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BIEL-023

B.Tech. – VIEP – ELECTRONICS AND COMMUNICATION ENGINEERING (BTECVI)

00664 **Term-End Examination**

June, 2018

BIEL-023 : INFORMATION THEORY AND CODING

Time : 3 hours | *Maximum Marks : 70*

Note : *Attempt any* ***seven*** *questions. All questions carry equal marks. Use of scientific calculator is permitted. Any missing data may be suitably assumed.*

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1. (a) Define Entropy and Information Rate.

   (b) A source produces six messages with probabilities $\frac{1}{4}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{8}$, $\frac{1}{8}$ and $\frac{1}{16}$. Obtain the information content of each message and the entropy. *4+6*

2. Determine the Huffman code and the coding efficiency for the following messages with their probabilities given : *10*

m_1	m_2	m_3	m_4	m_5	m_6	m_7
0·05	0·15	0·2	0·05	0·15	0·3	0·1

3. (a) Define the Shannon's theorem of channel capacity with its well-known expression. *2*

(b) An analog signal having 4kHz bandwidth is sampled at 1·25 times the nyquist rate, and each sample is quantized into one of 256 equally likely levels. Assume that the successive samples are statistically independent.

(i) What is the information rate of this source ?

(ii) Can the output of this source be transmitted without error over an AWGN channel with a bandwidth of 10 kHz and S/N ratio is 20 dB ?

(iii) Find S/N ratio required for error free transmission of part (ii). *2+3+3*

4. Six digits are transmitted with the probability given as :

A	B	C	D	E	F
$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{32}$	$\frac{1}{32}$

Find Shannon Fano's coding procedure and the coding efficiency. Assume r = 1 symbol/second. *10*

5. For the (7, 4) Hamming code with the parity check matrix given by

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

(a) Construct the Generator matrix.

(b) Find the code word that begins with 1010.

(c) Suppose that the received code word is 0111100. Then decode this received word. *10*

6. Consider a generator matrix G of a code given by

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

Determine parity matrix of the code and show that these two matrices satisfy the condition $HG^T = 0$. *10*

7. (a) A channel has the following channel matrix :

$$\left[p\left(\frac{y}{x}\right)\right] = \begin{bmatrix} 1-p & p & 0 \\ 0 & p & 1-p \end{bmatrix}$$

(i) Draw the channel diagram.

(ii) If the source has equally likely outputs, compute the probabilities associated with the channel for 'p' 0·2. *5*

(b) Find the receiver matrix given the following probabilities P(0/1) = 0·1, P(1/0) = 0·2, $P_x(0) = 0·4$, $P_x(1) = 0·6$ and also find the probability of error. *5*

8. Explain bandwidth-efficient modulation schemes. *10*

9. A (6, 3) systematic linear block code encodes the information sequence X = (x_1, x_2, x_3) into code word C = $(c_1, c_2, c_3, c_4, c_5, c_6)$ such that c_4 is a parity check on c_2 and c_3 and c_6 is a parity check on c_1 and c_3.

(a) Determine the generator matrix of this code.

(b) Find the parity check matrix, and determine the minimum distance of this code.

(c) How many errors of this code are capable of correcting ? *3+4+3*

10. Consider a telegraph source having two symbols, dot and dash. The dot duration is 0·2 second. The duration is 3 times the dot duration. The probability of dots occurring is twice that of dash and the time between symbols is 0·2 second. Calculate information rate of the telegraph source. *10*