BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

CLASS: BE **SEMESTER: VII**
BRANCH: ECE **SESSION : MO/2018**

SUBJECT : MEC1125 INFORMATION THEORY AND CODING

TIME: 1.5 HOURS **FULL MARKS: 25**

INSTRUCTIONS:
1. The total marks of the questions are 30.
2. Candidates may attempt for all 30 marks.
3. In those cases where the marks obtained exceed 25 marks, the excess will be ignored.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. The missing data, if any, may be assumed suitably.

Q1 (a) Define Kullback-Leibler distance between two probability mass functions p(x) and q(x). Also prove that D(p||q) not equal to D(q||p). [2]

(b) Prove that the entropy of a Gaussian random variable is only depending upon its finite variance of the distribution. Also compare its entropy with other continuous random variables. [3]

Q2 (a) Define information and entropy of a source. Also determine the av. Entropy of the English language assuming alphabets are equally likely. [2]

(b) Explain the properties of entropy for a discrete memoryless source. Show that entropy is bounded as $0 \le H(X) \le \log_2 K$, when K is the no. of symbols. [3]

Q3 (a) Define Instantaneous code. [2]

(b) Consider a discrete memoryless source having alphabet XX: {A, B, C, D} and corresponding probabilities {0.5, 0.25, 0.125, and 0.125}. Determine the arithmetic code for the sequence BCADA with pictorial illustration. [3]

Q4 (a) Explain rate distortion function for Gaussian source. [2]

(b) Describe Huffman coding algorithm. Consider a DMS with probabilities 0.37, 0.33, 0.16, 0.07, 0.04, 0.02 and 0.01, respectively. Construct Huffman coding for the DMS and find out code efficiency. [3]

Q5 (a) Evaluate the overall channel capacity of three cascaded connected BSC channels assuming that all have the same transition probability diagram with p=0.1 . [2]

(b) Prove that the information capacity of a continuous channel of bandwidth W hertz, perturbed by additive Gaussian noise of power spectral density N0/2 is given by $C = W\log_2\left(1+\frac{P}{N_0 W}\right)$ bits/sec. [3]

Q6 (a) Define channel capacity and explain Shannon limit. [2]

(b) Explain the channel capacity for MIMO systems. [3]