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**Code No. : 17454 (C) N**

# VASAVI COLLEGE OF ENGINEERING *(AUTONOMOUS)*, HYDERABAD

*Accredited by NAAC with A++ Grade*

## B.E. (E.C.E.) VII-Semester Main Examinations, Dec.-23/Jan.-24

## Coding Theory and Techniques (PE-III)

Time: **3 hours** Max. Marks: **60**

*Note: Answer all questions from **Part-A** and any **FIVE** from **Part-B***

***Part-A (10× 2 = 20 Marks)***

| Q. No. | Stem of the question | M | L | CO | PO |
|---|---|---|---|---|---|
| 1. | Determine whether $X^3+X^2+1$ is an irreducible polynomial or not. | 2 | 1 | 1 | 1 |
| 2. | Find the entropy of the source transmitting 4 symbols with probabilities 0.4, 0.2, 0.2, 0.2 ? | 2 | 1 | 1 | 1 |
| 3. | Explain briefly error detection and correction capabilities of linear block codes | 2 | 1 | 2 | 1 |
| 4. | What is coding efficiency and code rate? | 2 | 2 | 2 | 2 |
| 5. | Differentiate between hard and soft decision decoding. | 2 | 1 | 3 | 1 |
| 6. | What is a code tree? | 2 | 2 | 3 | 2 |
| 7. | What are the properties of LDPC Codes. | 2 | 1 | 4 | 1 |
| 8. | Differentiate between regular and Irregular LDPC codes | 2 | 1 | 4 | 1 |
| 9. | Construct GF(8) and form addition table. | 2 | 2 | 5 | 3 |
| 10. | Consider (255,247) RS Code. For a block of 255, how many errors can this code correct? | 2 | 1 | 5 | 1 |
| | ***Part-B (5×8 = 40 Marks)*** | | | | |
| 11. a) | Explain Lempel Ziv encoding algorithm. | 5 | 3 | 1 | 3 |
| b) | Encode the symbols s1-s4 with probabilities 0.45, 0.3, 0.2, 0.05 using Arithmetic coding technique. | 3 | 2 | 1 | 2 |
| 12. a) | Consider a (7,4) linear code whose generator matrix<br>G = [1 0 0 0 1 0 1<br>0 1 0 0 1 1 0<br>0 0 1 0 1 1 1<br>0 0 1 0 1 1]<br>i) Find all the code vectors of this code.<br>ii) Find minimum weight and minimum distance of the code. | 4 | 3 | 2 | 3 |
| b) | What are interleaved Codes? | 4 | 2 | 2 | 2 |

*Contd... 2*

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| 13. a) | A 1/3 rate Convolutional code has the following generators $g_1$ = [111], $g_2$ = [101], $g_3$ = [100]. Draw the trellis diagram for this code. If this code is used for transmission over AWGN channel with hard decision decoding and if the output of the detector is (101001011110111……) using the Viterbi algorithm, find the transmission sequence. | 6 | 3 | 3 | 2 |
| b) | What are the structural properties of convolutional codes? | 2 | 1 | 3 | 1 |
| 14. a) | Derive generator matrix G for LDPC codes from H matrix. | 5 | 3 | 4 | 1 |
| b) | Discuss the iterative decoding algorithm for binary LDPC codes. | 3 | 2 | 4 | 2 |
| 15. a) | The polynomial $P(x) = 1+X+X^4$ is a primitive polynomial over Galois Field, GF(2). Show 4-tuple representation for the elements of $GF(2^4)$. | 4 | 4 | 5 | 3 |
| b) | Find the generator polynomials and the minimum distance for (15,11) RS code. | 4 | 3 | 5 | 3 |
| 16. a) | Briefly explain Run-length encoding and it's applications. | 4 | 4 | 1 | 2 |
| b) | Write a short note on Product codes. | 4 | 2 | 2 | 1 |
| 17. | Answer any ***two*** of the following: | | | | |
| a) | Draw the encoder structure of a rate 1/2 Convolutional coder with $g_1$ = (101) and $g_2$ = (011). Find the codeword for an input 011. | 4 | 2 | 3 | 1 |
| b) | Let the transmission code be double error correcting RS code of length 7. Obtain syndrome polynomials for the following received vector $r = (0\ 0\ \alpha^5\ 1\ \alpha^2\ 0\ \alpha^2)$ | 4 | 2 | 4 | 1 |
| c) | Determine the generator polynomial of all the primitive BCH codes of length 7. Use the Galois field GF $(2^3)$ generated by $p(x) = 1 + x^2 + x^3$. | 4 | 3 | 5 | 2 |

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

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| i) | Blooms Taxonomy Level – 1 | 20% |
| ii) | Blooms Taxonomy Level – 2 | 35% |
| iii) | Blooms Taxonomy Level – 3 & 4 | 45% |

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