VIT

Reg. No. :

Final Assessment Test (FAT) – November/December 2022

Programme	**B.Tech.**	Semester	**Fall Semester 2022-23**
Course Title	**SIGNALS AND SYSTEMS**	Course Code	**BECE202L**
Faculty Name	**Prof. Jeetashree Aparajeeta**	Slot	G1+TG1
		Class Nbr	**CH2022231001097**
Time	**3 Hours**	Max. Marks	**100**

Section A (6 X 5 Marks)
Answer All questions

1. Determine the values of P_x and E_x for each of the following signals: **[2.5 x 2 = 5 marks]** [5]

   (i) $x_1(t) = \cos(t)$

   (ii) $x_2[n] = \cos(\pi n/4)$

2. Find the Convolution integral of [5]

   (i) $x_1(t) = \cos(t)\, u(t)$ with $x_2(t) = u(t)$

   (ii) $x_3(t) = r(t)u(t)$ with $x_4(t) = e^{-2t}u(t)$

   [2.5 x 2 = 5 marks]

3. Let $x[n] = 1 + \cos(\pi\, n/8)$ be a periodic signal with a fundamental period of 16. Its Discrete Fourier Series coefficients are defined by $a_k = 1/16 \sum x[n]\, exp\ (-jkn\pi/8)$ for all k. Determine the value of the coefficient a_{16}. [5]

4. For the continuous-time periodic signal $x(t) = 2 + cos2t + sin4t$, determine the fundamental frequency ω_0 and the Fourier series coefficient C_2 [5

5. What is sampling? How can an impulse train satisfy Sampling Theorem and bring about perfect reconstruction? Explain with neat expressions. [

6. A full-wave rectified sinusoidal waveform has a peak voltage of 10 V. Calculate its average value. **[5 marks]**

Section B (4 X 10 Marks)
Answer All questions

7. Perform the following operations on the given signal in Figure 1. **[4 + 3 + 3 = 10 marks]**

   (i) $[x(-t) + x(t)]\, u(t)$

   (ii) $x(t)[\delta\left(t + \frac{5}{2}\right) - \delta(t - \frac{5}{2})]$

   (iii) $x\left(-5 + \frac{2}{3}t\right)$

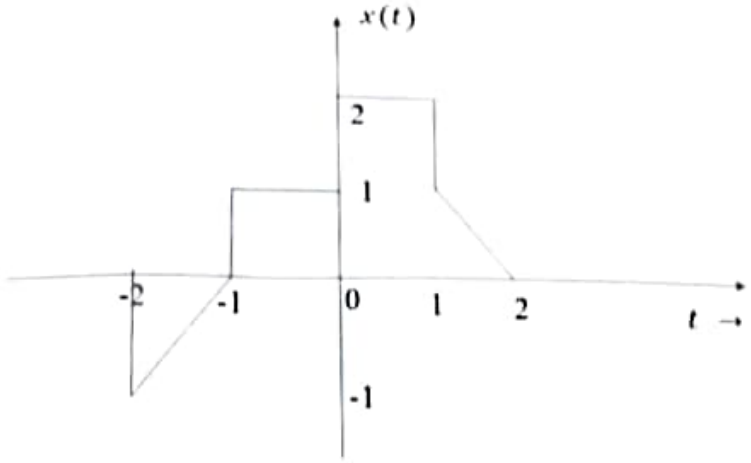

Figure 1

8. Define Hilbert Transform mathematically in time domain. Briefly explain its properties and applications. [10]

9. (i) Find the Nyquist rate and Nyquist interval for the continuous time signal given below: [8 marks] [10]

$$x(t) = \frac{1}{2\pi}(\cos(5000\pi t)\cos(2000\pi t))$$

(ii) If a signal is thought to have a maximum frequency between 1000 Hz and 4000 Hz, what can be an appropriate sample rate? Explain. What happens when the maximum frequency is 30 kHz? [2 marks]

10. Check for Linearity, Time invariance, Stability, Invertibility, Causality and Memory for the following systems: [2 x 5 = 10 marks] [10]

(i) $y(t) = x(\sin t)$

(ii) $y[n] = 5 + x[2n]$

Section C (2 X 15 Marks)

Answer All questions

11. (i) Use Laplace Transform to find the solution of the following equation: [15]

$$y'' + 3y' + 2y = e^{-t}, y(0) = y'(0) = 0 \quad [9 \text{ marks}]$$

(ii) Find the Z transform for the following expression:

$$x(n) = \left(\frac{1}{2}\right)^n . u(n) \qquad [6 \text{ marks}]$$

12. (i) List out the properties of the Continuous-Time Fourier Transform. [6 marks] [15]

(ii) A Discrete-Time Fourier Transform (DTFT) pair is given as follows: [3 x 3 = 9 marks]

$$\{0.8^n u[n]\} = \frac{1}{(1 - 0.8\, e^{-j\omega})}.$$

Compute DTFT of the following sequences using properties:

a) $x[n] = 0.8^n u[n-2]$

b) $x[n] = 0.8^n u[n]\cos(0.1\pi n)$

c) $x[n] = 0.8^{-n} u[-n]$

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