BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION MO/SP2022)

CLASS: BTECH **SEMESTER : VII**
BRANCH: CS & IT **SESSION : MO/2022**

SUBJECT: CS429 INFORMATION AND CODING THEORY

TIME: 03 HOURS **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates**

Q.1(a) Compare between self-information and entropy . [BL-2:– Understand, CO-1] [2]

Q.1(b) Discuss the properties of entropy function. [BL- 1: Remember, CO-1] [3]

Q.1(c) A zero memory source has a source alphabet, S={s_1, s_2, s_3} with P= {0.5, 0.3, 0.2}. Find the entropy of the source. Explain the significance of unit of the entropy. [BL-3: Apply, CO-1] [5]

Q.2(a) Explain the necessary and sufficient conditions for a code to be instantaneous. Give examples. [BL -2: Understand, CO-2] [2]

Q.2(b) What is the joint entropy H(X, Y), and what would it be if the random variables X and Y were independent? [BL-2: Understand, CO-1] [3]

Q.2(c) Consider a source with 8 alphabets, A to H with respective probabilities: 0.2, 0.2, 0.18, 0.15, 0.12, 0.08, 0.05 and 0.02. Construct a minimum redundancy code and determine the code efficiency. [BL-2: Apply, CO-3] **[5]**

Q.3(a) Discuss are the properties to be satisfied by a linear block code. [BL-2:Understand, CO-3] [2]

Q.3(b) Outline the features of Hamming code. Check whether (4, 7) over F(2) is Hamming code or not. [BL-4:Analyze, CO-1] [3]

Q.3(c) The parity matrix of a (3, 6) binary linear block code is given below. [5]

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

(i) Find all uncoded messages. (ii) Find generator and parity check matrix. (iii) Find all the coded messages. (iii) Draw the encoder circuit for the given code. [BL-3: Apply, CO-2]

Q.4(a) Can you claim that every linear block code is a cyclic code too? Justify your answer. [BL-5: Evaluate, CO-2] [2]

Q.4(b) Let C=(2,2) be a cyclic code over F(2). Try to detect and correct single-bit error for this code structure. Comment about the possibility. [BL-6: Create, CO-2] [3]

Q.4(c) Consider the (4, 7) cyclic code generated by g(x) = 1 + x + x^3. Suppose the message u = 1111 is to be encoded. Compute the code word in systematic form. [BL- 3: Apply, CO-3] [5]

Q.5(a) Differentiate between memory less and memory-based error control techniques. [BL- 4: Analyze, CO-2] [2]

Q.5(b) Discuss how you can apply the concept of convolutional code in satellite communication. [BL-6: Create, CO-5] [3]

Q.5(c) Draw a (1, 2, 2) encoder, if the generator polynomials are $g_1(x)$ =1 and $g_2(x)$=1+x+x^2 respectively. Also find the code vector for the input u = 1101 using transform domain approach. Draw the state transition diagram for the given encoder. [BL- 3: Apply, CO-3] [5]

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