Code No: RR210402 **Set No.1**

II B.Tech. I Semester Supplementary Examinations, M ay -2005
SIGNALS & SYSTEMS
(Common to Electronics & Communication Engineering, Electronics & Instrumentation Engineering, Electronics & Control Engineering, Electronics & Telematics and Instrumentation & Control Engineering)
Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain the significance of spectrum analysis of signal with regard to synthesis of systems.
   (b) Define orthogonal signal space and bring out clearly its application in representing a signal.
   (c) Obtain the condition under which two signals $f_1(t)$ & $f_2(t)$ are said to be orthogonal to each other. Hence prove that Sin nwot and Cos mwot are orthogonal to each other for all integer values of m,n.

2. (a) Find the exponential Fourier series and plot the magnitude and phase spectrums for the full wave rectified sine wave the following figure1.

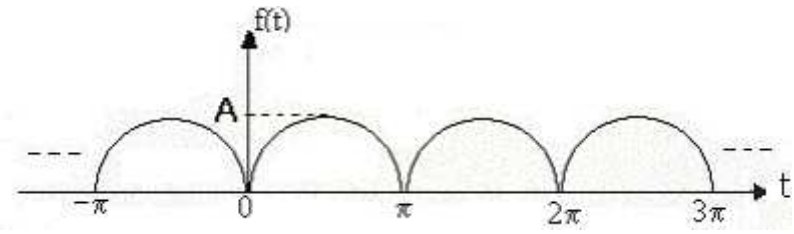

Figure 1:

   (b) Explain the conditions under which any periodic waveform can be expressed using Fourier series.

3. (a) Determine the Fourier transform of a square wave shown below the figure 2:

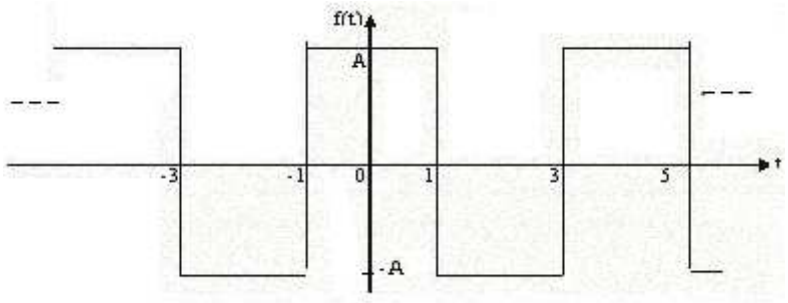

Figure 2:

(b) Find the Fourier Transform. of 5 $\sin^2(3t)$.

4. There are several possible ways of estimating an essential bandwidth of non-band limited signal. For a low pass signal, for example, the essential bandwidth may be chosen as a frequency where the amplitude spectrum of the signal decays to k percent of its peak value. The choice of k depends on the nature of application. Choosing k= 5 determine the essential bandwidth of g(t)=exp(-at) u(t).

5. (a) What do you understand by Energy spectral density and power spectral density? State and prove Parseval's theorem for energy signal.

   (b) If a signal g(f) is passed through an ideal LPF of bandwidth f_cHz, determine the energy density of the o/p signal.

6. Determine the cross correlation function $R_{12}(\lambda)$ of two signals $g_1(t)$ and $g_2(t)$ defined by

   $g_1(t) = \begin{cases} ACos(2\pi f_1 t + \theta_1), 0 \le t \le T \\ 0, \quad elsewhere \end{cases}$ $g_2(t) = \begin{cases} ACos(2\pi f_2 t + \theta_2), 0 \le t \le T \\ 0, \quad elsewhere \end{cases}$

   How does varying the frequency difference $|f_1\text{-}f_2|$ affect this cross-correlation function?

7. (a) Explain the time shifting property of Laplace transform

   (b) Suppose the Following facts are given about the signal x(t) with Laplace transform X(s):

   i. x(t) is real and even

   ii. X(s) has four poles and no zeros in a finite s-plane

   iii. X(s) has pole at s=$(1/2)e^{j\pi/4}$

   iv. $\int_{-\infty}^{\infty} x(t)dt = 4$

   Determine X(s) and ROC

8. (a) What are the methods by which inverse Z- transformation can be found out?

   (b) Given X (z)= $\frac{1}{1-az^{-1}}$,|z| > |a |. Find x (n) using long division method.

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Code No: RR210402 **Set No.2**

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1. (a) Explain orthogonality property between two complex functions $f_1(t)$ and $f_2(t)$ for a real variable 't'
   (b) Discuss how an unknown function f(t) can expressed using infinite mutually Orthogonal function. Hence show the representation of a wave forms f(t) using Trigonometric Fourier series.

2. (a) Obtain the Fourier components of the periodic rectangular waveform shown below the figure3:

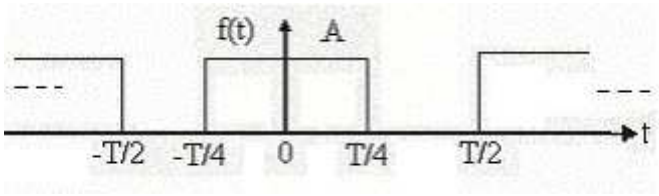

Figure 3:

   (b) Write a short notes on Dirichlets' conditions.

3. (a) Obtain the Fourier transform of the following:
      i. x(t)=A Sin $(2\pi f_c t)$. u(t).
      ii. x(t)=f(t).Cos$(2\pi f_c t+\Phi)$.
   (b) State and prove the following properties of Fourier transform.
      i. Multiplication in time domain.
      ii. Convolution in time domain.

4. Determine the maximum bandwidth of signals that can be transmitted through the lowpass RC filter shown in the figure7., if over this bandwidth the gain variation is to be with in 10 percent and the phase variation is to be within 7 percent of the ideal characteristics.

5. (a) State and prove Rayleigh Energy theorem.
   (b) Determine the signal energy and power for
      i. $f(t) = e^{-3|t|}$ and

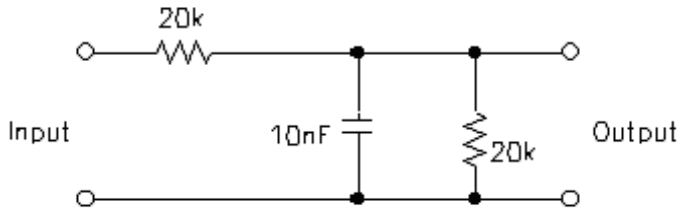

Figure 4:

ii. f(t) = e^{-3t}

6. Determine the cross correlation function $R_{12}(\lambda)$ of two signals $g_1(t)$ and $g_2(t)$ defined by
$g_1(t) = \begin{cases} ACos(2\pi f_1 t + \theta_1), 0 \le t \le T \\ 0, \quad elsewhere \end{cases}$ $g_2(t) = \begin{cases} ACos(2\pi f_2 t + \theta_2), 0 \le t \le T \\ 0, \quad elsewhere \end{cases}$
How does varying the frequency difference | f_1-f_2| affect this cross-correlation function?

7. (a) The differential equation of Laplace transform is $\frac{d^2y(t)}{dt^2} + 6\frac{dy(t)}{dt} + 8y(t) = \frac{dx(t)}{dt} + x(t), \frac{dy(0)}{dt} = 3$,y(0) = 1,x(t)=u(t). Find the transfer function.
   (b) Find the signal that corresponds to X(s)= $\frac{3s^2+22s+27}{(s+1)(s+2)(s^2+2s+5)}$.

8. (a) Given X (z) = z / [z-1]^3, find x (n) using contour integration method
   (b) Distinguish between one-sided and two –sided z-transforms. What are this applications.

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1. (a) A rectangular function defined by
$f(t) = \begin{cases} 1 & 0 < t < \pi \\ -1 & \pi < t < 2\pi \end{cases}$
Approximate above rectangular function by a single sinusoid sin t,Evaluate Mean square error in this approximation. Also show what happens when more number of sinusoidal are used for approximations.
(b) Discuss GIBB'S Phenomena in the above problem.

2. Find out the exponential Fourier series and plot the magnitude and phase spectra for the rectangular pulse train shown below the figure5:

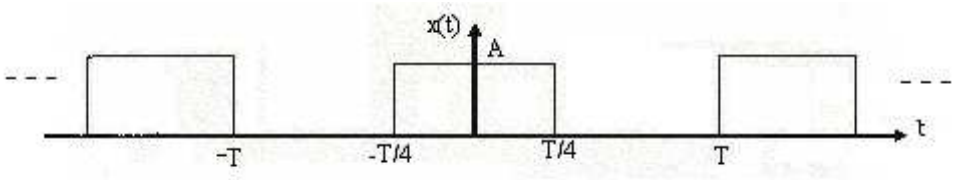

Figure 5:

3. (a) Find the Fourier transform of the following figure6 signal.

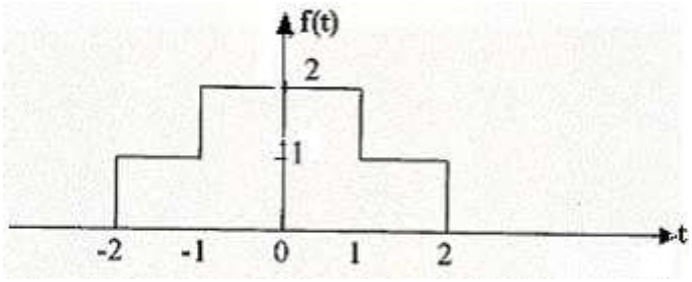

Figure 6:

(b) State and prove time shifting and convolution properties of Fourier Transform.

4. Determine the maximum bandwidth of signals that can be transmitted through the lowpass RC filter shown in the figure7., if over this bandwidth the gain variation is to be with in 10 percent and the phase variation is to be within 7 percent of the ideal characteristics.

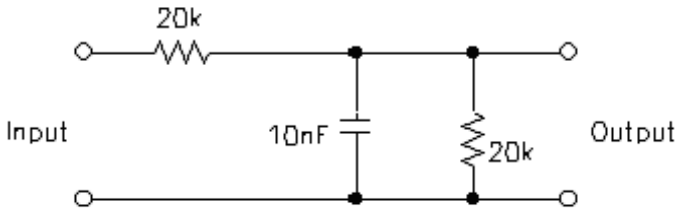

Figure 7:

5. (a) A power signal g(t) has a PSD $S_g(\omega)$ = N/(A^2) -2πB ≤ ω ≤ 2πB ., shown in the figure8. Where A and N are constants. Determine the PSD and the mean square value of its derivative d(g(t)/dt.

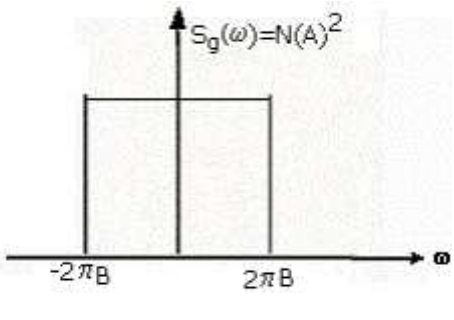

Figure 8:

(b) Derive the relation between power and power density spectrum.

6. Determine the cross correlation function $R_{12}(\lambda)$ of two signals $g_1(t)$ and $g_2(t)$ defined by

$$g_1(t) = \begin{cases} ACos(2\pi f_1 t + \theta_1), 0 \le t \le T \\ 0, \quad elsewhere \end{cases} \qquad g_2(t) = \begin{cases} ACos(2\pi f_2 t + \theta_2), 0 \le t \le T \\ 0, \quad elsewhere \end{cases}$$

How does varying the frequency difference | f_1-f_2| affect this cross-correlation function?

7. (a) The signal x(t) = sin 2t oscillates between +1 and -1 as t → ∞ . So it does not have a final value. Show that the application of the final value theorem gives an incorrect result for the signal.

(b) State and prove the time-differentiation and time-integration properties.

8. (a) State and prove the scaling and time shifting properties of z transform

(b) Find the z transform of (aˆn) cos (nπ/2)

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1. (a) Define Mean square error and derive the expression for evaluating Mean square error.
   (b) A rectangular function defined as,
   $$f(t) = \begin{cases} A & 0 < t < \frac{\pi}{2} \\ -A & \frac{\pi}{2} < t < \frac{3\pi}{2} \\ A & \frac{3\pi}{2} < t < 2\pi \end{cases}$$
   Approximate above function by A Cos t between the intervals$(0,2\pi)$ such that mean square error is minimum.

2. The complex exponential representation of a signal f(t) over the interval (0,T) is
   $f(t) = \sum_{n=-\infty}^{\infty} (3/4 + (n\pi)^2) e^{jn\pi t}$
   (a) What is the numerical value of T ?
   (b) One of the components of f(t) is A Cos3πt. Determine the value of A.
   (c) Determine the minimum number of terms which must be retained in the representation of f(t) in order to include 99.9% of the energy in the interval.

3. (a) Obtain the Fourier transform of the trapezoidal pulse shown in the following figure9.

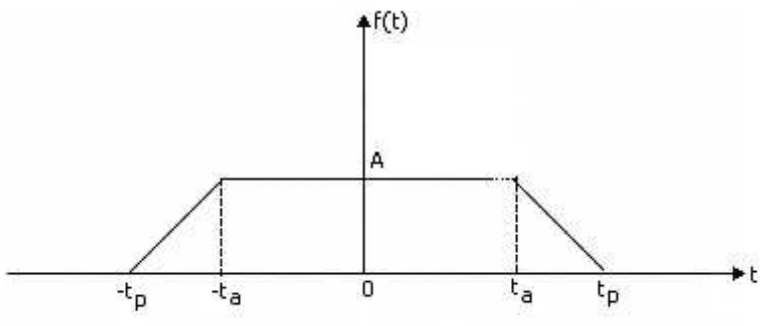

Figure 9:

   (b) Describe the symmetry property of Fourier transform.

4. (a) Explain the difference between a time invariant system and time variant system? Write some practical cases where you can find the systems. What do you understand by the filter characteristics of a linear system? Explain the condition of causality?
   (b) What is the effect of under sampling?
5. For the following signal find the power, and rms value, and sketch the PSD
   (a) (A+sin100t) cos 200t.
   (b) State and prove Parseval's theorem.
6. Determine the cross correlation function $R_{12}(\lambda)$ of the pair of rectangular pulses shown in the figure10 and sketch it. What is the value of $R_{21}(\lambda)$.

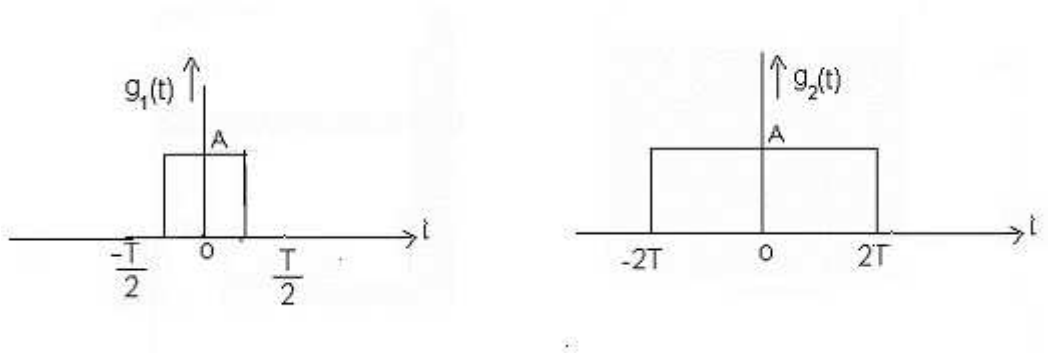

Figure 10:

7. (a) Use geometric evaluation from the pole-zero plot to determine the magnitude of the Fourier transform of the signal whose Laplace transform is specified as $X(s) = \frac{s^2-s+1}{s^2+s+1}$ $\Re$ e{s} > -(1/2)
   (b) Determine the Laplace transform and associated region of convergence
   And pole-zero plot for the following function of time x(t)=e^{-2t} u(t)+e^{-3t} u(t)
8. (a) What are the methods by which inverse Z- transformation can be found out?
   (b) Given X (z)= $\frac{1}{1-az^{-1}}$,|z| > |a |. Find x (n) using long division method.

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