BRAINWARE UNIVERSITY

Term End Examination 2023-2024
Programme – M.Sc.(MATH)-2022
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) If C be a linear code of length n over F_q, then indicate the correct option

a) $|C| = q^{2dim\,(C)}$ b) $|C| = q^{dim\,(C)}$

c) $|C| = q * dim\,(C)$ d) $|C| = q^2 * dim\,(C)$

(ii) Choose the correct answer: Locator Polynomial is used in

a) Encoding of BCH Codes b) Decoding of BCH Codes
c) Encoding of Hadamard Codes d) Decoding of Hadamard Codes

(iii) Select the dimension of a binary BCH code of length 63 with designed distance $\delta = 5$

a) 50 b) 51
c) 40 d) 41

(iv) There is an $[n, k, d]$ linear code over F_q, then write the name of $[n, k\text{-}r, d]$ linear code over F_q for any $1 \leq r \leq k-1$

a) lengthening b) subcodes
c) puncturing d) none of these

(v) Choose the correct option: A q-ary Reed Solomon code has length

a) q b) $q-1$

c) q^m d) $q^m - 1$

(vi) Establish a generator polynomial of the cyclic code {000, 110, 011, 101}

a) x
b) x-1
c) 1-x
d) 1+x

(vii) Select the right option: The first non-zero entry of a parity check matrix for Ham(r, q) is

a) 1
b) 2
c) 3
d) 4

(viii) For a (7,4) cyclic code, the generator polynomial $g(x)=1+x+x^3$, Select the data word of the codeword 0110100.

a) 010
b) 0001
c) 0110
d) 1011

(ix) Identify the correct option: Hamming Code is

a) Linear Block Codes
b) Non Linear Block codes
c) No binary code
d) None of these

(x) Choose the correct option: A linear code C over F_q of length n is

a) A subgroup of F_q^n
b) A subring of F_q^n
c) A super group of F_q^n
d) An integral domain of F_q^n

(xi) For a linear code C for u,v are in same coset of C and syndrome S, conclude which one is true?

a) S(u)>S(v)
b) S(u)=S(v)
c) S(u)<S(v)
d) none of these

(xii) Select the right option: The third step of decoding procedure of syndrome decoding should be

a) Find coset leader next to the syndrome
b) For a received word compute syndrome
c) Decode the received word
d) None of these

(xiii) Indicate p in a finite subfield F_p

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

(xiv) Name the error detection method consists of just one redundant bit per data unit

a) Simple Parity Check
b) Two dimensional Parity Check
c) CRC
d) Checksum

(xv) Identify the correct option: The dual of a code is defined by

a) inner product of two vectors is zero
b) inner product of two vectors is non-zero
c) inner product of two vectors is infinite
d) None of these

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. Illustrate the properties of $[n, k, d]$ linear code over Fq. (3)

4. Explain the advantages of linear codes. (3)

5. State self-dual and self-orthogonal of a linear code. (3)

6. Justify Sphere-covering bound. (3)

OR

Justify that a code C is u-error detecting if and only if $d(C) \geq u + 1$. (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. Evaluate singleton bound theorem. (5)

9. Show that every finite field has at least one primitive element. (5)

10. Conclude extended binary Golay code and explain its properties. (5)

11. Illustrate that characteristic of a field is either 0 or a prime number. (5)

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

OR

Construct a short note on Sphere-packing bound. (5)

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