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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SECOND SEMESTER M.TECH DEGREE EXAMINATION, DECEMBER 2018

Branch: Electronics and Communication Engineering

Stream(s): Telecommunication Engineering

Course Code & Name: 01EC6518- Information Theory

Answer *any two full* questions from *each* part

Limit answers to the required points.

Max. Marks: 60 Duration: 3 hours

PART A

1. a. Given a source $S=\{S_1,S_2,S_3,S_4,S_5,S_6,S_7\}$ with probabilities $P=\{0.3,0.3,0.09,0.09,0.09,0.09,0.04\}$. Construct a binary code using Shannon – Fano coding procedure. Calculate average length, variance and efficiency. (6)

   b. Given $S=\{S_1,S_2,S_3,S_4,S_5,S_6\}$, $X=\{0,1\}$ and $l_1=l_2=2, l_3=l_4=l_5=l_6=P$. Find minimum value of P so that instantaneous code exists. (3)

2. a. Possible outcomes of a random variable Y are y_1, y_2 and y_3. Two different distributions of this random variable are p(Y) = (1/2, 1/4, 1/4) and q(Y) = (1/3, 1/3, 1/3). Calculate relative entropies. (3)

   b. State and prove the necessary and sufficient condition for the existence of instantaneous codes. (6)

3. a. Derive the relation: I(X,Y) = H(X) + H(Y) –H(X,Y). (4)

   b. Derive the chain rule of relative entropy for Markov source. (5)

PART B

4. a. Explain Noisy Type writer channel in detail. Find the capacity of the same with noiseless subset of inputs. (6)

   b. How the weakly symmetric channels are different from symmetric channels. (3)

5. a. Describe Data compression as a consequence of Asymptotic Equi-partition Property. (5)

   b. Derive the capacity of a Binary channel, if a fraction 'p' is lost in the channel. (4)

6. a. State and prove Joint Source-Channel coding theorem. (5)

b. Mathematically state the properties of high probability set and typical set. (4)

PART C

7. a. Derive the relation between H(X) and h(X), for a continuous random variable X. (4)

   b. For a random variable A with uniform distribution 1/p on the interval from -p/2 to p/2, calculate the differential entropy. (4)

   c. State the properties of relative differential entropy and conditional differential entropy. (4)

8. a. Mathematically define a (2n R, n) code. Explain its features. (5)

   b. Derive shannon's limit for band limited gaussian channels. (4)

   c. Briefly explain Rate distortion based on channel coding. (3)

9. a. Derive the channel capacity of a coloured Gaussian channel using water filling algorithm. (6)

   b. Derive the Rate distortion measure based on single bit quantization of continuous signals. (6)