VIT

Vellore Institute of Technology

Continuous Assessment Test – I

Programme Name & Branch: B.Tech ECE

Course Code & Name: **ECE4007-Information theory and Coding**

Class Number: **VL2019205005057**

Slot: **B2+TB2**

Faculty: **Prof K.S.Preetha**

Date: **20-01-2020**

Exam Duration: 90 minutes

Maximum Marks: 50

Instruction: Answer ***all*** questions

1. A discrete memoryless source emits messages x_1, x_2, x_3 and x_4 with equal probabilities. The source is connected to the receiver is shown Figure 1. Calculate H(X), H(Y), H(X/Y), H(Y/X) and I(X,Y). 10

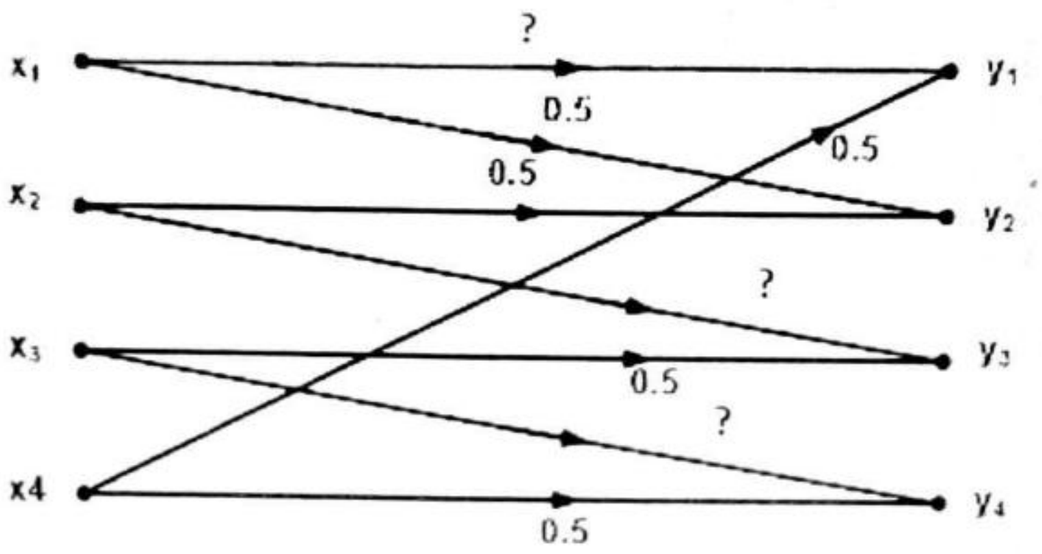

Figure 1

2. a) Consider the codes given below. 5
   i) Identify which of the below codes are uniquely decodable.
   ii) Verify the Kraft's Inequality for the given codes.

Symbol	***Code A***	***Code B***	***Code C***	***Code D***
S0	*0*	*0*	*0*	*00*
S1	*10*	*01*	*01*	*01*
S2	*110*	*001*	*011*	*10*
S3	*1110*	*0010*	*110*	*110*
S4	*1111*	*0011*	*111*	*111*

   b) A 2kHz channel has signal to noise ratio of 24 dB 5
   i) Calculate maximum capacity of this channel.
   ii) Assuming constant transmitting power, calculate maximum capacity when channel bandwidth is (a) halved (b) reduced to a quarter of its original value.

3 a) The international Morse code uses a sequence of symbols of dots and dashes to transmit letters of english alphabet. The dash is represented by a current pulse of duration 2ms and dot of 1ms. The probability of dash is half as that of dot. Consider 1ms duration of gap is given between the symbols. Calculate 6

i) Self-information of a dot and a dash
ii) Average information content of a dot-dash code
iii) Average rate of information

b) Prove the identity on the upper and lower bounds of entropy 4

$$0 \leq H(x) \leq log_2 m$$

4 Given a discrete memoryless source which emits the symbols $\{A, B, C, D, E, F, G\}$ with their corresponding probabilities $\left\{\frac{1}{3}, \frac{1}{3}, \frac{1}{9}, \frac{1}{9}, \frac{1}{27}, \frac{1}{27}, \frac{1}{27}\right\}$. Generate the code for the message *"BADGE"* using the following coding algorithms. 20

a) Find the compact code by applying:
i) Shannon Fano encoding
ii) Huffman binary encoding
iii) Huffman ternary encoding
b) Compute the efficiency for part (a).