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10EE52

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
Signals and Systems

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define signal. List the classification of signals. **(06 Marks)**

b. Determine and sketch the even and odd parts of the signal shown in Fig.Q1(b).

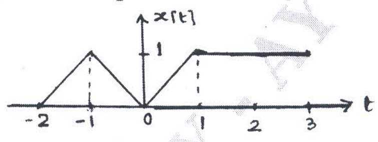

Fig.Q1(b) **(06 Marks)**

c. Fig.Q1(c)(i) shows a staircase like signal x(t) that may be views as the superposition of four rectangular pulses. Starting with the rectangular pulses. Starting with the rectangular pulse g(t) as shown in Fig.Q1(c)(ii). Construct this waveform and express x(t) in terms of g(t).

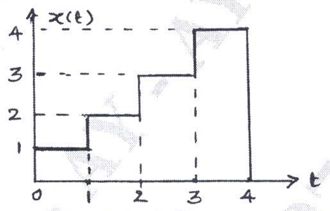

Fig.Q1(c)(i)

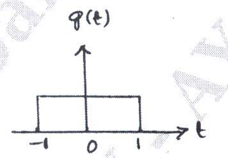

Fig.Q1(c)(ii) **(08 Marks)**

2 a. Determine the convolution of two given sequences

$$x[n] = \{ 1, \underset{\uparrow}{2}, 3, 4 \} \quad \text{and} \quad h[n] = \{ \underset{\uparrow}{1}, 1, 3, 2 \}$$

(06 Marks)

b. Find the convolution sum of two finite duration sequences

$$h[n] = \alpha^n u(n) \text{ for all n; } x[n] = \beta^n u[n] \text{ for all n}$$

(i) when $\alpha \neq \beta$ (ii) when $\alpha = \beta$. **(08 Marks)**

c. Check whether the following systems are

(i) Memory less (ii) Causal (iii) Stable

$h(t) = 3\delta(t)$ **(06 Marks)**

3 a. The differential equation of the system is given as

$$\frac{d^2y(t)}{dt^2} + 2\frac{dy(t)}{dt} + 2y(t) = x(t) \quad \text{with } y(0) = 3, \ \frac{dy(0)}{dt} = -5$$

Determine the total response of the system for a step input. **(08 Marks)**

b. Find the solution of the difference equation given below by using the prescribed initial conditions.

$$y(n) - 0.6\,y(n-1) = x(n) = (0.4)^n \text{ for } n \geq 0, \ y(-1) = 10.$$

(06 Marks)

c. Realize the following differential equation in Direct Form I and Direct Form II.

$$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) + \frac{1}{3}x(n-1)$$

(06 Marks)

4 a. State and prove Parseval's theorem in continuous Time Fourier series. **(06 Marks)**

b. Find the complex fourier coefficient for the periodic waveform x(t) shown in Fig.Q4(b). Also draw the amplitude and phase spectra.

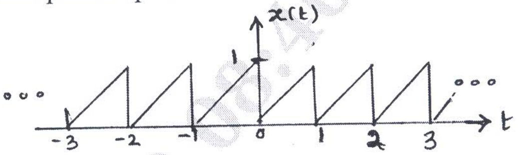

Fig.Q4(b). **(08 Marks)**

c. Find the complex fourier co-efficient for x(t) given below $x(t) = \sin(2\pi t) + \cos(3\pi t)$. Sketch the magnitude and phase spectra. **(06 Marks)**

PART – B

5 a. State and prove the following properties in Continuous Time Fourier Transform (CTFT):
(i) Time – Shifting Property (ii) Time differentiation property (iii) Parseval's theorem. **(12 Marks)**

b. Find the inverse fourier transform of the following using appropriate properties.

$$X(jw) = \frac{jw}{(2+jw)^2}$$ **(08 Marks)**

6 a. Find the DTFT for the following signal x(n) :

(i) $x(n) = 2^n u(-n)$ (ii) $x(n) = \left[\frac{1}{2}\right]^n u(n-4)$ **(08 Marks)**

b. State and prove the following properties in Discrete Time Fourier Transform (DTFT).
(i) Linearity property (ii) Time shift property. **(06 Marks)**

c. Using DTFT, find the total solution to the difference equation for discrete time $n \geq 0$

$$5y(n+2) - 6y(n+1) + y(n) = (0.8)^n u(n)$$ **(06 Marks)**

7 a. What is region of convergence (ROC)? Mention the properties of ROC. **(08 Marks)**

b. Determine the z-transform of $x(n) = 7\left(\frac{1}{3}\right)^n u(n) - 6\left(\frac{1}{2}\right)^n u(n)$ and plot pole-zero locations of x(z) in the z-plane. **(06 Marks)**

c. Prove the following properties of z-transform:
(i) Linearity (ii) Time shift. **(06 Marks)**

8 a. Determine inverse z-transform of

$$X(z) = \frac{z}{3z^2 - 4z + 1}$$

ROC (i) $|z| > 1$ (ii) $|z| < \frac{1}{3}$ (iii) $\frac{1}{3} < |z| < 1$ **(08 Marks)**

b. Find the transfer function and impulse response of the system described by the difference equation $y(n) - \frac{1}{2}y(n-1) = 2x(n-1)$ **(06 Marks)**

c. By using unilateral z-transform, solve the following difference equation

$$y(n) + 3y(n-1) = x(n)$$

with $x(n) = u(n)$ and the initial condition $y(-1) = 1$. **(06 Marks)**

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