Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

SEVENTH SEMESTER B.TECH. (E & C) DEGREE END SEMESTER EXAMINATION
NOVEMBER 2018
SUBJECT: INFORMATION THEORY AND CODING (ECE - 4009)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates
- Answer **ALL** questions.
- Missing data may be suitably assumed.

1A. For the state diagram of the first order markov source with source alphabet S= {0,1,2} is given in Figure Q1A. Compute H(s), $H(\bar{S})$, $H(\bar{S}^2)$, $H(\overline{S^2})$, if $p = 0.8$.

1B. Let S be zero memory source with source alphabet, $S = \{s_i\}, i = 1,2, \dots, q$, and symbol probabilities $P_1, P_2, \dots, P_q$. Construct a new zero memory source S' with twice as many symbols, $S' = \{s_i'\}, i = 1,2, \dots, 2q$. Let P_i', the symbol probabilities for the new source, defined by

$$P_i' = (1 - \epsilon)P_i, \quad i = 1,2, \dots, q$$
$$P_i' = \epsilon P_{i-q} \qquad i = q + 1, q + 2, \dots, 2q.$$

Express $H(S')$ in terms of $H(S)$.

(7+3)

2A. Decode the following binary sequence using Adaptive Huffman coding procedure for a source with 26 letter alphabet **A to Z**: **10010000000001000111100011011 0.**

2B. Show that Kraft's inequality is sufficient for the existence of an instantaneous code.

2C. For a binary erasure channel with the probability of error 0.01, compute the equivocation, $H(A/B)$ if the input symbols are equiprobable.

(4+3+3)

3A. Given the following table with the first and the second row indicating source symbols and the probabilities respectively:

S	s1	s2	s3	s4	s5	s6	s7
P(S_i)	1/3	1/3	1/9	1/9	1/27	1/27	1/27

Find a minimum variance Huffman code for this source when the code alphabet, (i) X={0,1} and (ii) X={0,1,2}. Also Compute Code efficiency and redundancy for both (i) and (ii).

3B. With an example explain how a reliable message can be transmitted through an unreliable channel by minimizing probability of error.

(7+3)

4A. Two binary symmetric channels, each with error probability 0.1, are cascaded as shown in the Figure Q4A. The inputs 0 and 1 are chosen with the probabilities 0.4 and 0.6 respectively. Find $H(A, B), H(A, C), H(A/C)$ and the capacity of this cascaded channel.

4B. Define Uniform channel. Derive an expression for the mutual information of r-ary symmetric channel with the overall probability of error p. Also find the capacity of this channel.

(7+3)

5A. Define Mutual information and describe the properties of mutual information including its additivity property.

5B. For a binary symmetric channel with the probability of error 0.01, determine the mutual information $I(A;B,C)$, where A is input alphabet, B and C are output alphabet of the channel if input symbols are equiprobable.

5C. For the channel with the channel matrix $P = \begin{bmatrix} 0.6 & 0.2 & 0.2 \\ 0.2 & 0.5 & 0.3 \\ 0.3 & 0.3 & 0.4 \end{bmatrix}$ and input symbols $a_1, a_2,$ and a_3 with probabilities 0.4, 0.3 and 0.3 respectively. Identify the maximum likelihood decision rule.

(4+3+3)

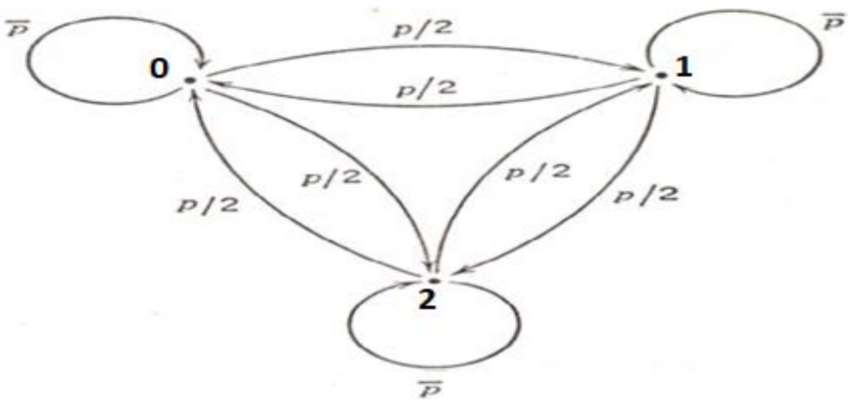

Figure Q1A

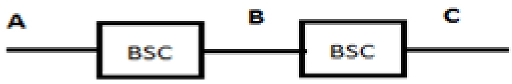

Figure Q4A