted: 3 Hours | Full Marks: 70

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable. All symbols are of usual significance.

GROUP A
(Multiple Choice Type Questions)

1. Answer any *ten* questions. 10×1 = 10

(i) The use of non-uniform quantization leads
(A) reduction in transmission bandwidth
(B) increase in maximum SNR
(C) increase in SNR for signal levels
(D) simplification of quantization process

(ii) A box contain 4 white and 3 black balls. Three balls are drawn from the box in succession. Find the probability that the first two balls are white and the third is black.
(A) $\frac{6}{35}$ (B) $\frac{4}{35}$ (C) $\frac{3}{35}$ (D) $\frac{7}{35}$

(iii) If the baud rate is 400 for a QPSK signal, the bit rate is
(A) 100 (B) 400 (C) 800 (D) 1600

(iv) Transversal equalizer uses tapped delay lines to
(A) reduce and SI (B) reduce BER
(C) increase bit rate (D) increase bandwidths

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(v) A ramp signal m(t) = αt is applied to a delta modulator with sampling period T_s and step size Δ. Slope overload distortion would occur if
(A) $\Delta < \alpha$ (B) $\Delta > \alpha$ (C) $\Delta < \alpha T_s$ (D) $\Delta > \alpha T_s$

(vi) In a PCM system, the number of quantization levels is 16 and the maximum signal frequency is 4 kHz, the bit transmission rate is
(A) 64 kbps (B) 32 kbps (C) 16 kbps (D) 8 kbps

(vii) For a BPSK system, the bit error probability is given by,
(A) $\frac{1}{2} erfc\left(\sqrt{\frac{E_b}{2N_0}}\right)$ (B) $\frac{1}{2} erfc\left(\frac{1}{2}\sqrt{\frac{E_b}{2N_0}}\right)$
(C) $\frac{1}{2} erfc\left(\sqrt{\frac{E_b}{N_0}}\right)$ (D) $\frac{1}{2} erfc\left(\frac{1}{2}\sqrt{\frac{E_b}{N_0}}\right)$

(viii) The power spectral density of white noise
(A) varies as square root of frequency
(B) varies as inverse of frequency
(C) varies as square of frequency
(D) is constant with frequency

(ix) Auto correlation function of a random process is defined as,
(A) $R(t_1, t_2) = E(XY) = \iint xy\, p(x, y)\, dxdy$
(B) $E(XY) = \iint x^2 y^2 dxdy$
(C) $R(t_1, t_2) = \iint x^2 y^2 dxdy$
(D) None of these

(x) The width of the power spectral density main lobe given the bandwidths of MSK signal and is given by _____ times the baseband frequency (f_b)
(A) 0.5 (B) 0.75 (C) 0.25 (D) 2.0

(xi) A scheme in which '1' is represented by a positive pulse for one half of symbol duration, a negative pulse for remaining half of the symbol and for '0' the order is reversed is known as
(A) NRZ unipolar (B) NRZ polar
(C) NRZ bipolar (D) Manchester code

(xii) In which modulation technique redundant bits should be reduced
(A) ADM (B) DPCM
(C) PCM (D) None of these

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GROUP B
(Short Answer Type Questions)

Answer any *three* questions. 3×5 = 15

2. Draw the line codes corresponding to the binary data 1101001 for the following: Unipolar NRZ, Polar RZ, Manchester coding. What are the properties of line coding? 3+2

3. Draw an eye diagram and mention the significance of its different parts. 5

4. Why is DPSK scheme of carrier modulation used? Compare the bandwidth and probability of error of QPSK, BPSK and BFSK. 2+3

5. State Sampling Theorem. A TV signal has a bandwidth of 4.5 MHz. The signal is sampled and converted into PCM signal. Determine the sampling rate if the signal is to be sampled at a rate of 20% above Nyquist rate. 2+3

6. What is companding? Why is companding needed? 5

GROUP C
(Long Answer Type Questions)

Answer any *three* questions. 3×15 = 45

7. (a) Draw the block diagram for generation and detection of the BFSK signal and explain its operation clearly. 6
   (b) Draw the signal space representation and find the distance between symbols. 3+2
   (c) What is the difference between MSK and QPSK? 4

8. (a) What do you mean by matched filter for digital reception? 5
   (b) Derive an expression for error probability of a matched filter. 3
   (c) State and explain Nyquist criterion for zero ISI. 3
   (d) What is the role of an equalizer? 4

9. (a) With neat block diagram explain the generation and reception of delta modulation. 6
   (b) What are the limitations of DM? How can these be solved? 3+2
   (c) For a sinusoidal signal ($A\cos\omega t$), find the condition for no slope overload if step size is Δ and sampling period is T_s. 4

10. (a) What are the salient features of spread spectrum? 2
    (b) With a neat block diagram, explain the principle of Direct Sequence Spread Spectrum (DSSS) transmitter and receiver. 8
    (c) Define processing gain. 2
    (d) A spread spectrum system has the following parameters: Message bit rate = 3 kbps, *pn* sequence chip rate = 3.027×10^6, then find the processing gain. 3

11. (a) What do you mean by information source and a discrete memoryless source? 2+2
    (b) With suitable expression, explain entropy of a communication system. 6
    (c) The probability of the five possible outcomes of an experiment are given as

$$P(x_1) = \frac{1}{2},\ P(x_2) = \frac{1}{4},\ P(x_3) = \frac{1}{8},\ P(x_4) = \frac{1}{16},\ P(x_5) = \frac{1}{16}$$

    Determine the entropy and information rate if there are 16 outcomes per second. 5

12. Write short notes on any *three* of the following: 3×5
    (a) Gaussian Minimum Shift Keying (GMSK)
    (b) Differential encoding
    (c) Linear prediction coder
    (d) Shannon's channel capacity
    (e) Regenerative repeater.