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B028414(028)

B. Tech. (Fourth Semester) Examination, April-May 2022

(AICTE Scheme)

(Electronics & Tele. Communication Engg. Branch)

SIGNALS & SYSTEMS

Time Allowed : Three hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : *Attempt all questions. Part (a) from each question is compulsory. Part (a) carries 4 marks. Attempt any* ***two*** *parts from part (b), (c) and (d) of each question & carries 8 marks each.*

Unit-I

1. (a) Explain deterministic and random signals with examples.

(b) Consider a discrete-time system with input $x[n]$

and output $y[n]$. The input-output relationship for this system is $y[n]=x[n]x[n-2]$.

(i) Is the system memoryless

(ii) Determine the output of the system when the input is $A\delta[n]$, where A is any real or complex number.

(iii) Is the system invertible?

(c) (i) Determine whether the following signals are energy signals, power signals, power signals, or neither.

(a) $x(t)=tu(t)$

(b) $x[n]=(-0.5)^n u[n]$

(ii) Determine the fundamental period of the signal

$x(t)=2\cos(10t+1)-\sin(4t-1)$

(d) Determine whether the system described by the following input-output relationship is :

(i) Stable or unstable

(ii) Linear or non-linear

(iii) Causal or non-casual

(iv) Shift-invariant or shift-variant :

$$y(n)=y(n-2)+n\,x(n)+x(n+2)$$

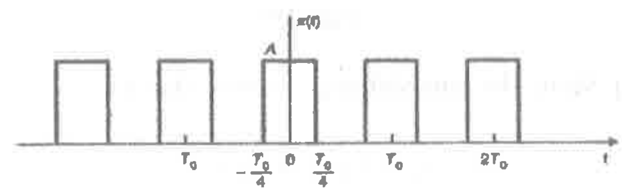
Unit-II

2. (a) State the conditions for existence of Fourier series.

(b) Consider the periodic square wave $x(t)$ shown in figure.

(i) Determine the complex exponential fourier series of $x(t)$.

(ii) Determine the trigonometric fourier series of $x(t)$.



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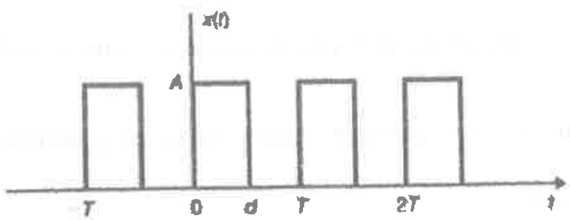
(c) Find and sketch the magnitude spectra for the periodic square pulse training signal $x(t)$ shown in Fig. for :

(i) $d = T_0/4$, and

(ii) $d = T_0/8$



(d) Verify the Parseval's identify for the Fourier series : i.e.,

$$\frac{1}{T_0}\int_{T_0} |x(t)|^2 \, dt = \sum_{k=-\infty}^{\infty} |c_k|^2$$

Unit-III

3. (a) Verify the time shifting property; that is

$$x(t-t_0) \leftrightarrow e^{j\omega t_0} X(\omega)$$

(b) Find the Fourier Transform of the Signal

$x(t) = \dfrac{1}{a^2 + t^2}$ and plot the spectrum.

(c) Obtain the Fourier Transform and spectrums of the following signals :

(i) $x(t) = \cos w_0 t$

(ii) $x(t) = \sin w_0 t$

(d) Find the inverse Fourier Transform of

$$X(w) = jw/(3 + jw)^2$$

Unit-IV

4. (a) Define ROC and write the properties of ROC.

(b) Find the z-transform $X(z)$ and sketch the pole zero plot with the ROC for the following sequence.

$$x[n] = \left(\frac{1}{3}\right)^n u[n] + \left(\frac{1}{2}\right)^n u[-n-1]$$

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(c) Verify the convolution property; that is

$$x_1[n] * x_2[n] \leftrightarrow X_1(z)X_2(z) \quad R' \supset R_1 \cap R_2$$

(d) Using partial fraction expansion, find the inverse z – transform of $X(z) = \frac{z}{z(z-1)(z-2)^2}$ for $|z| > 2$.

Unit-V

5. (a) (i) Define impulse response of a continuous time LTI system.

(ii) Define Eigen function of continuous time LTI system.

(b) Consider a continuous-time LTI system with the input-output relation given by

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

(i) Find the impulse response $h(t)$ of this system.

(ii) Show that the complex exponential e^{st} is an eigen function of the system.

(iii) Find the eigen value of the system corresponding to est by using the impulse response $h(t)$ obtained in part (*i*).

(c) Compute the output $y(t)$ for a continuous-time LTI system whose impulse response $h(t)$ and the input $x(t)$ are given by :

$$h(t) = e^{-at}u(t) \qquad x(t) = e^{at}u(-t)\; a > 0$$

(d) Consider a discrete-time system whose input $x[n]$ and output $y[n]$ are related by $y[n] - ay[n-1] = x[n]$ where a is a constant. Find $y[n]$ with the auxiliary condition $y[-1] = y_{-1}$ and $x[n] = Kb^n u[n]$.