

Indian Statistical Institute

M. TECH. (CrS) First Year : 2024-2025
Semester Examination

Subject: Information and Coding Theory

Date: 09/05/2025

Time: 3 hours

Marks:100

Note: Notations used are as explained in the class.

1. Prove that for a binary symmetric channel with crossover probability $p < 1/2$, the maximum likelihood decoding rule is the same as the nearest neighbour decoding rule. [10]
2. Suppose the parity check matrix of a $[n, k]$ linear code is $[A|I_{n-k}]$. Show that its generator matrix can be written as $[I_k| -A^T]$. [10]
3. State and prove the Gilbert-Varshamov bound. [10]
4. Show that Hamming distance obeys the triangle inequality. Also show that $R_n = F[x]/(x^n - 1)$ is not a field. [10]
5. Describe a systematic encoding of cyclic codes. Give a non-systematic encoder of RS codes. [10]
6. Construct a single-error correcting linear code with $n = 10$. Exhibit two codewords. [10]
7. Describe the majority logic decoding of RS codes. [10]
8. Describe briefly the different stages of decoding BCH codes. [10]
9. Prove that C is MDS if and only if every $n - k$ columns of H are linearly independent. Also prove that the dual of an MDS code is an MDS code. [10]
10. Prove that, the dual of a BCH code may not be a BCH code. Also prove that dual of an RS code is an RS code. [10]