Exam No. _____

GANPAT UNIVERSITY

M. Tech. Semester II (EC) Examination, April-June 2015

3EC201: Error Control Codes

Max. Time: 3 Hrs.] **[Max. Marks: 60**

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) Draw the addition and multiplication tables for finite fields $\mathbb{F}_3$, $\mathbb{F}_4$ and $\mathbb{F}_5$. 6

(B) For any q ary code with code word length n, prove the following: 4

i. Size of the codebook $A_q(n,1) = q^n$

ii. Size of the codebook $A_q(n,n) = q$

OR

1 (A) Find any one primitive root of finite field F_{27}/x^3+2x+1 over the basic field of $\mathbb{F}_3$. 4

(B) Let C be the ternary linear code with generator matrix G over $\mathbb{F}_3$. (a) List the elements of C, (b) find the minimum distance d(C), (c) How many errors can be detected? $G = \begin{bmatrix} 0 & 1 & 1 & 2 \\ 2 & 1 & 0 & 1 \end{bmatrix}$ 6

2 (A) Consider the linear (7, M, d) binary code C generated using generator polynomial $g(x) = x^3 + x^2 + 1$, find the following: 6

i. Find the systematic parity check matrix H for C.

ii. Determine the maximum codeword M and minimum Hamming distance d, justify your answer.

iii. Is C a perfect code? Justify your answer.

(B) i. List the conjugacy classes in GF(2^5) with respect to GF(2). 4

ii. What is MDS? State the condition of hamming distance for MDS code.

OR

2 (A) Construct the systematic cyclic codes for generator polynomial $g(x) = x^3 + x + 1$ over the finite field $\mathbb{F}_2$. 6

(B) What are the differences between block code and convolutional code. 4

3 (A) Construct a 3 error correcting BCH code over the finite field $F_{2^4}: F(x)/x^4 + x + 1$. 8

(B) How to find the duals of Hamming code? 2

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SECTION II

4	(A)	Draw the block and state diagram of convolutional encoder having generators as $g_1 = [1011], g_2 = [1101], g_3 = [1010]$. What is the constraint length and rate of this encoder? Draw the state diagram of this encoder.	6
	(B)	Briefly explain the distance property of convolutional codes.	4
		OR	
4	(A)	For the convolutional code having generator matrix $G = [101, 111]_2$ construct the trellis diagram. If the received sequence is [11 11 00 10 01 11 11], decode using Viterbi decoding and extract the data transmitted.	8
	(B)	For the message $m(x) = \left[0 \quad \frac{1}{1+x}\right]$ state the encoder which generates catastrophic condition.	2
5	(A)	Explain the decoding of convolutional codes using BCJR algorithm.	5
	(B)	Write short note on Alamouti Codes.	5
		OR	
5	(A)	Write short note on generation of Turbo codes.	5
	(B)	Briefly explain the Stack and Fano algorithm of decoding convolutional codes.	5
6	(A)	Write short note on iterative decoding.	6
	(B)	What is interleaving? Explain some common types of interleaving used in wireless communication.	4

END OF PAPER