Seat No._____

GANPAT UNIVERSITY

B. TECH. SEMESTER VII (EC) ELECTRONICS & COMMUNICATION ENGINEERING

REGULAR EXAMINATION, NOV / DEC-2016

2EC 701: - INFORMATION THEORY AND CODING

Time: 3 Hours **Total Marks: 70**

Instruction:

1. Attempt all questions.
2. Answers to the two sections must be written in separate answer books.
3. Figures to the right indicate full marks.
4. Assume suitable data, if necessary.

SECTION-I

1 (A) Define the Hamming Distance and Hamming Weight of a code-word with example. 4

(B) Consider a (7,4) code whose generator matrix is 8

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

a) Find all the code vectors of the code.
b) Find **H**, the parity check matrix of the code.
c) Detect valid codeword by syndrome decoding method for $r(x) = 1\,1\,0\,1\,1\,0\,1$
d) Find d_{min} , t_d and t_c.

OR

1 (A) Prove that a linear code the minimum distance is equal to the minimum weight of the code, i.e., d* = w*. 3

(B) Consider a simple (5,2) code with the generator matrix 5

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

a) find the parity check matrix H.
b) Construct the standard array for this code.
c) The decoder receives **r** = (01010,) is valid code-word?

(C) Discuss the decoding of a linear block code. 4

2 (A) Write a short note on Hamming codes-perfect codes for single errors. 5

(B) Consider a systematic block code whose parity check equations are 6

$p_1 = m_1 + m_2 + m_4$; $p_2 = m_1 + m_3 + m_4$; $p_3 = m_1 + m_2 + m_3$; $p_4 = m_2 + m_3 + m_4$

Where, m_i are message digits and p_i are check digits.

a) Find the generator matrix and the parity- check matrix for this code.
b) How many errors can the code correct?
c) Is the vector 10101010 a valid codeword?
d) Is the vector 11000101 a valid codeword?

OR

2 (A) Design a feedback shift register encoder for an (8,5) cyclic code with a generator $g(x) = 1 + x + x^2 + x^4$. Use encoder to find the codeword for the message 10101 in a systematic form. 8

(B) Prove that the A sphere of radius r $(0 \leq r \leq n)$ contains exactly $\binom{n}{0} + \binom{n}{1}(q-1) + \binom{n}{2}(q-1)^2 + \cdots + \binom{n}{r}(q-1)^r$ Vectors. 3

3 (A) Find a generator polynomial g(x) for a (7,4) cyclic code and find code vectors for the following data vectors: 0010,1110,1001,1011. 8

(B) Write notes on standard array and error detection and correction of the linear block codes. 4

SECTION-II

4 (A) State and explain various properties of information. 4

(B) State various types of sources and explain any one of them. 4

(C) State and explain source coding theorem. 4

OR

4 (A) Prove that maximum channel capacity C_∞=1.44 S/N_0. 6

(B) Design binary Huffman code for a discrete source of five independent symbols A, B, C, D, E with probabilities 0.4, 0.2, 0.8, 0.08 and 0.02 respectively. Find average code word length. 6

5 (A) What is entropy? Derive the expression for entropy? 6

(B) Develop Shannon – Fano code for five messages given by probabilities 1/2, 1/4, 1/8, 1/16, 1/16. Calculate the average number of bits/message. 5

OR

5 (A) Prove (i) Entropy of extremely likely and extremely unlikely message is zero. (ii) Entropy is maximum when the messages are equally likely. 6

(B) Define: (1) BSC (2) Prefix code (3) Information rate. 3

(C) Calculate the amount of information in terms of bits, nats and decit if probability of occurrence P_k=1/4. 2

6 (A) A rate ½ convolution encoder with constraint length 3 is described by $g_1(x) = 1+x+x^2$ and $g_2(x) = 1+x^2$. Draw the trellis diagram for this encoder and encode the message 10111. 6

(B) Write short note on Trellis coded modulation. 4

(C) Develop the primitive element for GF(5). 2

END OF PAPER