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Question Paper Code : P 1373

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2009.

Third Semester

Information Technology

IT 1201 — SIGNALS AND SYSTEMS

(Regulation 2004)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Determine whether the continuous-time signal $x(t)$ is periodic or not?
   $x(t) = x_1(t) + x_2(t) + x_3(t)$
   where $x_1(t), x_2(t)$ and $x_3(t)$ have periods of 8/3, 1.26 and $\sqrt{2}$ sec. respectively.

2. Plot the signal $y(t) = 3\delta(t - 0.5) + 4\delta(t + 1)$.

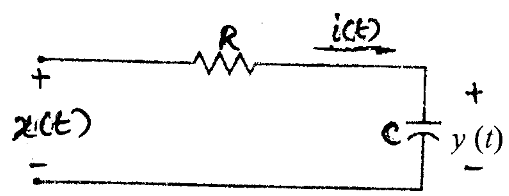
3. Find the Fourier series coefficients of the signal $x(t) = \sin \omega t$.

4. Find the Laplace transform of the signal

   $$x(t) = \delta(t) - \frac{4}{3}e^{-t}u(t) + \frac{1}{3}e^{2t}u(t).$$

5. Define the impulse response of a LTI system.

6. Find the differential equation that relates the input $x(t)$ and output $y(t)$ of the RC filter circuit shown in Fig. 1.



RC Filter Circuit
Fig. 1

7. Distinguish between DFT and DTFT.

8. Write a brief note on Time shifting property of Z-transform.

9. What is state transition matrix?

10. Draw the block diagram representation of the DT system described by the input $x(n)$-output $y(n)$ relation as follows :

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

PART B — (5 × 16 = 80 marks)

11. (a) (i) Briefly describe the following CT and DT system properties with example.

(1) Memory and memory less system.

(2) Causality.

(3) BIBO Stability

(4) Time Invariance.

(5) Linearity. (10)

(ii) Determine and sketch the Even and Odd parts of the signal depicted in Fig. 2. (6)

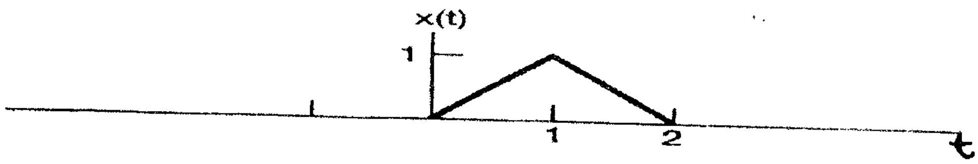


Fig. 2

Or

(b) (i) Determine whether the DT systems described by the following input $x(n)$-output $y(n)$ equations are linear or nonlinear.

(1) $y(n) = x(n^2)$

(2) $y(n) = x^2(n)$. (4)

(ii) Test the Memory less, Time Invariant, Linearity, Causality and Stability properties of the CT system given below :

(1) $y(t) = x(t-2) + x(2-t)$

(2) $y(t) = x(t)[\cos(3t)]$ where $x(t)$ is input and $y(t)$ is output. (12)

12. (a) (i) Find the complex-exponential Fourier series of the square wave $x(t)$ shown in Fig. 3 that converges to $x(t)$ for all time. (8)

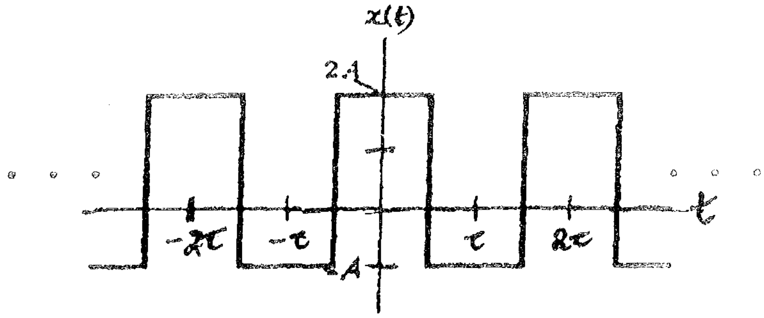


Fig. 3

(ii) Find the amplitude and phase spectra of the rectangular-pulse voltage signal shown in Fig. 4 using Fourier transform. (8)

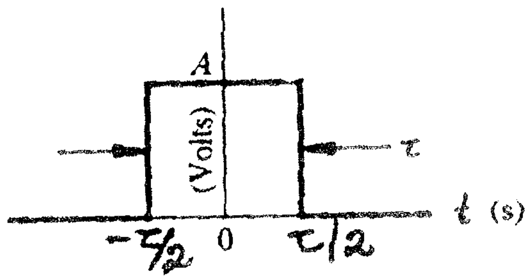


Fig. 4

Or

(b) (i) Use the initial-value theorem to find the initial value of the signal corresponding to the Laplace transform (6)

$$Y(s) = \frac{s+1}{s(s+2)}.$$

(ii) Find the inverse Laplace transform of (10)

$$X(s) = \frac{2s^2 + 5s + 5}{(s+1)^2(s+2)}.$$

13. (a) Find the convolution of the two continuous-time functions

$$x(t) = 3\cos 2t \text{ for all } t$$

and $y(t) = \begin{cases} e^t & t < 0 \\ e^{-t} & t \geq 0. \end{cases}$

Or

(b) Describe the role of state equations and matrix in the analysis of LTI-CT systems.

14. (a) (i) Find the inverse Z-transform using power series expansion and express the signal with first 4 samples : (6)

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

(ii) Find the IDFT of $X_3(k)$,

Where $X_3(k) = 4$ point DFT of $x_1(n) \times 4$ point DFT of $x_2(n)$

Given : $x_1(n) = \{ \underset{\substack{\uparrow \\ n=0}}{2}, 1, 2, 1\}$ and $x_2(n) = \{ \underset{\substack{\uparrow \\ n=0}}{1}, 2, 3, 4\}$. (10)

Or

(b) (i) Find the DTFT of $x[n] = a^n u[n]$, $|a| < 1$. (4)

(ii) Find the Z-transform and the ROC of the signal

$x(n) = [3(2^n) - 4(3^n)]u(n)$. (6)

(iii) Find the inverse Z-transform using partial-fraction expansion and express the signal.

$$Y(z) = \frac{z^{-3}}{2 - 3z^{-1} + z^{-2}}.$$ (6)

15. (a) Find the convolution sum of the input signal $x(n)$ with the impulse response of a LTI system $h(n)$

$x(n) = \{ \underset{\substack{\uparrow \\ n=0}}{1}, 2, 3, 1\}$ and $h(n) = \{1, \underset{\substack{\uparrow \\ n=0}}{2}, 1, -1\}$

Or

(b) Describe in detail the 8-point decimation in time FFT algorithm with example.