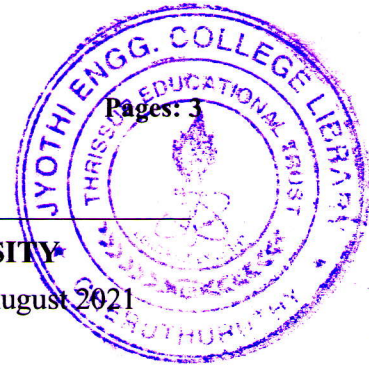


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Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
Seventh Semester B.Tech Degree Supplementary Examination August 2021

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) Explain Source Coding theorem and Kraft's inequality. (5)
- b) A DMS X having five symbols $x_1, x_2, x_3, x_4,$ and x_5 with respective probabilities 0.4, 0.19, 0.16, 0.15, 0.1. Construct Shannon-Fano code and calculate the efficiency and redundancy. (5)
- c) Find the capacity of a binary erasure channel. (5)
- 2 a) Given the messages S_1, S_2, S_3, S_4, S_5 and S_6 with respective probabilities 0.3, 0.2, 0.15, 0.1, 0.15 and 0.1. Construct a binary code by applying Huffman coding procedure. Determine the efficiency, redundancy and variance of the code. (8)
- b) Write the channel matrix and draw channel diagrams of a binary symmetric channel (BSC) and binary erasure channel (BEC). Find capacities. (7)
- 3 a) Discuss the conditions that are to be satisfied for a code to be instantaneous. Cite examples. (5)
- b) If X and Y are discrete random sources and $P(X, Y)$ is their joint probability distribution and is given as (10)

$P(X, Y) =$	0.08	0.05	0.02	0.05
	0.15	0.13	0.01	0.09
	0.10	0.05	0.02	0.05
	0.01	0.12	0.01	0.06

Calculate $H(X)$, $H(Y)$, $H(X/Y)$, $H(Y/X)$ and $H(X, Y)$. Verify the formula $H(X, Y) = H(X) + H(Y/X)$.

PART B

Answer any two full questions, each carries 15 marks.

- 4 a) Discuss the error detecting and correcting capability of block codes. (3)
- b) An analog signal has a bandwidth of 4 kHz. The signal is sampled at 2.5 times the (12)

Nyquist rate and each sample quantized into 256 equally likely levels. Assume that successive samples are statistically independent.

- (i) Find the information rate of the source.
- (ii) Can the output of this source be transmitted without errors over a Gaussian channel of bandwidth 50 kHz and S/N ratio of 20 dB.
- (iii) If the output of this source is to be transmitted without errors over an analog channel of S/N ratio 10dB, compute the bandwidth requirement of the channel.

- 5 a) Explain the trade-off between signal to noise ratio and bandwidth for a continuous Gaussian channel. (5)
- b) For a systematic (7,4) linear block code, the parity matrix P is given by (10)

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

- (i) Find the code vectors corresponding to the message vectors [0010], [1100], [1010].
- (ii) Draw the encoder circuit.
- (iii) A single error has occurred in each of the following received vectors. Detect and correct those received vectors.

(a) $R_A = [0111110]$

(b) $R_B = [1011100]$

- 6 a) Given a (7,4) linear block code whose generator matrix is given by (7)

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

- (a) Find the parity check matrix
 - (b) Find all possible code words
 - (c) Find d_{\min}
- b) State Shannon-Hartley Theorem. Discuss its implications. Explain Shannon's Limit. (8)

PART C

Answer any two full questions, each carries 20 marks.

- 7 a) Explain the encoding procedure for a (n, k) systematic cyclic code using shift registers with relevant diagrams. (7)
- b) For a systematic (7,4) cyclic code with generator polynomial $g(X) = X^3 + X^2 + 1$. (8)

Determine the correct codeword transmitted for the following received vectors using syndrome decoding technique (i) 1101101 (ii) 0101000 (iii) 0001100

- c) Give the properties of syndrome for cyclic code (5)
- 8 a) Draw a (3,2,1) convolutional encoder with impulse responses given as $g_1^{(1)}=[1,1]$, $g_1^{(2)}=[1,0]$, $g_1^{(3)}=[1,0]$, $g_2^{(1)}=[0,1]$, $g_2^{(2)}=[1,1]$, $g_2^{(3)}=[0,0]$. Find output for input sequence [1 0 1 0 0 1]. Find the equivalent generator matrix. (15)
- b) Discuss perfect codes. (5)
- 9 a) Generate a (7,4) systematic cyclic code for message words {1000, 1100, 1101, 1111}. Assume a suitable generator polynomial. (8)
- b) A convolutional code is described by $g^1 = [100]$, $g^2=[101]$, $g^3=[111]$. (12)
- (a) Draw the encoder for the corresponding to this code
- (b) Draw state diagram
- (c) Decode the transmitted sequence 101001011110111
