

**Fourth Semester FYUGP Degree (Reg) Examination April
2026**

KU4VACCMT201 - CODING THEORY

2024 Admission onwards

Time : 1.5 hours

Maximum Marks : 50

Section A

Answer any 6 questions. Each carry 2 marks.

1. Define a generator matrix for a linear code C .
2. What is the standard form of generator and parity-check matrices?
3. Does there exist any ternary $[7, 2]$ cyclic codes? Justify.
4. Define a cyclic linear code.
5. Find dimension of $C = \{000, 001, 002, 010, 020, 011, 012, 021, 022\}$ over F_3 .
6. Define Hamming weight of a word x in F_q^n .
7. Define a q -ary symmetric channel.
8. When do we say that an element in a finite field F_q is a primitive element?

Section B

Answer any 4 questions. Each carry 6 marks.

9. Show that $C = \{0000, 1100, 2200, 0001, 0002, 1101, 1102, 2201, 2202\}$ is a linear code over F_3 .
10. Show that if C is a linear code then
 - a) C is self-orthogonal if $C \subset C^\perp$.
 - b) C is self-dual if $C = C^\perp$.
11. Let $q = 3$. Find a basis for $C^\perp$ where $C = \langle S \rangle$, where $S = \{1020020102, 0001010001, 0000100200, 0000001001, 0000000012\}$.
12. Suppose the codewords from the code $\{000, 111\}$ are being sent over a BSC with crossover probability $p = 0.05$. Suppose that the word 110 is received. What is the more likely codeword to be sent and why?
13. Show that if a, b are any 2 elements of a field F , then $a \cdot b = 0$ implies $a = 0$ or $b = 0$.
14. Show that $\mathbb{Z}_m$ is a field if and only if m is a prime.

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Section C

Answer any 1 questions. Each carry 14 marks.

15. a) Let C be an $[n, k]$ linear code over F_q with generator matrix G . Then show that $v \in F_q^n$ if and only if v is orthogonal to every row of G .
 b) Show that H is the parity check matrix for C if and only if the rows of H are linearly independent and $HG^T = 0$.
16. Let π be the linear map from $F_q^n \rightarrow F_q[x]/\langle x^n - 1 \rangle$ defined by $\pi(a_0, a_1, \dots, a_{n-1}) = a_0 + a_1x + \dots + a_{n-1}x^{n-1}$. Then show that a non-empty subset C of F_q^n is a cyclic code if and only if $\pi(C)$ is an ideal in $F_q[x]/\langle x^n - 1 \rangle$.