D 132042 **(Pages : 3)** **Name....................................**

Reg. No................................

THIRD SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION, NOVEMBER 2025

(CBCSS)

Mathematics

MTH3E01—CODING THEORY

(2019 Admission onwards)

Time : Three Hours Maximum : 30 Weightage

Section A

Answer **all** *questions.*

Each question carries 1 *weightage.*

1. If the reliability of the channel is 0.85, then what is the probability of getting an accurate codeword of length 5 through this communication channel ?

2. Suppose $p = 0.90$, $|M| = 3$, $n = 4$, and C = {0000, 1010, 0111} Find $\theta_p, (C, 1010)$.

3. Find the dual of the code S = {0100, 0101}.

4. Find an upper bound for the size of the linear code with $n = 6$ and distance $d = 3$.

5. Find a generator matrix for Hamming code of length 7.

6. How many errors a Hamming code of length n and distance $d - 2t + 1$ can correct ?

7. Check whether the polynomial $1 + 2x + x^3 \in F_3[x]$ is irreducible over $\mathbb{Z}_3$.

8. Find the GCD of the pair of polynomials

$$f(x) = 1 + x + x^4 + x^5 + x^8 + x^9 \text{ and } g(x) = 1 + x^2 + x^3 + x^7.$$

(8 × 1 = 8 weightage)

Turn over

Section B

Answer any **two** *questions from each of the following three units.*

Each question carries 2 *weightage.*

Unit I

9. Consider a binary linear code C = {000, 110, 011, 101}. Write the extended code.

10. Find a generator matrix for the code {00000, 11100, 00111, 11011}.

11. Check whether the set S = {110, 011, 101, 111} is a linearly independent set of words in K^3.

Unit II

12. Show that any perfect code of length and distance $2t + 1$ has exactly two codewords.

13. Does there exist a (15, 7, 5) linear code ? Justify.

14. Show that for an (n, k, d) linear code C, every $n - k$ rows for the parity check matrix are linearly independent if and only if $d = n - k - 1$.

Unit III

15. Construct GF (2^3) using the polynomial $h(x) = x^3 + x + 1$.

16. Find the minimal polynomials of each of the elements in GF (2^4).

17. Discuss IMLD algorithm for 2-error correcting BCH code.

(6 × 2 = 12 weightage)

Section C

Answer any **two** *questions.*

Each question carries 5 *weightage.*

18. Find the cosets of the linear code C with the generator matrix $G = \begin{bmatrix} 100110 \\ 010011 \\ 001111 \end{bmatrix}$.

19. Explain the extended Golay code.

20. Prove that every cyclic code contains a unique idempotent polynomial which generates the code.

21. Let C be a linear code of length n and k with generator $g(x)$ and $1 + x^n = g(x)\,h(x)$. Prove that $C^{\perp}$ is a cyclic code of dimension $n - k$ with generator $x^k h(x^{-1})$.

(2 × 5 = 10 weightage)