Reg No.:_______________ Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S7 (R,S) Examination November 2025 (2019 Scheme).

Course Code: ECT453

Course Name: ERROR CONTROL CODES

Max. Marks: 100 **Duration: 3 Hours**

PART A

Answer all questions, each carries 3 marks. Marks

1 **Let the generator matrix of a LBC is given as** $\begin{bmatrix} 1 & 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 \end{bmatrix}$ **. Find the Dual code for any 2 bit message.** (3)

2 **A linear code C has parameters (n,k,d) = (6,3,d)** (3)

a. What is the possible value of d.

b. If d is maximum, what kind of code is C?

c. How many errors can be corrected and detected?

3 **State the properties of cyclic codes.** (3)

4 **Construct generator matrix for (7,4) cyclic code g(x) =1+x+x^3 .** (3)

5 **Determine the parameters of q-ary RS Code over GF(256) for a dmin=33.** (3)

6 **What are applications of Reed Muller codes.** (3)

7 **Draw the encoder circuit for a rate 1/3 convolutional encoder with generator sequences, g (1) = (1 0 0), g(2) = (1 0 1), g(3) = (1 1 1).** (3)

8 **What is the purpose of puncturing in turbo codes, and how does it affect the code rate.** (3)

9 **Construct the generator matrix of G_4 used in polar codes** (3)

10 **Differentiate regular and irregular LDPC.** (3)

PART B

Answer any one full question from each module, each carries 14 marks.

Module I

11 a) **Write a short note about hamming bound.** (5)

b) **Consider a (6,3) LBC** (9)

$$\mathbf{G} = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 \end{bmatrix}$$

I. Find all codewords

II. Find minimum hamming weight.

III. Draw the encoder circuit.

OR

12 a) For a (5,1) repetition code (9)

I. Write the parity check matrix

II. Evaluate the syndrome for all possible single error patterns.

b) Define (i) Singleton bound (ii) Gilbert-Varshamov bound (5)

Module II

13 a) Design an encoder for (7,4) binary cyclic code generated by g(x)= $1+x+x^3$.Find the code vector corresponding to the message vector 1001. (9)

b) Check whether $1+x+x^3$ is primitive , irreducible. (5)

OR

14 a) Design a BCH Code with block length n=7 and the error correcting capability t=1.Find the code word corresponding to the message d=[1 0 1 1] (7)

b) Construct the values of GF(2^4) for the polynomial $1+x+x^4$ (7)

Module III

15 a) For a RM (1,4), Find the minimum distance code length, Dimension and generate the code word corresponding to any 2 message blocks of this RM code. (9)

b) Discuss the decoding of Reed-Solomon code using Berlekamp's algorithm (5)

OR

16 a) Explain the method of encoding and decoding performed in RS code. (9)

b) Obtain the generator vectors of RM (1,3) code (5)

Module IV

17 For a (2,1,2) convolutional encoder with generator sequences g(1) = (1 1 1), g(2) = (1 0 1). (14)

i. Draw the binary encoder.

ii. State table.

iii. State transition table.

iv. State diagram.

v. Find the encoded sequence for the message 1 0 1 1 1.

OR

18 a) **Explain turbo codes with and without puncturing.** (5)

b) **For a (2,1,4) convolutional encoder with generator sequences g(1) = (0 1 1 1 1), g(2) = (0 1 1 0 1), draw the encoder ,compute the generator polynomial and find the output sequence produced by the information 1 0 1 1 1 using matrix method.** (9)

Module V

19 a) **Explain the relationship between Tanner graph and the parity-check matrix with an example. Define cycle for the Tanner graph of LDPC.** (7)

b) **Given the parity check matrix of an LDPC, decode the received data r=[0 ? ? 1 0 ? 0]. Assume that the channel is BEC.** (7)

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

OR

20 a) **What are frozen bits? Explain the encoding method with suitable example.** (7)

b) **Mention the applications of polar codes in 5G.** (7)

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