Code No: RR210402

Set No. 1

II B.Tech I Semester Supplementary Examinations, November 2006
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) Discuss the analogy between vectors and signals and hence explain orthogonal vector space and orthogonal signal spaces. [6M]
   (b) Explain the condition of orthogonality between two signal $f_1(t)$ & $f_2(t)$. [6M]
   (c) Show that the functions sin nwot and sin mw_ot are orthogonal to each other for all integer values of m and n. [4M]

2. Obtain the trigonometric Fourier series of the triangular waveform as shown below the figure2: [16M]

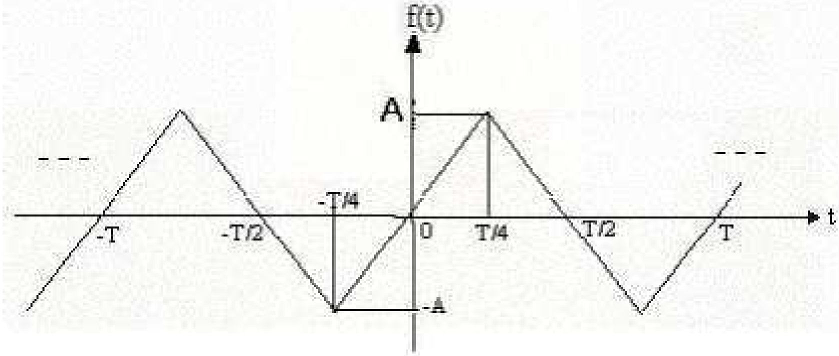

Figure 2

3. (a) Determine the Fourier transform of the sinusoidal pulse shown below: [8M]
   (b) Determine the Fourier transform of f(t) = $e^{-a|t|}$ sgn (t) the following figure 3b.
   [8M]

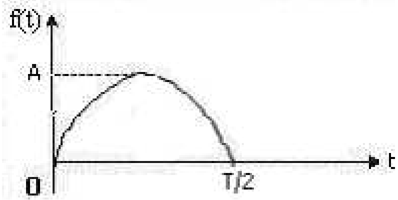

Figure 3b

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). [16M]

5. (a) A power signal g(t) has a PSD $S_g(\omega) = N/(A^2)$ $-2\pi B \leq \omega \leq 2\pi B$., shown in the figure5a. Where A and N are constants. Determine the PSD and the mean square value of its derivative d(g(t)/dt. [5+5=10M]

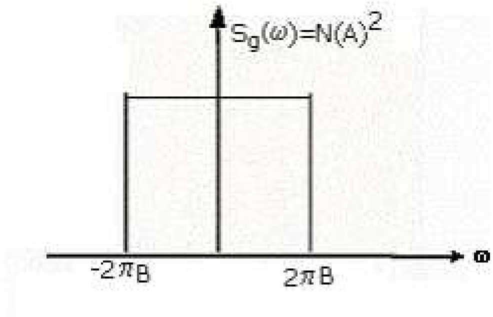

Figure 5a

   (b) Derive the relation between power and power density spectrum. [6M]

6. (a) Explain the difference between correlation and convolution with an example. [8M]

   (b) Find the autocorrelation of a triangular function. [8M]

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). [6+2=8M]

   (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). [6+2=8M]

8. (a) State and prove the convolution theorem and time shifting properties of z transform. [4+4=8M]

   (b) Using the power series method find the first five samples of $1/[1- 4z^{-1} + 6z^{-2}]$. [8M]

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Answer any FIVE Questions
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1. (a) Discuss the analogy between vectors and signals and hence explain orthogonal vector space and orthogonal signal spaces. [6M]
   (b) Explain the condition of orthogonality between two signal $f_1(t)$ & $f_2(t)$. [6M]
   (c) Show that the functions sin nwot and sin mw_ot are orthogonal to each other for all integer values of m and n. [4M]
2. (a) Find out the exponential fourier series & plot the magnitude and phase spectrum for the rectangular pulse train shown in the following figure2a. [12M]

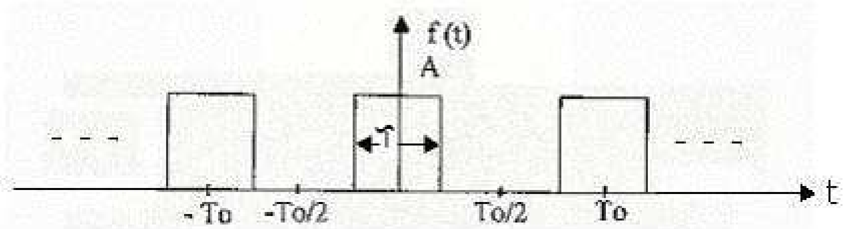

Figure 2a

   (b) Write short notes on exponential fourier spectrum. [4M]
3. Find the Fourier transform of the following functions.
   (a) Single triangular pulse with period T=8sec and amplitude A=10v. [6M]
   (b) One cycle sine wave. [5M]
   (c) A single symmetrical triangular pulse. [5M]
4. (a) Explain the characteristics of an ideal LPF. Explain why it cannot be realized? [2+4=6M]
   (b) A resistive network formed by two resistors R1 and R2 is used as an attenuator to reduce the voltage applied at terminals ab by a factor R2/R1+R2. Resistors R1 and R2 have stray capacitances across them of magnitude C1 and C2 respectively, as shown in the figure4b. What should be the relationship between R's ureand C's in order to have distortionless transmission? [10M]

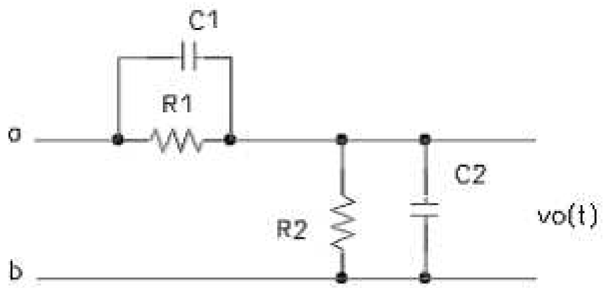

Figure 4b

5. (a) What do you understand by Energy spectral density and power spectral density? State and prove Parseval's theorem for energy signal. [2+2+6=10M]

   (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. [6M]

6. Determine the cross correlation function $R_{12}(\lambda\ )$ of the pair of rectangular pulses shown in the figure6 and sketch it. What is the value of $R_{21}(\lambda\ )$. [12+4=16M]

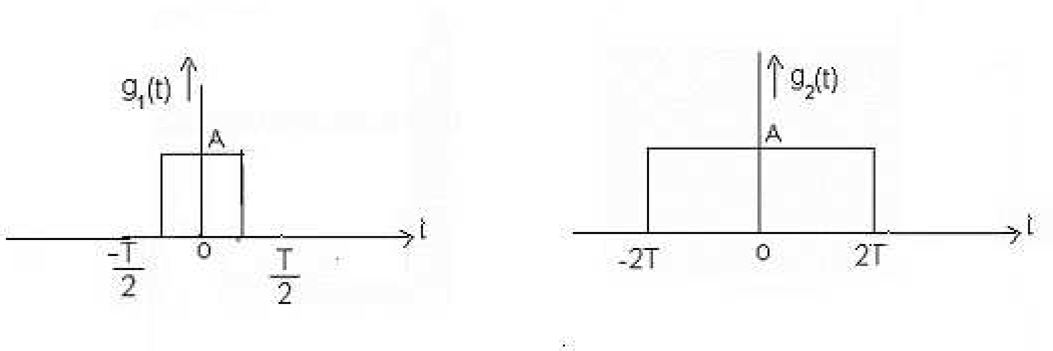

Figure 6

7. (a) The Laplace Transform of x(t) is X(s)= $[\frac{b_m s^m + b_{m-1}s^{m-1} + ...+b_0}{s(s^n + a_{n-1}s^{n-1} + ...+a_0)}]$. [8M]
   Find $\imath t_{t\to\infty}$x(t). [8M]

   (b) Find the signal that corresponds to X(s)= $\frac{6s^2-2s+2}{(s+1)(s^2+4s+13)}$. [8M]

8. (a) Given X (z) = z / [z-1]ˆ3, find x (n) using contour integration method. [8M]

   (b) Distinguish between one-sided and two –sided z-transforms. What are this applications. [8M]

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Code No: RR210402 **Set No. 3**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) Define what are Basis functions and explain how basis functions are used for representing an signal over a period $t_1 < t < t_2$. [4M]
   (b) Define and discuss the conditions for orthogonality of two functions $f_1(t)\&f_2(t)$. [6M]
   (c) Prove the orthogonality condition in the case of a signal represented by orthogonal signal space consisting of exponential functions, $\{e^{j_n wot}\}$ for 'n' integer. [6M]

2. (a) Find the Fourier series for the periodic signal shown below the figure2a: [10M]

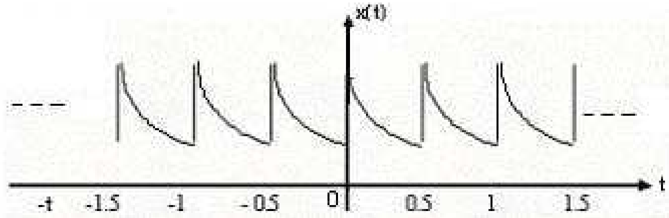

Figure 2a

   (b) With regard to Fourier series representation, justify the following statements:
      i. Odd functions have only sine terms.
      ii. Even functions have no sine terms
      iii. Functions with half wave symmetry have only odd harmonics. [2+2+2]

3. (a) Find the Fourier transform of the following function.
      i. $x(t)=$ Sin $((2\pi f_o t)$. [4M]
      ii. $x(t)=A$ rect(t/c) Cos $(2\pi f_c t)$. [4M]
   (b) State and prove differentiation and integration properties of Fourier transform. [4+4=8M]

4. Determine the maximum bandwidth of signals that can be transmitted through the lowpass RC filter shown in the figure4., 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. [16M]

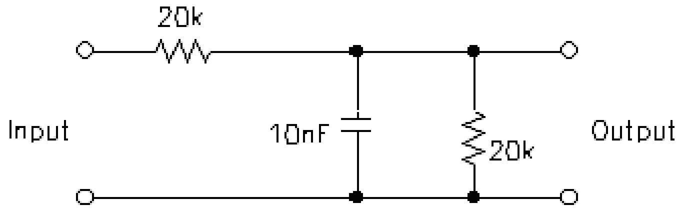

Figure 4

5. (a) State and prove Rayleigh's energy theorem. [8M]
   (b) Find the total energy of the Sinc pulse(A Sinc(2wt)). [8M]
6. (a) The Fourier transform of a signal is defined by |sinc(f)|.Show that the auto correlation function of a signal is triangular in form. [8M]
   (b) Prove that convolution and correlation are identical for even signals. [8M]
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). [6+2=8M]
   (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). [6+2=8M]
8. (a) Explain the properties of the region of convergence of X (z). [8M]
   (b) Discuss in detail about the double sided and single sided Z- transform. Correlate Laplace transform and Z-transform in their end use. [6+2=8M]

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1. (a) Define what are Basis functions and explain how basis functions are used for representing an signal over a period $t_1 < t < t_2$. [4M]
   (b) Define and discuss the conditions for orthogonality of two functions $f_1(t)\&f_2(t)$. [6M]
   (c) Prove the orthogonality condition in the case of a signal represented by orthogonal signal space consisting of exponential functions, $\{e^{j_n wot}\}$ for 'n' integer. [6M]

2. (a) Obtain the trigonometric Fourier series for the half wave rectified sine wave shown in figure2a: [10M]

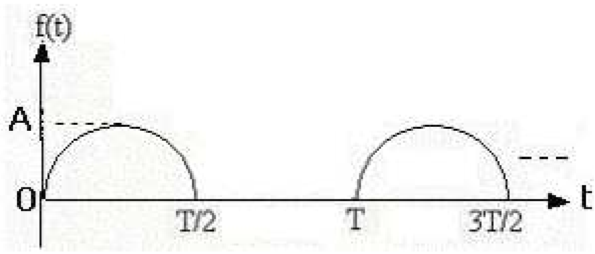

Figure 2a

   (b) Explain the significance of waveform symmetry in Fourier analysis. [6M]

3. (a) Obtain the Fourier transform of the following functions.:
      i. Impulse function f(t). [3M]
      ii. DC Signal. [3M]
      iii. Unit step function. [4M]
   (b) State and prove differentiation property of Fourier Transform. [6M]

4. Determine the maximum bandwidth of signals that can be transmitted through the lowpass RC filter shown in the figure4., 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. [16M]

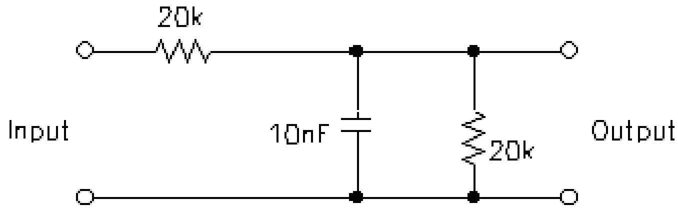

Figure 4

5. (a) A power signal g(t) has a PSD $S_g(\omega) = N/(A^2)$ $-2\pi B \leq \omega \leq 2\pi B$., shown in the figure5a. Where A and N are constants. Determine the PSD and the mean square value of its derivative d(g(t)/dt. [5+5=10M]

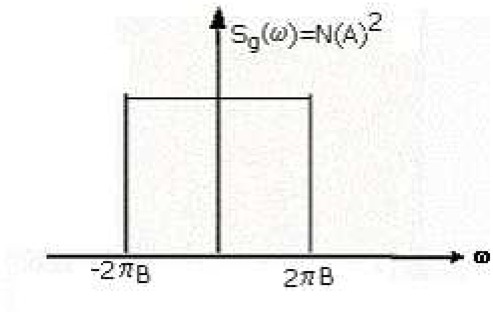

Figure 5a

   (b) Derive the relation between power and power density spectrum. [6M]

6. (a) Determine and sketch the auto correlation function of given exponential pulse. $F(t) = e^{-at}$. [8M]

   (b) Show that auto-correlation function and energy density spectrum form a Fourier transform pair. [8M]

7. (a) For the signal given below, find the Fourier transform from the Laplace transform, if possible. If it is not possible give the reason: $X(s)=\frac{(s+2)}{(s+1)(s+5)}$. [8M]

   (b) State and prove convolution and differentiation properties of Laplace transform. [4+4=8M]

8. (a) Given H (z)={z+1}/[3(zˆ2)-4z+1], find h (n) by partial fraction method. R.O.C. |z| > 1. [10M]

   (b) Prove the differentiation property of z-transaction. [6M]

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