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10EE52

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer FIVE full questions, selecting atleast TWO questions from each part.***
2. Missing data, if any, may be suitably assumed.

PART – A

1 a. Determine and sketch the even and odd parts of the signal given in Fig.Q1(a).

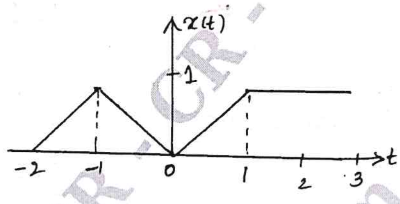

Fig.Q1(a) **(04 Marks)**

b. Given the signal in Fig.Q1(b). Sketch the following :

i) $x(-2t + 3)$ ii) $x\left(\frac{t}{2} - 2\right)$.

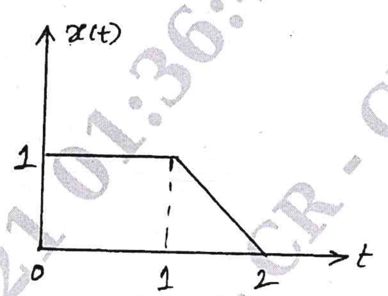

Fig.Q1(b) **(06 Marks)**

c. Determine whether the following signals are :
1) Static or dynamic
2) Causal or non causal
3) Linear or non linear
4) Stable or unstable
5) Time variant or invariant.

i) $y(t) = 10x(t) + 5$ ii) $y(t) = x(n) \cos(\omega_0 n)$. **(10 Marks)**

2 a. Obtain the convolution of the two functions given below :

$$x(t) = \begin{cases} 2; & -2 \le t \le 2 \\ 0; & \text{elsewhere} \end{cases} \qquad h(t) = \begin{cases} 4; & 0 \le t \le 2 \\ 0; & \text{elsewhere} \end{cases}.$$ **(10 Marks)**

b. Derive an expression for convolution sum. **(04 Marks)**

c. Convolve the following two sequences to get y(n).

$x(n) = \{\underset{\uparrow}{1}, 1, 1, 1\}$ $h(n) = \{\underset{\uparrow}{2}, 2\}$. **(06 Marks)**

3 a. Determine the natural response of the system described by the differential equation :

$$5\frac{d}{dt}y(t)+10y(t)=2x(t)\,;\;y(0)=3.$$ **(04 Marks)**

b. Find the forced response for the system given by the difference equation :

$$y(n)-\frac{1}{4}y(n-1)-\frac{1}{8}y(n-2)=x(n)+x(n-1) \text{ with input } x(n)=\left(\frac{1}{8}\right)^n u(n).$$ **(06 Marks)**

c. Draw the direct form I and II implementation for the system described by

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

ii) $\frac{d^2y(t)}{dt^2}+5\frac{dy(t)}{dt}+4y(t)=\frac{dx(t)}{dt}$. **(10 Marks)**

4 a. State and prove the following :

i) Convolution for Fourier series

ii) Parsevsal's theorem. **(06 Marks)**

b. Evaluate DTFS for the signal $x(n)=\sin\left(\frac{4\pi}{21}n\right)+\cos\left(\frac{10\pi}{21}n\right)+1$ sketch the magnitude and phase spectra. **(06 Marks)**

c. Find the Fourier series co-efficient for the signal of Fig.Q4(c).

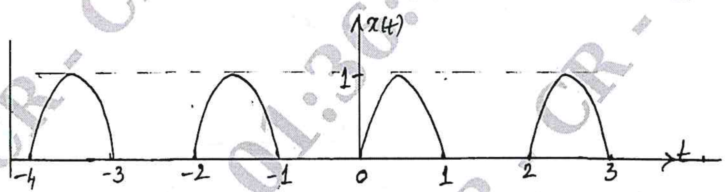

Fig.Q4(c) **(08 Marks)**

PART – B

5 a. Prove that :

if $x(t)\xrightarrow{FT}X(j\omega)$

then $\int_{-\infty}^{t}x(\tau)d\tau \xleftrightarrow{FT} \frac{X(j\omega)}{j\omega}+\pi X(j0)\delta(\omega)$. **(08 Marks)**

b. Find the frequency response and impulse response of the system described by the differential equation : $\frac{d^2y(t)}{dt^2}+5\frac{dy(t)}{dt}+6y(t)=-\frac{dx(t)}{dt}$. **(06 Marks)**

c. Specify the Nyquist rate for each of the following signal

i) $x_1(t)=\sin(200t)$

ii) $x_2(t)=\sin e^2(200t)$. **(06 Marks)**

6 a. Find the DTFT representation for the periodic signal $x(n)=\cos\frac{\pi}{3}n$. Also draw the spectrum. **(08 Marks)**

b. Obtain the frequency response and impulse response of the system having the output y(n) for the input x(n).

$$x(n)=\left(\frac{1}{2}\right)^n u(n);\ y(n)=\frac{1}{4}\left(\frac{1}{2}\right)^n u(n)+\left(\frac{1}{4}\right)^n u(n).$$ **(06 Marks)**

c. Obtain the relationship between DTFT and DTFS. **(06 Marks)**

7 a. Prove the following properties with respect to Z-transform.
i) Linearity ii) Scaling in Z-domain iii) Differentiation in Z – domain. **(12 Marks)**

b. Using appropriate properties to find the Z-transform of :

$$x(n)=n^2\left(\frac{1}{2}\right)^n u(n-3).$$ **(08 Marks)**

8 a. Using partial fraction method obtain the time domain signal with ROC's given below :

$$X(z)=\frac{(1/4)z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)}$$

ROC :

i) $|z|>\frac{1}{2}$

ii) $|z|<\frac{1}{4}$

iii) $\frac{1}{4}<|z|<\frac{1}{2}$. **(12 Marks)**

b. A causal system has input x(n) and output y(n) find the impulse response of the system if $x(n)=\delta(n)+\frac{1}{4}\delta(n-1)-\frac{1}{8}\delta(n-2)$ and $y(n)=\delta(n)-\frac{3}{4}\delta(n-1)$. **(08 Marks)**

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