15420

BRAINWARE UNIVERSITY

Term End Examination 2024-2025
Programme – M.Sc.(MATH)-2023
Course Name – Coding Theory
Course Code - MSCME401D
(Semester IV)

Full Marks : 60 **Time : 2:30 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A
(Multiple Choice Type Question) 1 x 15=15

1. *Choose the correct alternative from the following :*

(i) Choose the correct option: If α be a root of $1+x+x^4 \in F_2[x]$, then α is a primitive element of

a) F_2
b) F_4
c) F_8
d) F_{16}

(ii) Choose the right option: For a fixed positive integer m, all the integers divisible by m form an

a) Ideal of Z
b) Ideal of Z_2
c) Ideal of Z_m
d) None of these

(iii) If V be a vector space over F_q with $dim\ (V) = k$ then conclude that V has

a) q elements
b) q^k elements
c) k elements
d) none of these

(iv) Choose the right option: In the ring Z of integers

a) all integers form an ideal
b) all the even integers form an ideal
c) all the odd integers form an ideal
d) No integers form an ideal

(v) Select the correct option: A parity check matrix for G24 is

a) 12x12 matrix
b) 12x24 matrix
c) 24x24 matrix
d) 24x1 matrix

(vi) An (n, M) code C over F_q is of size: Identify the correct option

a) n b) M
c) $n+1$ d) $M+1$

(vii) Choose the right process of representing the elements u of F_q^k as codewords $v = uG$ in C

a) Encoding b) Decoding
c) Encrypting d) Decrypting

(viii) Identify in which type of coding we divide message into k bits blocks

a) Block; Blockwords b) Linear; Datawords
c) Block; Datawords d) None of these

(ix) Recognize the codes over F_3

a) Binary codes b) Ternary codes
c) Quaternary Codes d) None of these

(x) Select the right option: A simple parity check code can detect

a) two errors b) An even number of errors
c) An odd number of errors d) No errors

(xi) Select the correct option: $A_q(n, d)$ is called

a) Gilbert–Varshamov bound b) Singleton bound
c) Sphere-covering bound d) Plotkins bound

(xii) Indicate p in a finite subfield F_p

a) Smallest positive integer b) prime number
c) Characteristic of field F d) All of these

(xiii) For an n-dimensional vector space V over a finite field $GF(q)$, select the right answer

a) $|V| = q^{n+1}$ b) $|V| = q^n$
c) $|V| = q^{n-1}$ d) $|V| = q$

(xiv) Choose the correct option: Syndrome decoding is

a) Decoding algorithm of linear codes b) Encoding algorithm of linear codes
c) Encryption algorithm of linear codes d) Decryption algorithm of linear codes

(xv) Select the correct option for optimal code $A_q(n, n)$=

a) q^k b) q
c) q^n d) 1

Group-B

(Short Answer Type Questions) 3 x 5=15

2. If C be a linear code of length n over F_q, then evaluate $(C^{\perp})^{\perp} = C$ (3)

3. Explain decoding procedure of syndrome decoding. (3)

4. Illustrate extended code of a code C and parity-check coordinate. (3)

5. State the Minimum distance decoding rule. (3)

6. Justify Sphere-covering bound. (3)

OR

Justify the definition of perfect code. (3)

Group-C

(Long Answer Type Questions) 5 x 6=30

7. If V be a vector space over F_q and $dim(V)=k$ then evaluate that V has $\frac{1}{k!}\prod_{i=0}^{k-1}(q^k - q^i)$ different bases. (5)

8. If C is a q-ary Reed Solomon code generated by $g(x) = \prod_{i=1}^{\delta-1}(x - \alpha^i)$ with $2 \leq \delta \leq q - 1$ then justify the extended code $\underline{C}$ is a MDS code. (5)

9. Explain Decoding with a binary Hamming code. (5)

10. Justify linear codes with example. (5)

11. Establish that Z_m is a field if and only if m is a prime. (5)

12. Using Sphere-covering bound construct that $A_2(5,4) = 2$ (5)

OR

Construct a generator matrix and parity check matrix for binary linear code C= <{11101, 10110, 01011, 11010}> (5)

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