333652(33)

BE (6th Semester)
Examination, April-May, 2018
(New Scheme)
Information Theory & Coding

Time Allowed : 3 hours | *Maximum Marks :* 80
Minimum Pass Marks : 28

Note : (*i*) Part (*a*) of each Unit is compulsory. Attempt any **two** parts from (*b*), (*c*) and (*d*) of each Unit.

(*ii*) The figures in the right-hand margin indicate marks.

Unit-I

1. (*a*) Define Information. [2]

(*b*) Draw the complete block diagram of a communication system and explain each block. [7]

(*c*) What is Entropy? Derive the expression for the max. value of average information per message (H_{max}) and plot it against probability of message P. Explain inverted U-shape curve. [7]

(*d*) An analog signal is band-limited to B Hz and sampled at Nyquist rate. The samples are quantized into 4 levels. Each level represents one message. Thus there are 4 messages. The probabilities of occurrence of these 4 levels (messages) are $P_1 = P_4 = \frac{1}{8}$ and $P_2 = P_3 = \frac{3}{8}$. Find out information rate of the source. [7]

Unit-II

2. (*a*) State Source Coding Theorem. [2]

(*b*) Apply Shannon-Fano coding procedure for the following message ensemble :

$[X] = [\ x_1 \quad x_2 \quad x_3 \quad x_4 \quad x_5 \quad x_6 \quad x_7 \quad x_8\ ]$

$[P] = [\ 1/4 \quad 1/8 \quad 1/16 \quad 1/16 \quad 1/16 \quad 1/4 \quad 1/16 \quad 1/8\ ]$

Take $M = 2$ and find the efficiency. [7]

(*c*) Apply Huffman coding procedure for the following message ensemble :

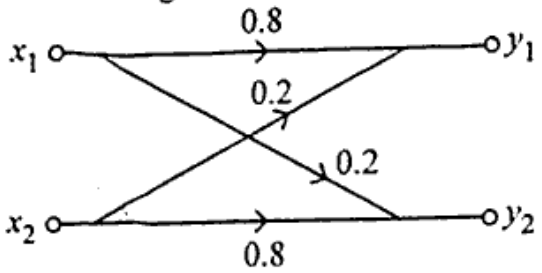
$[X] = [\ x_1 \quad x_2 \quad x_3 \quad x_4 \quad x_5 \quad x_6 \quad x_7\ ]$

$[P] = [\ 0.4 \quad 0.2 \quad 0.12 \quad 0.08 \quad 0.08 \quad 0.08 \quad 0.04\ ]$

Take $M = 2$ and find the efficiency of the code. [7]

(*d*) What is Binary Symmetric Channel? Derive the formulae for channel capacity of binary symmetric channel.

Find the channel capacity for the channel shown in figure. [7]



Unit-III

3. (*a*) What do you mean by Channel Capacity? [2]

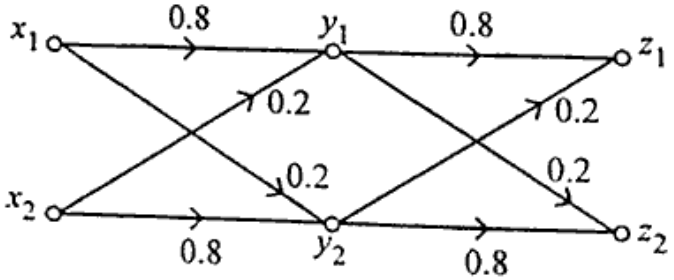
(*b*) What is Mutual Information? Write down the properties of mutual information. Prove the following relationships (any ***one***) : [7]

$I(X ; Y) = H(X) - H(X/Y)$

$I(X ; Y) = H(Y) - H(Y/X)$

(*c*) State Shannon-Hartley theorem and prove that there is trade-off between Bandwidth and Signal to Noise Ratio. [7]

(*d*) Find channel capacity for the cascaded channel shown in figure. [7]



Unit-IV

4. (*a*) Define Linear Block Code. [2]

(*b*) The generator matrix for a (6, 3) block code is given below. Find all the code vectors of this code : [7]

$$G = \left[\begin{array}{ccc:ccc} 1 & 0 & 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 \end{array}\right]$$

(*c*) What is Syndrome Decoding? Explain with the help of an example. How it is used to detect and correct the errors? [7]

(*d*) What do you mean by cyclic code? The generator polynomial of a (7, 4) cyclic code is $G(p) = p^3 + p + 1$; find the code vector for the code (0101) in non-systematic form. [7]

Unit-V

5. (*a*) What is error detecting and correcting code? [2]

(*b*) Explain convolutional code with suitable example. [7]

(*c*) Write short notes on (any ***two***) : [7]

(*i*) Code tree (*ii*) Trellis

(*iii*) Turbo encoder and decoder

(*d*) A rate 1/3 convolutional coder with constraint length of '3' uses the generating vectors

$g_1 = (100),\ g_2 = (101),\ g_3 = (111)$

(*i*) Sketch encoder configuration and prepare the logic table.

(*ii*) Draw the state diagram for coder. [7]