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10EC55

Fifth Semester B.E. Degree Examination, July/August 2022
Information Theory and Coding

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Explain with a diagram communication system. **(05 Marks)**

b. A single TV picture may be through of as an array of black, white and grey dots with 500 rows and 600 columns. Suppose that each of these dots may take any one of 10 distinguishable levels. What is the amount of information provided by 1 picture? **(05 Marks)**

c. A voice single in a PCM system is sampled at 2.5 times the Nyquist rate and is quantized into 16 levels with the following probabilities.

$P_1 = P_2 = P_3 = P_4 = 0.08$
$P_5 = P_6 = P_7 = P_8 = 0.065$
$P_9 = P_{10} = P_{11} = P_{12} = 0.055$
$P_{13} = P_{14} = P_{15} = P_{16} = 0.05$

Calculate the entropy and information rate of the PCM signal if the bandwidth of signal is 3.5KHz. **(10 Marks)**

2 a. Explain briefly properties of codes. **(10 Marks)**

b. A source produces 2 symbols with probabilities ¾ and ¼ design a variable length code using Shanon – Fano algorithm. So that the coding efficiency is atleast 85%. **(10 Marks)**

3 a. Explain with basic block diagram of characterization of a binary communication channel. **(10 Marks)**

b. In communication system a transmitter has 3 input symbols $A = \{a_1, a_2, a_3\}$ and receiver also has 3 output symbols $B = \{b_1, b_2, b_3\}$. The matrix shows JPM with marginal probabilities.

b_i / ai	b_1	b_2	b_3
a_1	1/12	*	5/36
a_2	5/36	1/9	5/36
a_3	*	1/6	*
P(bi)	1/3	14/36	*

i) Find the missing probabilities (* in the table).
ii) Find $P(b_3/a_1)$ and $P(a_1/b_3)$
iii) Are the events a_1 and b_1 statically independent? Why? **(10 Marks)**

4 a. A black and white television picture may be views as consisting of approximately 3×10^5 elements each one of which may occupy one of 10 distinct brightness levels with equal probabilities assume :
i) The rate of transmission is 30 picture frame Per second.
ii) The signal–to–noise ratio is 3dB using the channel. Capacity theorem calculate the minimum bandwidth required to support the transmission of the resultant video signal. **(10 Marks)**

b. Define mutual information and explain its properties. **(05 Marks)**

c. A channel has a 10MHz bandwidth if (s/N) ratio is 100 calculate the channel capacity and the maximum information rate. **(05 Marks)**

PART – B

5 a. Explain with basic block diagram of error control coding. **(10 Marks)**

b. For a systematic (6.3) linear block code, the parity matrix P is given by

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

Find all possible code – vectors. **(10 Marks)**

6 a. Explain with basic block diagram of encoding using (n – k) bit shift register. **(06 Marks)**

b. Explain briefly properties of cyclic codes. **(04 Marks)**

c. A (15.5) linear cyclic code has generator polynomial.

$g(x) = 1 + x + x^2 + x^4 + x^5 + x^8 + x^{10}$

i) Draw the block diagram of an encoder and syndrome calculator for this code.

ii) Find the code polynomial for the message polynomial $D(x) = 1 + x^2 + x^4$ in systematic

iii) Is $v(x) = 1 + x^4 + x^6 + x^8 + x^{14}$ a code polynomial. **(10 Marks)**

7 a. Determine the parameters of a q–ary RS code vector for a $d_{min} = 9$ also find the total number of codewords in the code and also the nearest neighbors for any code word at a distance of $d_{min} = 9$. **(10 Marks)**

b. Explain briefly :

i) Golay code

ii) Cyclic code

iii) Burst error correcting code

iv) Burst and random error. **(10 Marks)**

8 a. For the convolution encoder shown in Fig.Q8(a). The information sequence is d = 10011 find the output sequence using the following two approaches.

i) Time domain approach

ii) Transfer domain approach.

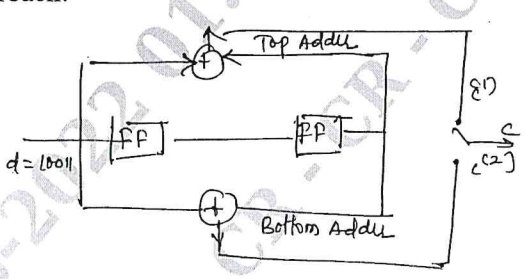

Fig.Q8(a) **(10 Marks)**

b. Consider the convolutional encoder show in Fig.Q8(b) the code is systematic

i) Draw the state diagram

ii) Draw the code tree

iii) Find the encoder output produced by the message sequence 1011.

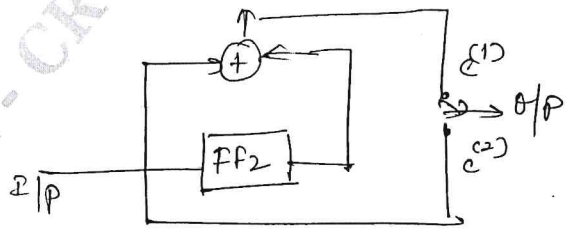

Fig.Q8(b) **(10 Marks)**

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