Roll No.

Printed Pages : 3

8507

BT-5 / D–15

INFORMATION THEORY AND CODING

Paper–ECE-305-E

Time allowed : 3 hours] *[Maximum marks : 100*

*Note : Attempt any **five** questions by selecting at least **one** from each of the following four units.*

Unit–I

1. (a) Let a coin is tossed four times. Let a randon variable is defined as H = h, where h is number of heads which appear. Determine and plot (i) CDF (ii) PDF.

Also determine mean and variance and the random variable. 4,4,3,3

(b) Explain, what do you understand by (i) Ergodicity (ii) Laws of large numbers. 3,3

2. (a) Joint pdf of two random variables X and Y is given by

$$f(x, y) = \begin{cases} k(1+xy) & 0 \le x \le 2 \\ & , \; 0 \le y \le 2 \end{cases}$$

Find (i) value of k

(ii) pdf of x

(iii) pdf of y

(iv) are the random variable x and y independent. 4,2,2,2

(b) What do you understand by Markov matrix. Show that if P is a Markov matrix then P^n is also a Markov matrix for any positive integer n. 10

Unit–II

3. State and prove :

   (a) Noiseless Coding theorem 12

   (b) Theorem of decodability. 8

4. (a) Find the capacity of the memory less channel specified by the matrix : 10

$$\begin{bmatrix} \frac{1}{2} & \frac{1}{4} & \frac{1}{4} & 0 \\ \frac{1}{4} & \frac{1}{4} & \frac{1}{4} & \frac{1}{4} \\ 0 & 0 & 1 & 0 \\ \frac{1}{2} & 0 & 0 & \frac{1}{2} \end{bmatrix}$$

   (b) What do you understand by the term mutual information I (XY). Prove the following relationships :

   (i) $I(XY) = H(X) + H(Y) - H(XY)$ 6

   (ii) $I(XY) = I(YX)$. 4

Unit–III

5. (a) Construct the standard array for the (5,2) systematic code with generators matrix

$$G = \begin{bmatrix} 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 1 \end{bmatrix}$$ 14

   (b) Form a decoding table also

   (c) Let the received word is [1 1 1 1 1], find the decoded word.

   (d) Explain the error detecting and correcting capability of linear block codes. 6

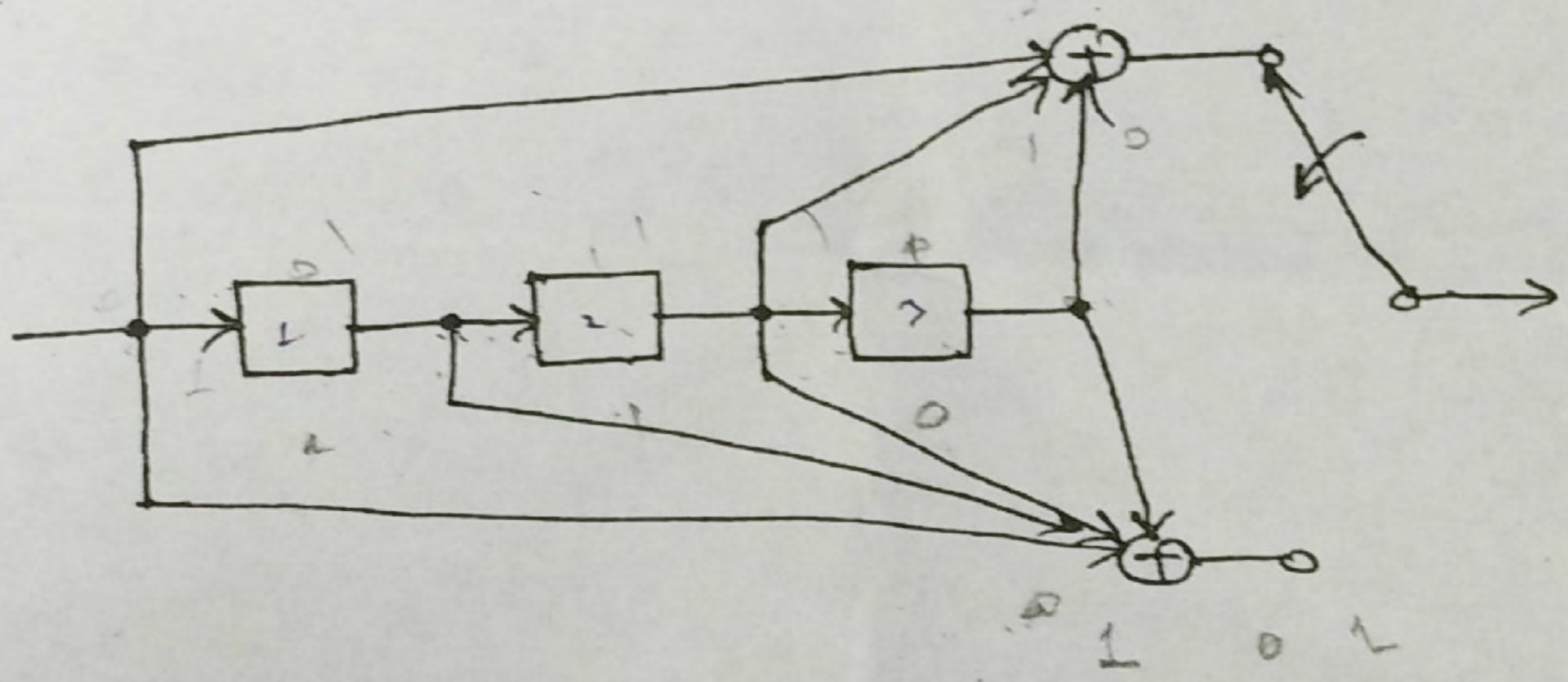
6. (a) Devise an encoder and decoder for the (15, 11) cyclic code generated by $\bar{g}(x) = 1 + x + x^4$. 12

(b) Show that the non zero code polynomial of minimum degree cyclic code is $\bar{g}(x) = 1 + g_1x + g_2x^2 + \ldots\ldots + g_{n-k-1} x^{n-k-1} + x^{n-k}$. 8

Unit–IV

7. Describe the functioning and applications of various ARQ and hybrid ARQ schemes. 20

8. For the binary convolutional encoder shown below



Determine :

(a) impulse response 3

(b) state diagram 3

(c) code tree 4

(d) trellis diagram 4

(e) free distance 6