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

CLASS: BE **SEMESTER : VII**
BRANCH: ECE **SESSION : MO/19**

SUBJECT: MEC1125 INFORMATION THEORY AND CODING

TIME: 3:00 HOURS **FULL MARKS: 60**

INSTRUCTIONS:
1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1(a) Define Kullback-Leibler distance between two probability mass functions. [2]
Q.1(b) Explain, entropy is a concave function. [4]
Q.1(c) 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. [6]

Q.2(a) Define Instantaneous Codes. [2]
Q.2(b) Consider a discrete memoryless source having alphabet YY: $\{A_1, A_2, A_3, A_4\}$ and corresponding probabilities {0.5, 0.125, 0.25, and 0.125}. Determine the arithmetic code for the sequence $A_2A_3A_1A_4A_1$ with pictorial illustration. [4]
Q.2(c) 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. [6]

Q.3(a) Describe the basic properties of Binary Symmetric Channel and Binary Erasure Channel. [2]
Q.3(b) Evaluate the overall channel capacity of two cascaded connected BSC channels assuming that all have the same transition probability diagram with p=0.2 [4]
Q.3(c) Prove that the information capacity of a continuous channel of bandwidth W hertz, perturbed by additive Gaussian noise of power spectral density $N_0/2$ is given by $C = W\log_2\left(1+\frac{P}{N_0W}\right)$ bits/sec. [6]

Q.4(a) What is systematic encoder? [2]
Q.4(b) Explain the Singleton and the Humming bounds for linear block codes. [4]
Q.4(c) Consider a (n, k) = (7, 1) repetition code generated by the generator matrix G = [1 1 1 1 1 1 1]. Evaluate the syndrome S for all possible single-error patterns. [6]

Q.5(a) Define primitive element of a Galois field. [2]
Q.5(b) Explain BCH code. [4]
Q.5(c) For nonsystematic coding in (7, 3) cyclic code (under *GF (2)*) with generator polynomial $g(x) = (1+x)(x^3+x+1)$, determine generator matrix, G & parity check matrix, H. [6]

Q.6(a) Define code rate and constraint length of a convolutional encoder. [2]
Q.6(b) Draw convolutional encoder, state diagram and its one stage of trellis diagram with transfer function matrix $G(x)= [1+x^2 \;\; x+x^2]$. [4]
Q.6(c) Describe Viterbi decoding of convolutional codes with its advantages. [6]

Q.7(a) What is the difference between Block cipher and Stream cipher? [2]
Q.7(b) Explain public-key encryption using block diagram. How can we incorporate authentication using the digital signature? [4]
Q.7(c) Discuss RSA algorithm with suitable example. [6]

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