Student Exam No._____

GANPAT UNIVERSITY

M. Tech. Semester II Electronics & Communication Engineering

Regular Examination, June/July 2014

3EC 201: Error Control Codes

Max. Time: 3 Hrs.] **[Max. Marks: 70**

Instructions:

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.
5. Question numbers three and six are compulsory.

SECTION-I

1 (A) Find the primitive element of finite number field F_5. (6)

(B) State and explain the following bounds. (6)

i. Hamming bound.
ii. Gilbert-Varshamov bound.

OR

1 (A) Generate the addition and multiplication table for the finite number field F_7. (6)

(B) Find the upper and lower bound of the dimension of a linear binary code C(9, k, 5). (3)

(C) Find the greatest common divisor for the following polynomials over F_7. (3)
$g(x) = x^4$ and $r(x) = 4x^3 + 3x^2 + 5x$.

2 (A) Let C be the binary code with generator matrix G. (6)

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

i. List all the elements of C.
ii. Calculate the minimum Hamming distance.
iii. How many errors can the code correct?

(B) Find the primitive root of polynomial for the polynomial $x^{13} - 1$ in GF_3 on base of the factor $x^3 + 2x + 2$. (5)

OR

2 (A) Let C be a code in GF_5 with generator matrix G. (6)

$$G = \begin{bmatrix} 0 & 1 & 3 & 3 & 0 \\ 2 & 1 & 0 & 2 & 1 \\ 1 & 1 & 0 & 1 & 0 \end{bmatrix}$$

i. Find the generator matrix in standard form.
ii. Find the generator matrix for the dual of C.

(B) What is the difference between systematic and non systematic code? State the procedure for finding systematic cyclic code. (5)

3 (A) Find the generator polynomial for the BCH code having minimum hamming distance of 8 in $GF_{16}[x]/(x^4 + x + 1)$. (8)

(B) Define the expurgated and extended codes of linear code. (4)

SECTION II

4 (A) Let α = x be the primitive element of F_{32} with minimal polynomial $m_{\alpha}(x) = x^5 + x^2 + 1$ Calculate the minimal polynomial of α^3. (6)

(B) Construct the trellis diagram for the convolutional encoder having generator matrix $G(x) = [1 + x^2 \quad 1 + x + x^2]$. For the received sequence r = [11, 10, 00, 10, 11, 01, 00, 01, ..], decode the transmitted code word using viterbee decoding algorithm. (6)

OR

4 (A) Construct the systematic generator matrix for Hamming code from the (7,4) cyclic code with the polynomial $g(x) = 1 + x + x^3$. Also find the parity check matrix from the generator matrix. (6)

(B) What is a catastrophic encoder in convolutional codes? Explain using suitable example. (6)

5 (A) Write short note on decoding of BCH code using Peterson algorithm. (5)

(B) Using the factors of $x^7 - 1$ find 8 (eight) different generator polynomials and state the (n, k) class of codes that each generator polynomial represents. (6)

OR

5 (A) Briefly explain the Space Time Codes. (5)

(B) Write short note on decoding of Turbo coded data. (6)

6 (A) Generator matrix for rate 2/3 convolutional encoder is defined as $G = \begin{bmatrix} 1+x & 1+x^2 & x \\ x+x^2 & 1+x & 0 \end{bmatrix}$. Find the systematic form of generator matrix. Also draw the block diagram of non systematic and systematic convolutional encoder. (6)

(B) What is interleaving? Explain some common types of interleaving used in wireless communication. (6)

END OF PAPER