G 656 **(Pages : 3)** **Reg. No.....................................**

Name.....................................

B.TECH. DEGREE EXAMINATION, MAY 2014

Seventh Semester

Branch : Electronics and Communication Engineering

INFORMATION THEORY AND CODING (L)

(Old Scheme—Prior to 2010 Admissions)

[Supplementary]

Time : Three Hours Maximum : 100 Marks

Answer **all** *questions.*

Each question in Part (a) carries 4 marks and in Part (b) carries 12 marks.

1. Define self information and mutual information. Give mathematical expressions and units in both case.
2. A source 'S' produces four alphabets A, B, C, D with corresponding probabilities $p_A = 0.5$, $p_B = 0.3$, $p_C = 0.15$ $p_D = 0.05$. Find entropy of the source and its second extension.
3. Sketch the transition matrix of binary erasure channel and derive the expression of channel capacity.
4. State and explain Shannon's source coding theorem.
5. What are instantaneous codes ? Give an example. Why they are called so ?
6. Explain zip coding algorithm with an example.
7. Discuss the error detection and correction capabilities of Hamming codes.
8. Give the general format of the generator polynomial of cyclic codes. Explain the method of making generator polynomial of (G, 4) cyclic codes.
9. What is interleaving ? Mention different types and uses of interviewers.
10. Derive the probability of error and throughput in the case of selective repeat ARQ stratergy.

(10 × 4 = 40 marks)

Part B

11. (a) Prove the following relations :—

(i) $H(X, Y) = H(X) + H(Y/X)$.

(ii) $I(X ; Y) = H(X) - H(X/Y)$.

(iii) $I(X ; Y) = I(Y ; X)$.

(12 marks)

Or

Turn over

(b) Determine H (X), H (Y), H (X, Y), H (X/Y) and H (Y/X) for the joint probability matrix given below and using the values verify the relations among the given entropies :

$$P(X, Y) = \begin{array}{c} \\ X \end{array} \begin{array}{c} Y \\ \begin{bmatrix} 0.2 & 0 & 0.2 & 0 \\ 0.1 & 0.01 & 0.01 & 0.01 \\ 0 & 0.02 & 0.02 & 0 \\ 0.04 & 0.04 & 0.01 & 0.06 \\ 0 & 0.06 & 0.02 & 0.20 \end{bmatrix} \end{array}$$

(12 marks)

12. (a) (i) Sketch a cascade of two binary symmetric channels and derive the relation of mutual information and compare it with a single stage binary symmetric channel.

(6 marks)

(ii) Derive the relationship for the capacity of a channel with infinite bandwidth.

(6 marks)

Or

(b) (i) State and prove Shannon-Hartley theorem.

(4 marks)

(ii) Sketch the transition matrixes of a binary symmetric and unsymmetric channels. Derive the relation of Channel capacity C in both cases.

(8 marks)

13. (a) Consider a source with 8 alphabets, A to H, with respective probabilities 0.22, 0.20, 0.18, 0.15, 0.10, 0.08, 0.05 and 0.02. Construct a binary Huffman code and determine the code efficiency.

(12 marks)

Or

(b) A source S has 6 symbols with probabilities p_1 to p_6 such that $p_1 = 1/3$, $p_2 = 1/6$, $p_3 = \frac{1}{6}$, $p_4 = 1/6$, $p_5 = 1/12$. Find p_6 and then using Shannon-Fano coding method construct a binary code and determine the efficiency and redundancy of the code.

(12 marks)

14. (a) The generator matrix of a (6, 3) systematic linear block code is given as :

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

(i) Find all code vectors.

(ii) Sketch the encoder diagram.

(iii) Find the parity check matrix.

(iv) Find the error syndrome for single bit error patterns.

(12 marks)

Or

(b) Construct a systematic (7, 4) cyclic code using the generator polynomial $g(x) = x^3 + x + 1$. What is the error correcting capabilities of this code ? Construct the decoding table and determine the transmitted code word for the received code word 1101100.

(12 marks)

15. (a) Construct a (2, 1, 4) convolution encoder. Given $g^{(1)} = (1111)$ and $g^{(2)} = (1001)$ are the generator polynomials. Sketch its code tree and code trellis.

(12 marks)

Or

(b) Describe the following decoding methods used to decode a convolution code.

(i) ML decoding.

(ii) Sequential decoding.

(12 marks)

[5 × 12 = 60 marks]