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MMTE-005

M.Sc. (MATHEMATICS WITH APPLICATIONS IN COMPUTER SCIENCE) M.Sc. (MACS)

Term-End Examination

MMTE-005 : CODING THEORY

Time : 2 Hours] *[Maximum : Marks : 50*

(Weightage : 50%)

Note: Answer any four questions from questions 1 to 5 Questions 6 is compulsory. All questions carry equal marks. Use of calculator is not allowed.

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1. (a) Give an example, with justification of each of the following: 6
   (i) Linear code
   (ii) Hamming distance
   (iii) Cyclic code

   (b) Define a linear perfect code. Show that the (7, 4, 3) binary Hamming code is perfect. 4

2. (a) Construct the generating idempotents of all duadic codes of length 23 over F_2. 6

(b) Let C be the binary code with genetator matrix

$$G = \begin{bmatrix} 110000 \\ 001100 \\ 000011 \end{bmatrix}$$. Find the weight distribution

of C. 4

3. (a) Let C be the narrow-sense binary BCH code of designed distance $\delta = 5$, which has a difining set $T = \{1, 2, 3, 4, 6, 8, 9, 12\}$. Let α be a primitive 15th root of unity, where $\alpha^4 = 1 + \alpha$, and let the generator polynomial of C be $g(x) = 1 + x^4 + x^6 + x^7 + x^8$. If y (x) $y(x) = x + x^4 + x^7 + x^8 + x^{11} + x^{13}$ is received, find the transmitted code word. You can use the following table: 6

0 0 0 0	0	1 0 0 0	α^3	1 0 1 1	α^7	1 1 1 0	α^{11}
0 0 0 1	1	0 0 1 1	α^4	0 1 0 1	α^8	1 1 1 1	α^{12}
0 0 1 0	α	0 1 1 0	α^5	1 0 1 0	α^9	1 1 0 1	α^{13}
0 1 0 0	α^2	1 1 0 0	α^6	0 1 1 1	α^{10}	1 0 0 1	α^{14}

(b) For a prime q, define a q-cuclotonic coset C_s of s module $\left(q^t - 1\right)$. Compute all the 2-cyclotonic cosets module 7. 4

4. (a) For positive integers $r, m; r < m;$ explain the construction of the need-muller code R (r, m). Write the generator matrix G (1, 3) of R (1, 2).

(b) Find the convotutional code (2, 1) with generator matrix $G = [1, 1+D]$, for the message m=1+D+D^2. 4

5. (a) List all the code words of the code C over Z_4 generated by $\begin{bmatrix} 1 & 2 & 3 & 0 & 1 \\ 2 & 2 & 0 & 1 & 1 \end{bmatrix}$. Also find the lee weight distribution of this code.

(b) Draw the Tanner graph of the code C, with pairity check matrix

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

6. Which of the following statements are True and which are False? Give reasons for your answers. Marks will only be given for valid reasons: 10

(i) The number of polynomials over a finite field is finite.

(ii) There is a quadratic residue code of length 7 over F_3.

(iii) The length of a self and code cannot be odd.

(iv) The code {0, 1} is a perfect code over F_2.

(v) Every convolutional code is a cylic code.

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