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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February / March 2023 Semester End Main Examinations

Programme: B.E. **Semester: V**

Branch: Electronics & Telecommunication Engineering **Duration: 3 hrs.**

Course Code: 19ET5PCITC **Max Marks: 100**

Course: Information Theory & Coding **Date: 23.02.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1 a) State and prove Theorem of total probability **04**

b) One bag contains 4 white balls and three black balls and the second bag contains 3 white balls and 5 black balls. One ball is drawn at random from the first bag and placed unseen in the second bag. What is the **06**

i. Probability that the a ball drawn from first bag is black
ii. Probability that the a ball drawn from second bag is white

c) For the first order Markov source with a source alphabet S={A,B,C} shown in the figure 1.c **10**

i. Compute the probabilities of the states
ii. Find H(S) and H(S^2)

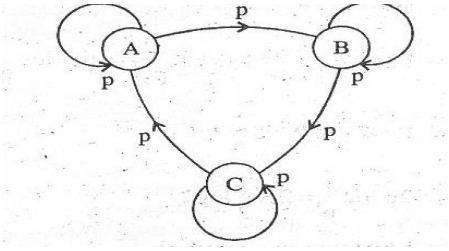

Fig 1.c

UNIT - II

2 a) For the following codes check Instantaneous property. Justify your answer with proper proof .If instantaneous calculate the minimum average length. **08**

Source symbols	Code A	Code B	Code C
S1	00	0	0
S2	01	10	01
S3	10	110	011
S4	11	1110	0111

b) Construct a Ternary and quaternary Huffman code by placing the composite symbol as high as possible. Compute the coding efficiency and redundancy in each case. **12**

Symbol	S1	S2	S3	S4	S5	S6	S7	S8
P	0.22	0.2	0.18	0.15	0.1	0.08	0.05	0.02

UNIT - III

3 a) With an example, Explain Noise matrix having 3 rows and 4 columns **05**

b) Show that I(A,B) is always non –negative. **05**

c) A transmitter has an alphabet consisting of 5 letters$\{a_1,a_2,a_3,a_4,a_5\}$ and the receiver has an alphabet of four letters$\{b_1,b_2,b_3,b_4\}$. The joint probabilities of the system are given below. Compute different entropies of this channel. **10**

$$P(A/B) = \begin{bmatrix} 0.25 & 0 & 0 & 0 \\ 0.10 & 0.30 & 0 & 0 \\ 0 & 0.05 & 0.10 & 0 \\ 0 & 0 & 0.05 & 0.1 \\ 0 & 0 & 0.05 & 0 \end{bmatrix}$$

OR

4 a) Define Binary erasure channel and show that the channel capacity of BEC is $\bar{P}$. **08**

b) A CRT terminal is used to enter alphanumeric data into a computer. The CRT is connected through a voice grade telephone line having usable band width of 3Khz and an output (S/N) of 10dB.Assume that the terminal has 128 characters and data is sent in an independent manner with equal probability. **06**
i.Find the average information per character
ii.Find the capacity of the channel
iii.Find maximum rate at which data can be sent from terminal to computer without error.

c) Describe Shannon Hartley Law implications **06**

UNIT - IV

5 a) Describe i. Types of errors ii. Types of codes **06**

b) For a systematic (6,3) linear block code, the parity matrix P is given by **14**

$$P = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 0 \end{bmatrix}$$

i. Find all the possible code vectors.
ii. Construct the standard array look-up table
iii. Detect the errors and correct the errors in the received vectors Ra=100110; Rb=001100
iv. Construct the corresponding syndrome calculation circuit for the received vector $R=\{r_1, r_2, r_3, r_4, r_5, r_6\}$
v. Construct error correcting circuit.

OR

6 a) Define and list the properties of Cyclic code. **06**

b) For the (7,4) single error correcting cyclic code $D(x) = d_0+d_1x+d_2x^2+d_3x^3$ Using the generator polynomial $g(x)= 1+x+x^3$.Find the code vectors for the message data in both non – systematic and systematic form. **10**

i. $D = (d_0\ d_1\ d_2\ d_3) = (1\ 1\ 1\ 0)$

ii. $D = (1\ 0\ 0\ 1)$

c) Consider a single error correcting code for a message block of size 11. **04**

i. How many check bits are required?

ii. Find a parity check matrix for this code.

UNIT - V

7 a) Briefly explain the construction RS codes. **06**

b) Consider the (2,1,1) convolutional code with $g^{(1)} =(11)$, $g^{(2)}=(10)$ **14**

i. Draw the encoder block diagram

ii. Draw the state diagram

iii. Draw the code tree

iv. Find the code-word corresponding to the information sequence (10111)

v. Verify the output using time domain approach.

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