

26023816



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Reg. No.....

Name.....

M.Sc. DEGREE (C.S.S.) EXAMINATION, MAY 2026

Fourth Semester

Faculty of Science

Branch I (A)—Mathematics

MT04E14—CODING THEORY

(2016—2018 Admissions—Mercy Chance)

Time : Three Hours

Maximum Weight : 30

Part A

*Answer **all** question.*

Each question carries 1 weight.

1. List all code words in C_1 and give three information sets for C_1 .
2. What is a perfect code ? Give an example.
3. Define a self dual code. Give an example.
4. Find the greatest common divisor of $x + 1$ and $x^4 + 1$.
5. Show that $x^4 + x^3 + x^2 + x + 1$ is irreducible over $GF(2)$ but not primitive.
6. Show that the order of a subgroup H of a group G , divides the order of G .
7. Which length 7 binary cyclic code contain the vector $(0, 1, 0, 0, 1, 1, 1)$.
8. Define a BCH code.

$(5 \times 1 = 5)$

Part B

*Answer any **five** question.*

Each question carries 2 weight.

9. Give generator and parity check matrices for the binary code consisting of all even weight vectors of length 8.

Turn over





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10. Calculate the probability of correctly decoding a message in C_3 using syndrome decoding if $q = 0.9$ and $p = 0.1$.
11. Show that the ternary $[12, 6]$ Golay code has minimum weight 6.
12. Perform the computation $(1000)^{1/2}$ in GF (16).
13. Show that every finite field has a primitive element.
14. Find a primitive polynomial of degree 2 over GF (5).
15. Find all binary cyclic codes in R_5 .
16. Define the Vandermonde determined and find its value.

(5 × 2 = 10)

Part C

*Answer any **three** question.*

Each question carries 5 weight.

17. (a) Prove that if d is the minimum weight of a code C , then C can correct $t = \left\lfloor (d - 1)/2 \right\rfloor$ or fewer errors, and conversely.
- (b) Give the parity check equation for the $[6, 3]$ binary code C_3 with generator matrix

$$G = \begin{pmatrix} 1 & 0 & 0 & 0 & 1 & 1 \\ 0 & 1 & 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 \end{pmatrix}.$$

- (c) Find the weight distribution of C_2 .
18. (a) Prove that every vector in a fixed coset has the same syndrome. Also show that vectors in different cosets have q^{n-k} syndromes occur as syndromes of some vectors.
- (b) Construct a standard array for the ternary Hamming $[4, 2, 3]$ code. Here $q = 3$ and $r = 2$.





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19. (a) Using the double error - correcting BCH code decode the following received vector
- $$x = (1, 1, 0, 1, 1, 1, 1, 0, 1, 0, 1, 1, 0, 0, 1).$$
- (b) Define the Golay code and show that the ternary $[12, 6]$ Golay code has minimum weight 6.
20. (a) Prove that every finite field has p^m elements for some prime p .
- (b) Factor $x^{16} - x$ into irreducible factors over $\text{GF}(2)$.
21. (a) Prove that every cyclic $[n, k]$ code C has an idempotent generator $e(x)$. Also show that the matrix M formed by $e(x)$ and its next $k - 1$ cyclic shifts is a generator matrix for C .
- (b) Let C_1 and C_2 be cyclic codes with generator polynomials $g_1(x)$ and $g_2(x)$ and idempotent generators $e_1(x)$ and $e_2(x)$ prove that $C_1 \cap C_2$ has as generator polynomial $\text{l.c.m.}(g_1(x), g_2(x))$ and as idempotent generator $e_1(x) \cdot e_2(x)$.
22. (a) Give a generator polynomial of a triple-error-correcting BCH code of length 15.
- (b) What is the dimension of this code.
- (c) Give a generator matrix for this code.

$(3 \times 5 = 15)$

