M. Tech. Electronics & Communication Engineering (CBCS Pattern) Semester-I

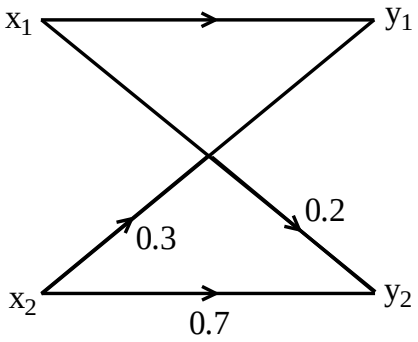
PECS141(A) - Information Theory and Coding

P. Pages : 2 **GUG/W/24/10982**

Time : Three Hours * 4 1 3 6 * Max. Marks : 70

Notes : 1. All questions carry marks as indicate.
2. Assume suitable data wherever necessary.
3. Illustrate your answers wherever necessary with the help of neat sketches.
4. Solve **any five** questions.

1. a) Find the mutual information and channel capacity of the channel shown in fig. **7**



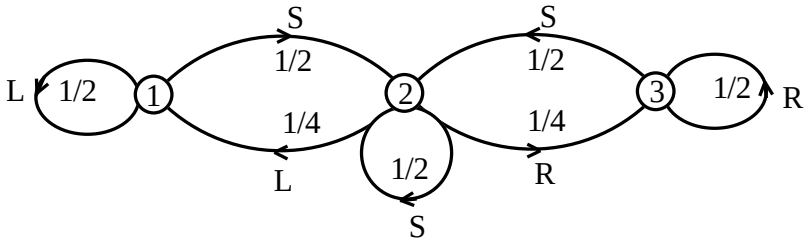
Given $p(x_1) = 0.6$ and $p(x_2) = 0.4$.

b) Show that the mutual information of a channel is symmetric that is $I(x:y) = I(y:x)$. **7**

2. a) State and explain: **9**

i) Shanon's source coding theorem
ii) Shanon's channel coding theorem
iii) Shanon's information capacity theorem.

b) For the source model shown below. Determine entropy of source. **5**



$$\left(p_1 = \frac{1}{4},\ p_2 = \frac{1}{2},\ p_3 = \frac{1}{4}\right)$$

3. A memoryless source emits messages m_1 & m_2 with probabilities 0.8 and 0.2 respectively. Find Huffman binary code for this source as well as for its second and third order extension (i.e. for N = 2 and 3). Determine the code efficiency and redundancies in each case. **14**

4. a) For a symmetric (6, 3) Linear block code the parity matrix is- **10**

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

i) Find probable code vectors.
ii) Find the minimum weight of code.
iii) Find parity check matrix.
iv) For a received code vectors R = 110010 detect and correct error that has accured due to noise.

b) Explain briefly BCH codes. **4**

5. For a (6, 3) code, generator matrix G is- **14**

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

a) For all possible data words, find the corresponding codewords and verify the error correcting and detecting capability of the code.

b) Draw the encoder.

c) Determine the corresponding data word for a received code vector r = 100011 if the channel is a BSC and the maximum likelihood distance is used.

6. a) For a (2, 1, 3) convolution code described by $g_1 = [1 \quad 0 \quad 1]$ and $g_2 = [1 \quad 1 \quad 0]$. **8**
Draw state diagram, tree diagram and trellis diagram.

b) Differentiate between convolution code and block codes. **6**

7. a) Explain iterative coding using BCJR algorithm. **7**

b) Discuss upper and lower bounds in linear code. **7**

8. Write a short note on **any two.** **14**

a) Justeen Codes

b) Reed Solomon Codes

c) Turbo Codes

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