

R18

Code No: 155BG

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, January - 2025

ERROR CORRECTING CODES
(Electronics and Communication Engineering)

Time: 3 Hours

Max. Marks: 75

- Note:** i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

- 1.a) Why is the logarithmic function used to define a measure of information? [2]
- b) A source emits 3 messages with probabilities $p_1=0.7$, $p_2=0.2$, $p_3=0.1$. Calculate source, entropy, maximum entropy, source efficiency and redundancy. [3]
- c) What are the advantages of majority logic decodable codes compared to other decoding methods? [2]
- d) Discuss the algebraic properties of cyclic codes. [3]
- e) Discuss the advantages of convolutional codes compared to other error correction techniques. [2]
- f) What are some applications of convolutional codes in practical systems? [3]
- g) What is the role of the interleaver in turbo codes? [2]
- h) What are the trade-offs between complexity and performance in product codes? [3]
- i) How does Alamouti's 2×1 scheme operate? [2]
- j) How do linear dispersion codes relate to both space-time coding and spatial multiplexing? [3]

PART – B

(50 Marks)

- 2.a) What is the significance of minimum distance in linear block codes? How does it relate to error correction capability?
- b) Design a single-error-correcting code with a message block size=11 and show by an example that the code can correct single errors. [5+5]

OR

3. A parity check matrix a particular (7, 4) linear block code is given by

$$[H] = \begin{bmatrix} 1 & 1 & 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$$

- a) Find the generator Matrix G
- b) List all Code vectors
- c) What is the minimum distance between code vectors?
- d) How many errors can be detected? [10]

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4. The generator polynomial of a (7, 4) cyclic code is $G(p) = p^3 + p + 1$. Find all the code vectors for the code in non-symmetric form. [10]

OR

5. Explain the concept of syndrome decoding in cyclic codes. How does it work, and what are its advantages? [10]

6. A rate 1/3 convolution encoder has generating vectors as $g_1 = (100)$, $g_2 = (110)$ and $g_3 = (101)$.

a) Sketch the encoder configuration.

b) Draw the code tree, state diagram and Trellis diagram.

c) If input message sequence is 0011, determine the output sequence of the encoder. [3+3+4]

OR

7. Explain the Viterbi algorithm and sequential decoding of convolution codes. [10]

8.a) How do LDPC codes perform on the Binary Erasure Channel (BEC) compared to other channel models?

b) How is the erasure recovery process performed using iterative decoding algorithms? [5+5]

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OR

9.a) Describe the iterative decoding process for product codes and its advantages over non-iterative methods.

b) How do modern coding techniques like turbo and LDPC codes approach the Shannon limit? [5+5]

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10.a) How do different digital modulation schemes (e.g., QPSK, QAM) affect the design and performance of space-time codes?

b) What are linear dispersion codes, and how do they provide a unified framework for MIMO communication? [5+5]

OR

11.a) Explain the concept of linear multi-layer detection. How does it simplify MIMO decoding?

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b) How is QL decomposition used in MIMO detection? What advantages does it offer? [5+5]

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