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10EE52

Fifth Semester B.E. Degree Examination, Aug./Sept.2020
Signals and Systems

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Distinguish between :
   i) Energy signal and power signal
   ii) Even and odd signal
   iii) Periodic and non-periodic signal. **(06 Marks)**

b. Determine whether or not the following signal is periodic. If it is periodic, determine its fundamental period :
   i) $x[n] = \sin\left[\frac{1}{3}(\pi n)\right]\cdot\cos\left[\frac{1}{5}(\pi n)\right]$
   ii) $x[n] = \cos\frac{1}{3}n$. **(04 Marks)**

c. For the given signal x(t) as shown in Fig.Q1(c) sketch the following :

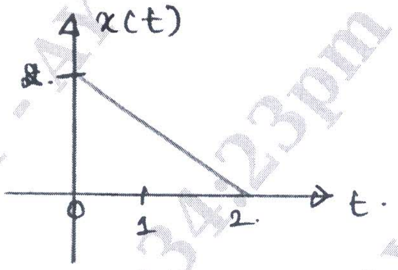

Fig.Q1(c)

   i) $x[2(t-2)]$ ii) $x(-2t-1)$ iii) $x\left(\frac{t}{2}+2\right)$ iv) $x(-t)$. **(04 Marks)**

d. Determine whether the system given below is :
   i) Linear ii) Time invariant iii) causal iv) Memoryless $y(t) = e^{x(t)}$. **(06 Marks)**

2 a. Determine the convolution of $x_1(t) = e^{-3t}u(t)$ and $x_2(t) = u(t+2)$. Also sketch the result. **(08 Marks)**

b. Find the step response of an LTI system if the impulse response $h(t) = t^2\cdot u(t)$. **(06 Marks)**

c. Determine the convolution sum of the sequences.
   $x_1[n] = \{1, 1, \underset{\uparrow}{0}, 1, 1\}$ and $x_2[n] = \{1, -2, -3, \underset{\uparrow}{4}\}$. **(06 Marks)**

3 a. Distinguish between forced response and natural response. Find the forced response for the system given by : $\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = x(t) + \frac{d}{dt}x(t)$ input $x(t) = 5\cdot u(t)$. **(08 Marks)**

b. Draw the direct form – I and direct form – II implementations for the system described by the difference equation : $y[n] - \frac{1}{4}y[n-1] + \frac{1}{8}y[n-2] = x[n] + \frac{1}{2}x[n-1]$. **(06 Marks)**

c. For each of the impulse responses, determine whether the corresponding system is memoryless, causal and stable.
   i) $h(t) = e^{2t}\cdot u(t-2)$
   ii) $h[n] = 2^n\cdot u[-n]$. **(06 Marks)**

4 a. State and prove time shift property as applied to Fourier series. **(06 Marks)**

b. Determine the Fourier coefficients for the signal x(t) as shown in Fig.Q4(b). Plot its magnitude spectrum and phase spectrum.

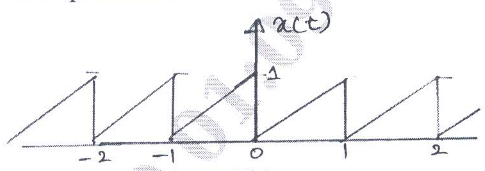

Fig.Q4(b) **(08 Marks)**

c. State and prove Parseval's theorem in case of Discrete Time Fourier Series (DFTS). **(06 Marks)**

PART – B

5 a. State and prove convolution property of discrete time Fourier transforms. **(06 Marks)**

b. Obtain Fourier transform of the following signals :

i) $x(t) = e^{at}u(-t)$

ii) $x(t) = e^{-a|t|}$. **(06 Marks)**

c. Obtain Fourier transform of the following sequences :

i) $x[n] = -a^n \cdot u[-n-1]$

ii) $x[n] = \delta[n]$

iii) $x[n] = a^n \cdot u[n]$. **(08 Marks)**

6 a. State and prove low pass sampling theorem. **(10 Marks)**

b. The system produces the output of $y(t) = e^{-t} \cdot u(t)$ for an input of $x(t) = e^{-2t} \cdot u(t)$. Determine the impulse response and frequency response of the system. **(10 Marks)**

7 a. Define Z – transform of a signal. What does ROC mean? Mention the properties of ROC. **(08 Marks)**

b. Find the Z – transform of :

i) $x[n] = \alpha^n \cdot u[n]$

ii) $x[n] = -u[-n-1] + \left(\frac{1}{2}\right)^n \cdot u[n]$

Mention their ROC. **(06 Marks)**

c. Find the inverse Z – transform of the following using partial fraction expansion method :

$$x[z] = \frac{z+1}{3z^2 - 4z + 1} \text{ ROC } |z| > 1.$$ **(06 Marks)**

8 a. A causal LTI system is described by the difference equation :

$y[n] = y[n-1] + y[n-2] + x[n-1]$

Find the system function H[z]. Plot the poles and zeros and indicate the ROC. Also determine the impulse response of the system. **(06 Marks)**

b. Solve the following difference equation using unilateral Z – transform.

$$y[n] - \frac{3}{2}y[n-1] + \frac{1}{2}y[n-2] = x[n]$$

for $n \geq 0$ with initial conditions, $y[-1] = 4$, $y[-2] = 10$ and $x[n] = \left[\frac{1}{4}\right]^n \cdot u[n]$. **(10 Marks)**

c. Discuss the stability, causality and anticausality of the system from the nature of their transfer function. **(04 Marks)**

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