

Reg No.: _____

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: EC401

Course Name: INFORMATION THEORY & CODING

Max. Marks: 100

Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks.

Marks

- 1 a) A source emits one of four symbols S_0, S_1, S_2 and S_3 with probabilities $1/3, 1/6, 1/4, 1/4$ respectively. The successive symbols emitted by the source are statistically independent. Calculate the entropy of the source. (3)
- b) If X and Y are discrete random sources and $P(X,Y)$ is their joint probability distribution and is given as (12)
- | | | | | |
|-----------|------|------|------|------|
| $P(X,Y)=$ | 0.08 | 0.05 | 0.02 | 0.05 |
| | 0.15 | 0.07 | 0.01 | 0.12 |
| | 0.10 | 0.06 | 0.05 | 0.04 |
| | 0.01 | 0.12 | 0.01 | 0.06 |
- Calculate $H(X), H(Y), H(X/Y), H(Y/X), H(X, Y)$ and $I(X,Y)$.
Verify the formula $H(X, Y) = H(X)+H(Y/X)$.
- 2 a) State Shannon's channel coding theorem. Give its positive and negative statements. (5)
- b) An information source produces sequences of independent symbols A,B,C,D,E,F,G with corresponding probabilities $1/3,1/27,1/3,1/9,1/9,1/27,1/27$. Construct a binary code and determine its efficiency and redundancy using (10)
- i) Shannon –Fano coding procedure
 - ii) Huffman coding procedure.
- 3 a) What is meant by a symmetric channel? How do we find the capacity? (5)
- b) Discuss binary symmetric and binary erasure channel? Draw the channel diagrams and derive the expressions for their channel capacities. (10)

PART B

Answer any two full questions, each carries 15 marks.

- 4 a) The parity matrix of a (6,3) linear systematic block code is given below. (7)
- $$P = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \\ 0 & 1 & 1 \end{bmatrix}$$
- Construct standard array.
- b) State and derive Shannon-Hartley theorem. Explain the implications. (8)
- 5 a) Derive the expression for channel capacity when bandwidth becomes infinite. (7)

- b) A voice grade channel of the telephone network has a bandwidth of 3.4 KHz. (8)
- (a) Calculate channel capacity of the telephone channel for signal to noise ratio of 30 dB.
- (b) Calculate the minimum SNR required to support information transmission through the telephone channel at the rate of 4800 bits/sec.
- 6 a) Define ring and field. Discuss properties. (5)
- b) The parity matrix for a (7,4) linear block code is given below: (10)

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

- i) Find generator and parity check matrices
- ii) Draw the encoder circuit.
- iii) Sketch the syndrome calculation circuit
- iv) Illustrate the decoding of the received vector corresponding to the message vector 1001, if it is received with 5th bit in error.

PART C

Answer any two full questions, each carries 20 marks.

- 7 a) Draw a (2, 1,3) convolutional encoder with [1, 0, 1, 1] and [1, 1, 1, 1] as the impulse responses. Find the output of the convolutional encoder for input sequence 11011 using transform domain approach (8)
- b) Given $G(D) = [1, 1 + D + D^3]$, design a (2, 1, 3) convolutional encoder of rate = $\frac{1}{2}$. (7)
- c) Discuss properties of Hamming codes. (5)
- 8 a) Construct a convolution encoder, given rate $\frac{1}{3}$, constraint length $L = 3$. Given $g^{(1)} = (1\ 0\ 0)$, $g^{(2)} = (1\ 0\ 1)$, $g^{(3)} = (1\ 1\ 1)$. Sketch state diagram and trellis diagram of this encoder. (15)
- b) Discuss syndrome decoding of cyclic code. Draw syndrome decoder circuit for a (15, 9) cyclic code with generator polynomial $g(X) = 1 + X^3 + X^4 + X^5 + X^6$ (5)
- 9 a) Draw a (2,1,2) convolutional encoder with the feedback polynomials as $g_1(X) = 1 + X + X^2$ and $g_2(X) = 1 + X^2$. Draw the code tree and trace output for input sequence 10011. (8)
- b) Discuss generation of Hamming codes. (7)
- c) What is minimum free distance of a convolutional code? (5)
