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Paper Id: 1102529 **Roll No.**

B TECH
(SEM IV) THEORY EXAMINATION 2018-19
INFORMATION THEORY AND CODING

Time: 3 Hours ***Total Marks: 70***

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 7 = 14

a. Define channel capacity.
b. What is information rate?
c. Relate the amount of information provided and probability of occurrence of Events.
d. Why we use logarithmic function to measure information?
e. Describe Extension of Discrete memory less source.
f. List out the properties of Entropy.
g. Define source coding theorem

SECTION B

2. Attempt any *three* of the following: 7 x 3 = 21

a. Calculate mutual information and capacity of binary erasure channel.
b. State and prove properties of a typical set.
c. Explain the preview of the channel coding theorem and the properties of channel capacity.
d. Prove the expected length L of any instantaneous D-ary code for a random variable X is greater than or equal to the entropy $H_D(X)$; that is, $L \geq H_D(X)$, with equality if and only if $D^{-l_i} = p_i$.
e. Explain the physical significance of different Entropies.

SECTION C

3. Attempt any *one* part of the following: 7 x 1 = 7

a. Prove that for any countably infinite set of code-words that form a prefix code, the codeword lengths satisfy the extended Kraft inequality,

$$\sum_{i=1}^{\infty} D^{-l_i} \leq 1.$$

And show that the (0, 10, 110 and 111) code-words for transmitting four messages follows the Kraft inequality.

b. Explain Log Sum Inequality and Data-Processing Inequality.

4. Attempt any *one* part of the following: 7 x 1 = 7

a. For a binary communication system, a “0” or “1” is transmitted. Because of noise on the channel, a “0” can be received as “1” and vice-vers a. Let m0 and m1 represent the events of transmitting “0” and “1” respectively. Let r0 and r1 denote the events of receiving “0” and “1” respectively. Let p(m 0) = 0.5, p(r1/m0) = p = 0.1, P(r0/m1) = q = 0.2

i. Find p(r0) and p(r1)
ii. If a “0” was received what is the probability that “0” was sent
iii. If a “1” was received what is the probability that “1” was sent.
iv. Calculate the probability of error.
v. Calculate the probability that the transmitted symbol is read correctly at the receiver.

b. DMS has an alphabet of x_i ; i=1,2,3,….,8; with probabilities 0.25, 0.20, 0.15, 0.12, 0.10, 0.08, 0.05, 0.05. Determine the Entropy & Code efficiency & code redundancy, using Huffman coding procedure.

5. Attempt any *one* part of the following: 7 x 1 = 7

(a) Using 3 stage shift register & 2 stage Modulo-2 adder with impulse response of paths (111) and (101), find the convolution code if the given sequence is 10011, also draw the code tree, state transition diagram.

(b) Derive the expression for channel capacity for infinite bandwidth.

6. Attempt any *one* part of the following: 7 x 1 = 7

(a) Explain Standard Arrays.

(b) For the given generator polynomial $g(x) = 1+x+x^3$ find the generator matrix G for a symmetric (7, 4) cyclic code & find the systematic cyclic code for message bits 1010.

7. Attempt any *one* part of the following: 7 x 1 = 7

(a) Using 3 stage shift register & 2 stage Modulo-2 adder with impulse response of paths (111) and (101), draw trellis diagram and if the transmitted code is 00000000 and received code have error on 2nd and 6th bit due to channel noise, then detect and correct the errors by using Viterbi decoding of the convolution code.

(b) How and when Shortened codes are applied?