

GANPAT UNIVERSITY
M. TECH SEM- II (EC) REGULAR EXAMINATION APRIL-JUNE 2016
3EC 201: Error Control Codes

MAX. TIME: 3 HRS

MAX. MARKS: 60

- Instructions:** (1) This Question paper has two sections. Attempt each section in separate answer book.
 (2) Figures on right indicate marks.
 (3) Be precise and to the point in answering the descriptive questions.
 (4) Assume data if necessary, standard terms and notations are used.

SECTION: I

- Q.1** Prove the following: (5)
 (A) i. For a Hamming code with generator matrix G and parity check matrix H , prove that $GH^T = 0$.

- ii. For any two code words x and y , Hamming distance $d(x, y) \geq 0$ for all x and y .
 (B) Find the addition and multiplication tables for \mathbb{F}_5 and \mathbb{F}_7 . (5)
 OR

- Q.1**
 (A) Find any two primitive elements of finite field \mathbb{F}_{11} . (5)

- (B) Check whether $(7, 16, 3)$ and $(6, 8, 3)$ are perfect codes or not. (5)

- Q.2** For the generator matrix G of the ternary code find the following: (5)
 (A) i. Parity check matrix

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

- ii. All possible code words.
 (B) Find the irreducible polynomials of degree 3 in finite field \mathbb{F}_3 . (5)
 OR

- Q.2** Find the GCD (Greatest Common Divisor) of the polynomials x^4 and $4x^3 + 3x^2 + 5x$ in finite field \mathbb{F}_7 . (4)

- (A) How to generate extended, dual and punctured codes from linear block codes? (6)

- Q.3** Consider a generator polynomial $g(x) = x^3 + 2x + 2$, find any fifteen nonsystematic cyclic codes of length 6 in finite field \mathbb{F}_{27} . (5)

- (A) List the conjugacy class for finite field $\mathbb{F}_{27}/x^3 + 2x + 2$ over the basic field of \mathbb{F}_3 . (5)

SECTION: II

- Q.4**
 (A) Construct the 2 error correcting BCH code in finite field $\mathbb{F}_{16}: x^4 + x + 1$. (6)

- (B) Write the procedure to convert cyclic polynomial to generator matrix of Hamming code. (4)

OR

- Q.4**
 (A) Briefly explain iterative decoding. (5)
 (B) Describe the procedure of Berlekamp-Massey for decoding the BCH code. (5)

- Q.5 Consider a rate half convolution code defined by generators $g^{(1)} = [1 \ 0 \ 1]$ and $g^{(2)} = [0 \ 1 \ 1]$. (10)
 Draw the convolutional encoder for this code and find the code word for message sequence $m = [11, 00, 10, 101]$. Also find the systematic convolutional code for the same and draw the block diagram.

OR

- Q.5 Consider a rate 1/3 convolution code defined by generators $g^{(1)} = [1 \ 0 \ 0 \ 1]$, $g^{(2)} = [0 \ 1 \ 1 \ 0]$ and $g^{(3)} = [1 \ 0 \ 0 \ 0]$. Find the code for message $m = [10, 01, 11, 110]$ and draw the systematic convolutional encoder for the same. (7)
- (A) Briefly explain interleaving and its types. (3)
- Q.6 Calculate the monic irreducible polynomial of finite field F_{27}/x^3+2x+2 for the conjugacy class (5)
- (A) of primitive root starting from α^5 .
- (B) How diversity gain is achieved in Space Time Block code? Explain using equation. (5)

-----END OF PAPER-----