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**PRESIDENCY UNIVERSITY  
BENGALURU**

**SCHOOL OF ENGINEERING  
MID TERM EXAMINATION - OCT 2023**

**Semester :** Semester V - 2021

**Course Code :** ECE3028

**Course Name :** Sem V - ECE3028 - Speech Signal Processing

**Program :** B. TECH

**Date :** 31-OCT-2023

**Time :** 11:30AM - 1:00PM

**Max Marks :** 50

**Weightage :** 25%

**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. Speech Coding is the process of transforming a speech signal into a representation for efficient transmission and storage of speech. Mention four applications of speech coding  
(CO1) [Knowledge]
2. Synthesis of Speech is the process of generating a speech signal using computational means for effective humanmachine interactions. Mention four applications of speech synthesis  
(CO1) [Knowledge]
3. "Signal resolution" refers to **how detailed the waveform is allowed to be**. Analog signals have an infinite amount of points that can be attained between a "high" and "low" - this is a reflection of the real world, since we can always find an infinite amount of points between two finite points. For a range of 0-5V, and a 10-bit resolution, what is the binary value for 3.65V?  
(CO2) [Knowledge]
4. In electronics, an analog to digital converter (ADC ) is a system that converts an analog signal into a digital signal. There are a number of processes to be followed in analog to digital conversion. Explain the term Resolution/Quantization Step-Size (Q).  
(CO2) [Knowledge]
5. In mathematical physics, the Dirac delta distribution ( $\delta$  distribution), also known as the unit impulse,[1] is a generalized function or distribution over the real numbers, whose value is zero everywhere except at zero, and whose integral over the entire real line is equal to one. For the sequence  $x[n] = \{2, -3, 1, 0, 1, -3, 2\}$ , express the signal  $x[n]$  as shifted version of impulse (delta) signal.  
(CO1) [Knowledge]

**PART B**

**ANSWER ALL THE QUESTIONS**

**(2 X 10 = 20M)**

6. 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

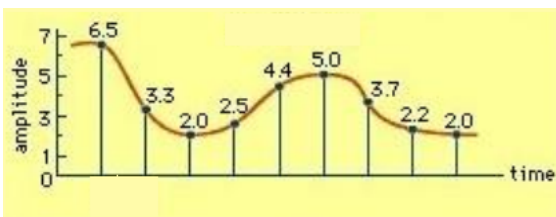
$$x[n] = 2\delta[n+2] + \delta[n+1] + \delta[n] + \delta[n-1]$$

Also find the output signal using convolution operation for a system with response

$$h[n] = 2\delta[n+1] + \delta[n] + 2\delta[n-1] - 3\delta[n-2]$$

(CO1) [Comprehension]

7. An analog signal is a voltage, current, or physical quantity that continuously and infinitely varies in accordance with some time-varying parameter. Convert the following time varying signal of 0 - 7 V to a digital signal using a 3-bit ADC. Also draw the encoded graphs



(CO1) [Comprehension]

**PART C**

**ANSWER THE FOLLOWING QUESTION**

**(1 X 20 = 20M)**

8. 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 by completing the following table by filling the empty cells

- Joint probabilities  $f(a, p)$ ,  $f(a, t)$ ,  $f(a, k)$ ,  $f(i, p)$ ,  $f(i, t)$ ,  $f(i, k)$ ,  $f(u, p)$ ,  $f(u, t)$ ,  $f(u, k)$
- Conditional probabilities  $f(a | p)$ ,  $f(a | t)$ ,  $f(a | k)$ ,  $f(i | p)$ ,  $f(i | t)$ ,  $f(i | k)$ ,  $f(u | p)$ ,  $f(u | t)$ ,  $f(u | k)$
- Also compute conditional entropy of  $H(Y | X)$  for all the vowels 'Y' and consonants 'X'

Input Symbol	Output Symbol			P(X)
	$Y_1$	$Y_2$	$Y_3$	
$X_1$		$\frac{3}{8}$	$\frac{1}{16}$	$\frac{1}{2}$
$X_2$	$\frac{1}{16}$		$\frac{2}{16}$	$\frac{1}{4}$
$X_3$		$\frac{1}{4}$		$\frac{1}{4}$
P(Y)	$\frac{1}{8}$		$\frac{1}{8}$	

(CO2) [Application]