G 717 (Pages : 3) Reg. No.....................

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

B.TECH. DEGREE EXAMINATION, MAY 2014

Seventh Semester

Branch : Electronics and Communication Engineering

EC 010 702—INFORMATION THEORY AND CODING (EC)

(2010 Admissions)

[Improvement/Supplementary]

Time : Three Hours Maximum : 100 Marks

Part A

Answer **all** *questions.*
Each question carries 3 marks.

1. Define entropy. List its properties.
2. What are optimal codes ? Explain.
3. Sketch the channel transition diagram of a binary symmetric channel.
4. Make mod-2 multiplication and mod-5 addition table.
5. Explain the basic principle of LDPC codes.

($5 \times 3 = 15$ marks)

Part B

Answer **all** *questions.*
Each question carries 5 marks.

6. Define channel capacity. Express the channel capacity of a BSC channel and make a plot of it.
7. Explain the importance of Kraft's inequality in forming instantaneous codes.
8. State and explain Shannon-Hartely theorem.
9. Define vector space and subspace and list the conditions for a selected set of vectors to be a subspace.
10. Give the characteristics of Hamming codes. Explain with an example.

($5 \times 5 = 25$ marks)

Part C

Answer **all** *questions.*
Each question carries 12 marks.

11. (a) Define mutual information. List three properties and derive it.

Or

Turn over

(b) Determine different entropies of the joint probability matrix given below and verify various entropy relationships.

X \ Y				
	0.2	0	0.2	0
	0.1	0.01	0.01	0.01
	0	0.02	0.02	0
P(X, Y)	0.04	0.04	0.01	0.06
	0	0.06	0.02	0.2

12. (a) The probability of occurrence of seven symbols is given by $\frac{1}{15}, \frac{1}{15}, \frac{2}{15}, \frac{2}{15}, \frac{3}{15}, \frac{3}{15}$ and $\frac{3}{15}$ respectively. Encode this sequence using

    (i) Shannon-Fano algorithm.

    (ii) Huffman algorithm.

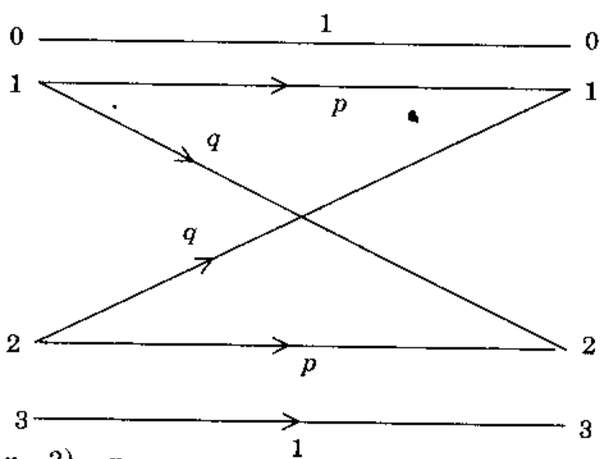
Or

(b) (i) Explain the steps involved in arithmetic coding.

(ii) In a text it was observed that the probability of occurrence of symbols $\{a, b, c\}$ are $\{0.4, 0.5, 0.1\}$. Use arithmetic coding to encode the string 'bbbc'.

13. (a) (i) Derive the channel capacity of a binary noiseless symmetric channel.

(ii) Calculate the capacity of the discrete channel shown in figure below. Assume $r = 1$ symbol/second.



$p(x=0) = p(x=3) = p.$

$p(x=1) = p(x=2) = Q.$

(b) (i) A Gaussian channel has a bandwidth of 4 kHz and a two-sided noise power spectral density $\eta/2$ of 10^{-14} watt/Hz. The signal power at the receiver has to be maintained at a level less than or equal to $\frac{1}{10}^{th}$ of a milliwatt. Calculate the capacity of this channel.

(ii) A black and white TV picture can be viewed as consisting of approximately 3×10^5 elements, each one of which may occupy one of ten distinct brightness levels with equal probability. Assume rate of transmission as 30 picture frames per second and S/N ratio is 30 dB. Calculate the minimum bandwidth required to support this video signal, using channel capacity theorem.

14. (a) The parity part of a G-matrix for a (7, 4) linear block code is given below :

$$[P] = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 0 & 1 \end{bmatrix}$$

(i) Write G and H matrices.

(ii) Draw the encoder logic diagram.

(iii) Sketch the syndrome circuit and explain the decoding of the received vector of the input message 1011, if it is received with 5^{th} bit in error.

Or

(b) (i) Construct an extension field GF (2^4) of binary Galois field GF(2), using a primitive polynomial $p(X) = 1 + X + X^4$. Represent it in polynomial and 4-tuple formats.

(ii) If 'β' is a root of the polynomial $f(x)$ over GF(2), show that, the conjugates of 'β' are also roots of the same polynomial.

15. (a) For a (7, 4) cyclic encoder, given that the generator polynomial $g(X) = 1 + X + X^3$:

(i) Illustrate the systematic code generation for the input polynomial $u(X) = 1 + X^2 + X^3$.

(ii) Sketch the decoder logic diagram.

(iii) Describe the decoding of the received codeword corresponding to the transmitted codeword in part (i), is received with 4^{th} bit in error.

Or

(b) Sketch an encoder diagram of rate $\frac{1}{3}$, constraint length 3, systematic convolution encoder with $g^{(1)} = 101$, $g^{(2)} = 110$ and $g^{(3)} = 111$.

(i) Make a truth table, with present and next states.

(ii) Sketch the tree diagram and state diagram of this encoder.

(iii) Find the output of this encoder, for the input sequence 1010.

(5 × 12 = 60 marks)