53 (EC 502) DGCM

2019

DIGITAL COMMUNICATION

Paper : EC 502

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. *(a)* State the impulse sampling for low-pass signals. Why is an LPF required before the sampler ? Hence show that the spectrum of the ideally sampled version of $x(t)$ is a periodic repetition of $X(f)$. What is 'aperture effect' in practical sampling ? 2+1+5+2=10

   (b) Derive the expression for maximum SNR_Q in case of sinusoidal signal. Waveform coding is to be done by delta modulator under no slope overload condition (granular noise is present). 10

Contd.

2. *(a)* State the operating principle of a predictor block in linear delta modulation. 5

(b) Discuss the operation of a DPCM circuit. 10

(c) A message signal bandlimited to $4kHz$ is to be transmitted using a PCM system. If the quantization error of any sample is to be at the most ±1% of the dynamic range of the message signal, determine the minimum value of 'n' for the sampling rate and the corresponding bit rate of transmission process. 5

3. *(a)* Prove that the error probability for digital baseband signalling is given by $P_e = Q[d/z]$ where 'Q' is the Q-function defined by $Q(k) = \frac{1}{\sqrt{2\pi}} \int_k^{\infty} exp.[-\lambda^2/2] d\lambda$ and 'd' is the distance metric between the transmitted symbols. 10

(b) Discuss the coherent detection of binary ASK (BASK) bandpass signal and hence calculate the minimum error probability for such scheme. 10

4. *(a)* Calculate the power spectra for a binary FSK (BFSK) signal and hence discuss the result. 7+3=10

(b) If $x(t)$ is a triangular pulse of 1 *ms* width and 10^{-2} *volts* height, calculate the SNR at the output of a matched filter. Assume the channel noise to be white and with a PSD of 10^{-8} *W/Hz*. Explain the role of a matched filter at the front end of a digital communication receiver. 8+2=10

5. *(a)* A source is producing sequences of independent symbols *A*, *B*, *C*, *D* and *E* with the following probabilities :

$A = 1/2; B = 1/6; C = 1/12; D = 1/6; E = 1/12$ 6+6=12

(i) Devise an unambiguous binary code for these symbols.

(ii) Compute the coding efficiency of your code.

(b) A DMS 'S' has an alphabet $\{S_0, S_1\}$ with corresponding probabilities $p(S_0) \equiv p_0 = 1/4$ and $p(S_1) \equiv p_1 = 3/4$. Find the entropies of the source 'S' and that for the extended source S^3. 8

6. Write short notes on ***any two*** from the following : 10+10=20

(a) Discrete Memoryless Channel (DMC)

(b) Line coding in digital communication

(c) Differential Phase Shift Keying (DPSK)

(d) Binary Erasure Channel (BEC) and its transition matrix.