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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SECOND SEMESTER M.TECH DEGREE EXAMINATION, APRIL-MAY 2017

Electronics and Communication Engineering

(Telecommunication Engineering)

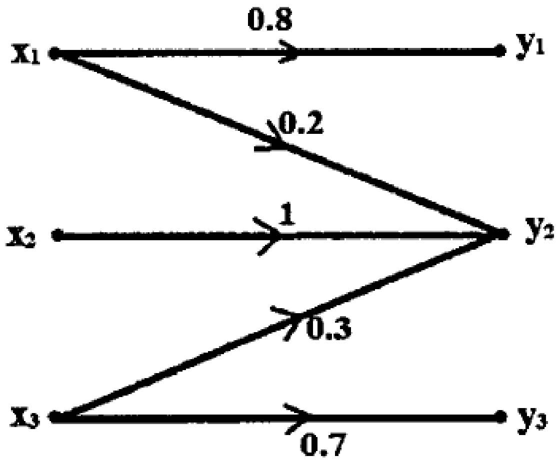
01EC6518 Information Theory

Max. Marks : 60 Duration: 3 Hours

Answer any two questions from each Part

Part A

1. a) The channel matrix between the source 'X' and the destination 'Y' in a communication system is given by:



Source emits symbols with probabilities 0.3, 0.4 and 0.3. Find H(X), H(Y), H(X/Y), H(Y/X) and I(X;Y). (7)

b) Differentiate between Memory less sources and Markov sources. (2)

2. a) Determine the Lempel Ziv code for the bit stream 0001011100010100101. Also recover the original sequence from the encoded stream. (4)

b) Find a binary Huffman code for the source emitting symbols with probabilities 0.49, 0.14, 0.14, 0.07, 0.04, 0.02, 0.02, 0.01. Also find the code efficiency and redundancy. (5)

3. a) Explain about marginal entropy of a source. Derive a relation for marginal entropy. (4)

b) Briefly explain about i) Non-singular codes ii) Uniquely decodable codes iii) Instantaneous codes with an example. (3)

c) A source emits 6 messages whose code words are generated from the set {0, 1, 2}. Can an instantaneous code with code word lengths for each of the messages as {1, 1, 2, 4, 4, 5} be generated? Justify. (2)

Part B

4. a) State and prove the properties of typical sets. (4)

   b) Discuss the consequence of AEP. (3)

   c) Briefly explain i) typical set ii) high probability sets. (2)

5. a) Prove that feedback cannot increase the capacity of a channel. (5)

   b) Find the capacity of a symmetric channel defined by a source emitting two equally likely messages where the channel transition probabilities for a row in the channel transition matrix is {0.3, 0.2, 0.5}. (4)

6. a) State and prove the Asymptotic Equipartition theorem. (3)

   b) Define Jointly Typical Sequences. State and prove the properties of joint AEP. (6)

Part C

7. a) Briefly explain Shannon limit. A binary telephone channel which is band limited from 250 Hz to 3550 Hz has a SNR of 30 dB. Calculate the capacity of the channel in bps. (4)

   b) Evaluate the differential entropy for the exponential density, $f(x) = \lambda . e^{-\lambda x}$, where $x \geq 0$. (4)

   c) If $h(X)$ represents the differential entropy for the function $f(x)$, prove that $h(aX) = h(X) + \log |a|$. (4)

8. a) State and prove the converse to the rate distortion theorem. (7)

   b) Evaluate the rate distortion function for a binary source. (5)

9. a) Derive the differential entropy of a Gaussian distribution. (4)

   b) Consider "k" independent Gaussian channels in parallel with a common power constraint. Explain the process of power distribution among the channels so as to maximize the capacity. (8)