53 (EC 502) DGCM

2013

(December)

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)* Draw the block diagram of a digital Communication system. Explain the functions of different blocks in brief. 10

   (b) Describe how quantization noise can be reduced effectively without increasing no of bits per sample in a PCM system. Explain advantages of non linear quantization over Linear quantization. 10

2. *(a)* Show that in a pulse coded modulation system $SNR = 1 \cdot 8 + 6n$ where n is the no. of bits per sample. 8

(b) Consider a sinusoidal signal given by $S(t) = 3\cos(100\pi t)$

(i) Find the signal to quantization noise ratio when the signal is quantized using $10bit$ PCM.

(ii) Also find the minimum no of bits needed to achieve a signal to noise ratio of at least $40dB$. 8

(c) Discuss different types of noises in a Delta modulation system. 4

3. *(a)* Why digital modulation techniques are required in digital communication system ? 4

(b) What is DPSK ? Draw the block diagrams of a DPSK transmitter and receiver and explain how it works. 10

(c) Describe non coherent detection FSK signal with block diagram. 6

4. (a) What is an optimum filter ? Show that in a noisy environment in a receiver the SNR is optimized when the filter has impulse response

$$h(t) = S(T - t)$$

where $S(t)$ is the input signal, T is the sampling period and $h(t)$ is impulse response of matched filter. 10

(b) Show that in a Binary communication system *bit* error probability is

$$P_b = Q\left(\sqrt{\frac{E_p + E_q - 2E_{pq}}{2N}}\right)$$

where E_p and E_q are energies of signal shapes taken for binary 0 and 1. E_{pq} is the cross correlation between p and q signal shapes. 10

5. (a) Define entropy. Show that a memoryless source shows maximum entropy when all the emitting symbols are equiprobable. 10

(b) A memoryless source emits messages m_1 and m_2 with probabilities 0·8 and 0·2, respectively. Find the optimum (Huffman) binary code for this source as well as for it's second and third order expansions (i.e. for $N = 2$ and 3). Determine the code efficiencies in each case. 10

6. (a) State Shanon's theorem for channel capacity and show that for a channel having infinite bandwidth, it's channel capacity is

$$C = 1{\cdot}44\frac{S}{N} bits/sec.$$ 10

(b) State Cyclic Linear block code theorem. Find a generator polynomial $g(x)$ for $a(7, 4)$ cyclic code, and find code vectors for the following data vector *(i)* 1010, *(ii)* 1111, *(iii)* 0001. 10

7. Write short notes : ***(any two)*** 10×2

(a) Companding

(b) DPCM

(c) MSK

(d) Linear Block Code

(e) Error probability in binary PCM system

(f) Convolutional coding.
