Reg. No.										

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

SEVENTH SEMESTER B.TECH. (E & C) DEGREE END SEMESTER EXAMINATION
DECEMBER 2018/JANUARY 2019
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} is given in Figure Q1A. Compute H(s), $H(\bar{S})$. Obtain the second extension of this source and hence compute $H(s^2)$. Given $p = 0.8$.

1B. For a discrete memoryless source S with alphabet S={s_i}, i=1,2,…q, and probabilities {P_i}, i=1,2,…,q, prove that $H(S^n) = nH(S)$.

(7+3)

2A. Encode the following string **SHANNON** using Adaptive Huffman coding Procedure for a source with 26 letter alphabet **A to Z.**

2B. Given the following table with source symbols and probabilities. Design a binary Shannon Fano code and hence compute code efficiency:

S	s1	s2	s3	s4	s5	s6	s7	s8
P(s_i)	0.4	0.2	0.1	0.1	0.02	0.1	0.04	0.04

(7+3)

3A. Find the minimum variance Huffman code for the source shown in the following table using the code alphabet X= {0,1,2}.

S	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10
P(s_i)	0.20	0.18	0.12	0.10	0.10	0.08	0.06	0.06	0.06	0.04

Find efficiency and redundancy of this code.

3B. With an example show that the Huffman code produces a compact code.

3C. Define channel capacity. Find the capacity of Binary erasure channel. Sketch the Mutual information versus probability of input symbol curve.

(4+3+3)

4A. Two binary symmetric channels, each with error probability 0.1, are cascaded as shown in the Figure Q4A. If input symbols are equiprobable, find $H(B/A), H(A,C), H(C/B)$ and the capacity of this cascaded channel.

4B. Obtain the lower and upper bounds of the mutual information of an r-ary uniform communication channel.

4C. State and prove Kraft's inequality.

(4+3+3)

5A. Consider a Binary symmetric communication channel with the probability of error 0.2, whose input source is the alphabets A = {0,1} with probabilities {0.5, 0.5} whose output alphabets are B = {0,1} and C={0,1}. Compute I(A;B,C).

5B. For the channel with the channel matrix $P = \begin{bmatrix} 0.5 & 0.2 & 0.2 \\ 0.2 & 0.3 & 0.5 \\ 0.3 & 0.3 & 0.4 \end{bmatrix}$ 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. Find the probability of error.

5C. The binary symmetric channel with the probability of error is given by 0.01. Show how to reduce this error to the order of 10^{-5}. What is the penalty for achieving this error?

(4+3+3)

Figure Q1A

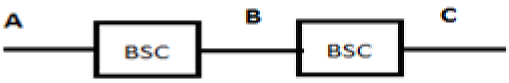

Figure Q4A