5E3109

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B. Tech. (Sem. V) (Main/Back) Examination, December - 2013
Electronics & Communication
5EC1 Signals and Systems (Common for 5EI1 & 5BM1)

Time : 3 Hours] [Total Marks : 80
[Min. Passing Marks : 24

Attempt any five questions. Selecting one question from each unit. All questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used / calculated must be stated clearly.

Use of following supporting material is permitted during examination.
(Mentioned in form No. 205)

1. NIL 2. NIL

UNIT - I

1 (a) Determine whether or not each of the following signals is periodic. If the signal is periodic, determine its fundamental period :

(i) $x(t)=\left[\cos(2t-\pi/3)\right]^2$

(ii) $x(n)=\left[\sin(\pi n/5)\right]/(\pi n)$

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(b) For each of the following systems, determine whether the system is (i) stable, (ii) causal, (iii) linear, (iv) time invariant and (v) memoryless :

(i) $y(t)=\int_{-\infty}^{2t} x(\tau)d\tau$

(ii) $y(n)=x(n)+3u(n+1)$

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OR

1 (a) Consider the difference equation

$$y(n)+\frac{1}{15}y(n-1)-\frac{2}{5}y(n-2)=x(n)$$

(i) Determine the general form of the homogeneous solution to this equation.

(ii) Find the impulse responses of both causal and anticausal LTI systems characterized by this equation.

(iii) Show that causal LTI system is stable and the anticausal LTI system is unstable.

(iv) Find a particular solution when

$$x(n)=\left(\frac{3}{5}\right)^n u(n)$$

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(b) Let $x(t)$ be the input to an LTI system with unit impulse response $h(t)$, where $x(t)=e^{2t}u(-t)$ and $h(t)=u(t-3)$. Find the corresponding output $y(t)$ using convolution.

4

UNIT - II

2 (a) Determine the Fourier series representations for the following signals :

(i) $x(t)$ periodic with period 4 and

$$x(t)=\begin{cases}\sin \pi t, & 0\le t\le 2\\ 0, & 2<t\le 4\end{cases}$$

(ii) $x(n)=\sin(2\pi n/3)\cos(\pi n/2)$

8

(b) State and prove the time shifting and time reversal properties of continuous-time Fourier series.

8

OR

2 (a) For the continuous periodic signal

$x(t)=2+\cos\left(\frac{2\pi}{3}t\right)+4\sin\left(\frac{5\pi}{3}t\right)$, determine the fundamental frequency and the Fourier series coefficients.

4

(b) List the symmetric properties of discrete-time Fourier series and prove any two of them. 8

(c) State and prove the Parseval's relation for continuous or discrete periodic signals. 4

UNIT - III

3 (a) Determine the Fourier transform of $x(t)=e^{-|t|}$. Using this Fourier transform pair and appropriate Fourier transform properties find the Fourier transform of

(i) $te^{-|t|}$

(ii) $\frac{4t}{\left(1+t^2\right)^2}$ 10

(b) State and prove the multiplication property of the discrete-time Fourier transform. 6

OR

3 (a) Determine the discrete-time Fourier transform of the periodic inpulse train

$$x(n)=\sum_{k=-\infty}^{\infty}\delta(n-kN)$$

Derive the expression used. 8

(b) Consider the response of an LTI system with impulse response $h(t)=e^{-at}u(t), a>0$, to the input signal $x(t)=e^{-bt}u(t), b>0$. Find the response using convolution property of continuous-time Fourier transform for the cases,

(i) $b\neq a$

(ii) $b=a$ 8

UNIT - IV

4 (a) The system function of a causal LTI system is $H(S)=\frac{S+1}{S^2+2S+2}$. Determine and sketch the response $y(t)$ when the input is $x(t)=e^{-|t|}$, $-\infty<t<\infty$. 8

(b) Explain the properties of the region of convergence for the Z-transform. 8

OR

4 (a) Determine the Z-transform of the sequence

$$x(n)=\begin{cases} n, & 0\le n\le N \\ 2N-n, & N+1\le n\le 2N \\ 0, & \text{Otherwise} \end{cases}$$

Show the region of convergence in Z-plane and sketch the pole-zero plot. 8

(b) With the help of suitable example, show that the ROC for the Laplace transform of a linear combination of signals can extend beyond the intersection of the ROCs for the individual terms. 8

UNIT - V

5 (a) State and prove the sampling theorem for low-pass signals. 8

(b) Explain the recovery of a discrete-time signal from its samples and hence derive the expression for ideal band limited interpolation formula. 8

OR

5 Write short notes on :
(i) Sampling in frequency domain
(ii) Aliasing. 8+8
