Roll No											

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF INFORMATION SCIENCE
END TERM EXAMINATION - JUN 2023

Semester : Semester IV - 2021
Course Code : CSA3056
Course Name : Sem IV - CSA3056 - Intelligent Signal Processing
Program : BCA AR-VR

Date : 12-JUN-2023
Time : 1.00PM - 4.00PM
Max Marks : 100
Weightage : 50%

Instructions:
(i) Read all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and non-programmable calculator are permitted.
(iv) Do not write any information on the question paper other than Roll Number.

PART A

ANSWER ALL THE QUESTIONS **(5 X 2 = 10M)**

1. Information theory is a mathematical representation of parameters and conditions impacting the processing and transmission of information. Calculate the amount of information if probability is 0.25.
(CO3) [Knowledge]

2. In information theory, the entropy of a random variable is the average level of "information", "surprise", or "uncertainty" inherent to the variable's possible outcomes. Express conditional entropy in terms conditional and joint probability.
(CO3) [Knowledge]

3. A Boolean expression is a logical statement that is either TRUE or FALSE. Boolean expressions can compare data of any type as long as both parts of the expression have the same basic data type. Prove that $X \cdot (X + Y) = X$.
(CO1) [Knowledge]

4. What do you mean by lossless channel? Give one example of loss less channel.
(CO4) [Knowledge]

5. Information theory, a mathematical representation of the conditions and parameters affecting the transmission and processing of information. Express amount of information in terms of probability.
(CO2) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS **(2 X 15 = 30M)**

6. There are different types of operations which can be performed on a time domain signal to achieve different versions of the same signal.

$$x[n] = \{1, 1, 1, \underset{\uparrow}{0}, 1, 1, 1\}$$

Draw the following versions for the discrete time domain signal given above
(i) x [2n]
(ii) x [-n]
(iii) x [n/3]
(iv) x [n+2]

(CO4) [Comprehension]

7. Default question text.In mathematics (in particular, functional analysis), convolution is a mathematical operation on two functions (x[n] and h[n]) that produces a third function (x[n]* h[n]) that expresses how the shape of one is modified by the other. Draw the input signal .
Also find the output signal using convolution operation for a system with response
$h[n] = 2\delta\,[n+1] + \delta\,[n] + 2\delta\,[n-1] - 3\delta\,[n-2]$

(CO3) [Comprehension]

PART C

ANSWER ALL THE QUESTIONS **(3 X 20 = 60M)**

8. Shannon Fano Algorithm is an entropy encoding technique for lossless data compression of multimedia. Named after Claude Shannon and Robert Fano, it assigns a code to each symbol based on their probabilities of occurrence. It is a variable-length encoding scheme, that is, the codes assigned to the symbols will be of varying lengths.
Given the following messages with respective probabilities in the table below, construct a binary code by applying Shannon-Fano Encoding procedure.
Also determine
a) Average length of the code
b) Code Efficiency
c) Redundancy of the code
d) Draw the code tree or graph

Symbol	Probability
X_1	0.4
X_2	0.3
X_3	0.2
X_4	0.05
X_5	0.05

(CO2) [Application]

9. A discrete time signal cannot take real values of time. It can only take discrete values of time.
For the signal x[n] = {2, -3, 1, 0, 1, -3, 2}
Draw the following versions
(i) x [3n]
(ii) x [n-2]
(iii) x [-n]
(iv) x [n+1]

(CO4) [Application]

10. Joint probability is a statistical measure that calculates the likelihood of two events occurring together and at the same point in time. Joint probability is the probability of event Y occurring at the same time that event X occurs. Assume that you have the joint probability of a vowel 'Y' and a consonant 'X' occurring together. Compute the following

a) Joint probabilities f(a, p), f(a, t), f(a, k), f(i, p), f(i, t), f(i, k), f(u, p), f(u, t), f(u, k)

b) Conditional probabilities f(a | p), f(a | t), f(a | k), f(i | p), f(i | t), f(i | k), f(u | p), f(u | t), f(u | k)

c) Also compute conditional entropy of H (Y | X) for all the vowels 'Y' and consonants 'X'

$f(x,y)$	p	t	k	$f(y)$
a	$\frac{1}{16}$	$\frac{3}{8}$	$\frac{1}{16}$	$\frac{1}{2}$
i	$\frac{1}{16}$	$\frac{3}{16}$	0	$\frac{1}{4}$
u	0	$\frac{3}{16}$	$\frac{1}{16}$	$\frac{1}{4}$
$f(x)$	$\frac{1}{8}$	$\frac{3}{4}$	$\frac{1}{8}$	

(CO3) [Application]