Code No: X0423/R07 **Set No. 1**

II B.Tech I Semester Regular Examinations, November 2009
SIGNALS AND SYSTEMS
(Common to Electronics & Communication Engineering, Electronics & Instrumentation Engineering, Bio-Medical Engineering and Electronics & Control Engineering)

Time: 3 hours Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) Define and sketch the following elementary signals
   i. Unit impulse signal
   ii. Unit Step signal
   iii. Signum function

   (b) Explain the Analogy of vectors and signals in terms of orthogonality and evaluation of constant. [6+10]

2. (a) Derive polar Fourier series from the exponential Fourier series representation and hence prove that $D_n = 2|C_n|$

   (b) Show that the magnitude spectrum of every periodic function is Symmetrical about the vertical axis passing through the origin. [8+8]

3. (a) State and prove time convolution and time differentiation properties of Fourier Transform.

   (b) Find and sketch the Inverse Fourier Transform of the Waveform shown in figure 3b. [8+8]

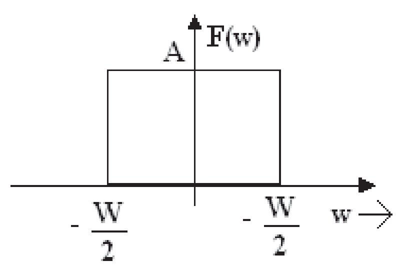

Figure 3b

4. (a) Explain how input and output signals are related to impulse response of a LTI system.

   (b) Let the system function of a LTI system be $\frac{1}{jw+2}$. What is the output of the system for an input $(0.8)^t u(t)$. [8+8]

5. (a) State and Prove Properties of cross correlation function.

   (b) If V(f) = AT sin 2π fT/2π fT find the energy contained in V(t). [8+8]

6. (a) A low pass signal x(t) has a spectrum x(f) given by
$x(f) = \begin{matrix} 1 - |f|/200 & |f| < 200 \\ 0 & elsewhere \end{matrix}$
Assume that x(t) is ideally sampled at fs=300 Hz. Sketch the spectrum of $x_\delta(t) for\ |f| < 200$.

   (b) The uniform sampling theorem says that a band limited signal x(t) can be completely specified by its sampled values in the time domain. Now consider a time limited signal x(t) that is zero for $|t| \geq T$. Show that the spectrum x(f) of x(t) can be completely specified by the sampled values x(kf_o) where $f_0 \leq 1/2T$. [8+8]

7. (a) The impulse response of a network is given by
$h(t) = 0.24\left(e^{-0.36t} - e^{-2.4t}\right)$. Determine the step response V_0(t).

   (b) Find inverse laplace transform of $\frac{s+1}{(s+1)^2+4}$ $\quad$ Re$\{S\} > -1$. [8+8]

8. (a) A finite sequence x[n] is defined as x[n] = {5,3,-2,0,4,-3} Find X[Z] and its ROC.

   (b) Consider the sequence x[n] = $\begin{cases} a^n & 0 \leq n \leq N-1,\ a > 0 \\ 0 & otherwise \end{cases}$
Find X[Z].

   (c) Find the Z-transform of $x(n) = \cos(n\omega)u(n)$. [5+5+6]

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Code No: X0423/R07

Set No. 2

II B.Tech I Semester Regular Examinations, November 2009
SIGNALS AND SYSTEMS
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Define and sketch the following elementary signals
   i. Unit impulse signal
   ii. Unit Step signal
   iii. Signum function

   (b) Explain the Analogy of vectors and signals in terms of orthogonality and evaluation of constant. [6+10]

2. (a) State the properties of Fourier series.

   (b) Obtain the trigonometric fourier series representation for a half wave rectified Sine wave shown in figure 2 [6+10]

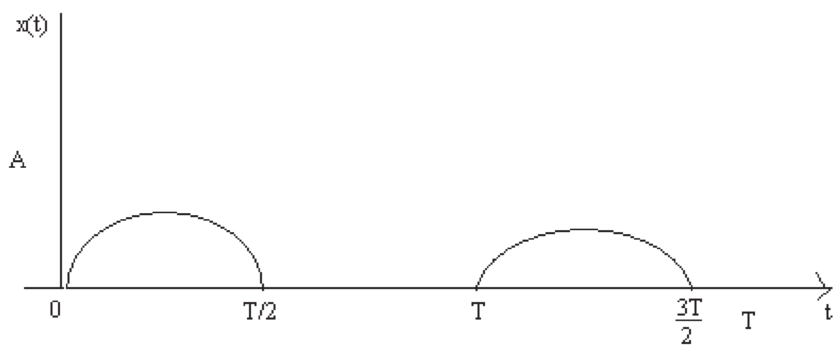

Figure 2

3. (a) Obtain the Fourier transform of the following functions:
   i. Impulse function δ(t)
   ii. DC Signal
   iii. Unit step function.

   (b) State and prove time differentiation property of Fourier Transform. [12+4]

4. (a) Explain how input and output signals are related to impulse response of a LTI system.

   (b) Let the system function of a LTI system be $\frac{1}{jw+2}$. What is the output of the system for an input $(0.8)^t\, u\,(t)$. [8+8]

5. Find the power of periodic signal g(t) shown in figure 5c. Find also the powers of [4×4]

   (a) -g(t)
   (b) 2g(t)
   (c) g(t).

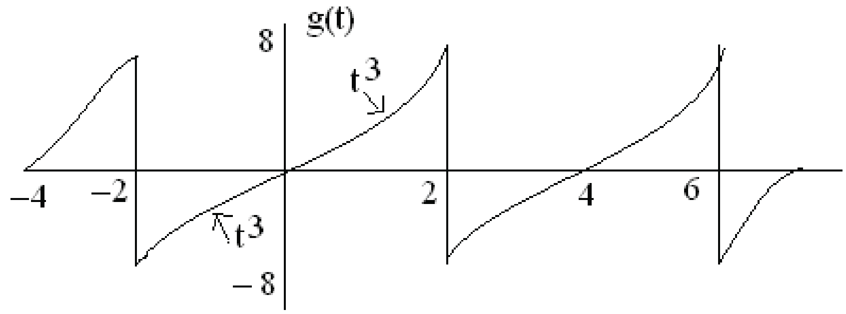

Figure 5c

6. (a) A signal x(t)= 2 cos 400 π t + 6 cos 640 π t. is ideally sampled at $f_s = 500Hz$. If the sampled signal is passed through an ideal low pass filter with a cut off frequency of 400 Hz, what frequency components will appear in the output.

   (b) A rectangular pulse waveform shown in figure 6b is sampled once every T_S seconds and reconstructed using an ideal LPF with a cutoff frequency of $f_s/2$. Sketch the reconstructed waveform for $T_s = \frac{1}{6}$ sec $and\, T_s = \frac{1}{12}$ sec. [8+8]

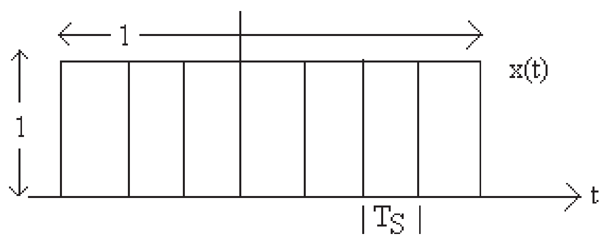

Figure 6b

7. (a) Find the inverse Laplace transform of the following:

   i. $\frac{s^2+2s+5}{(s+3)(s+5)^2}$ Re(s) > -3

   ii. $\frac{2s+1}{s+2}$ Re(s) > -2

   (b) Find the laplace transform of sin ωt . [10+6]

8. (a) A finite sequence x[n] is defined as x[n] = {5,3,-2,0,4,-3} Find X[Z] and its ROC.

   (b) Consider the sequence x[n] = $\begin{cases} a^n & 0 \leq n \leq N-1,\ a > 0 \\ 0 & otherwise \end{cases}$

   Find X[Z].

   (c) Find the Z-transform of $x(n) = \cos(n\omega)u(n)$. [5+5+6]

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Code No: X0423/R07 **Set No. 3**

II B.Tech I Semester Regular Examinations, November 2009
SIGNALS AND SYSTEMS
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Time: 3 hours Max Marks: 80

Answer any FIVE Questions
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1. (a) Define and discuss the conditions for orthogonlity of functions.
   (b) Prove that sinusoidal functions are orthogonal functions. [8+8]

2. (a) Explain about even and odd functions.
   (b) Obtain the trigonometric fourier series for the periodic waveform as shown in figure 2 [6+10]

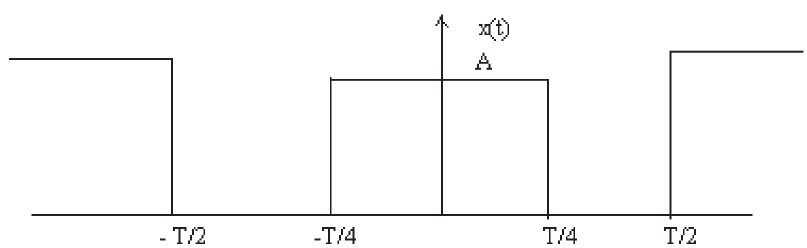

Figure 2

3. (a) Obtain the Fourier Transform of the following:
      i. $x(t) = A \text{ Sin } (2\pi f_c t)\ u(t)$
      ii. $x(t) = f(t) \text{ Cos } (2\pi f_c t + \phi)$
   (b) State and prove the following properties of Fourier Transform [8+8]
      i. Multiplication in time domain
      ii. Convolution in time domain.

4. (a) Explain the characteristics of an ideal LPF. Explain why it can't be realized.
   (b) Differentiate between causal and non-causal systems. [12+4]

5. (a) State and Prove Properties of auto correlation function?
   (b) A filter has an impulse response h(t) as shown in figure 5b The input to the network is a pulse of unit amplitude extending from t=0 to t=2. By graphical means determine the output of the filter. [8+8]

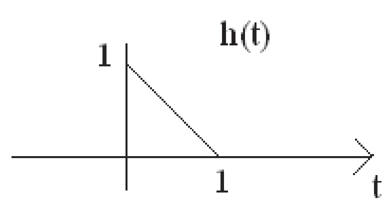

Figure 5b

6. (a) The signal x(t) with Fourier transform $x(j\omega) = u(\omega) - u(\omega - \omega_0)$ can undergo impulse train sampling without aliasing, provided that the sampling period $T < 2\pi/\omega_o$. Justify.

   (b) Determine the Nyquist rate of the following signal
   $x(t) = \left(\frac{\sin 4000\Pi t}{\Pi t}\right)^2$

   (c) Determine the Nyquist sampling rate and Nyquist sampling interval for the signal $\sin c(50\Pi t), \sin c(100\Pi t)$. [5+5+6]

7. (a) Determine the laplace transform of signal shown in figure 7a.

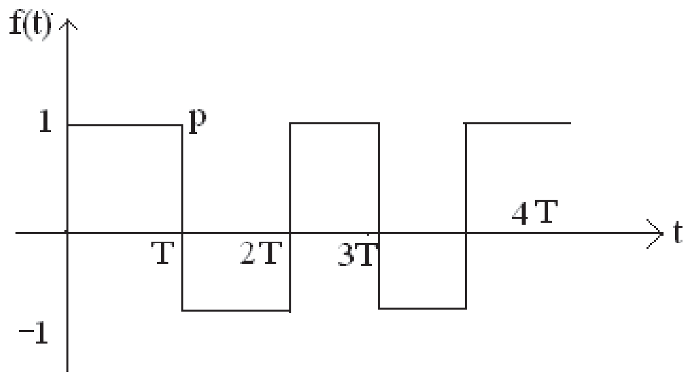

Figure 7a

   (b) Find the step response of series RL circuit.

   (c) Find the step response of series RC circuit. [6+5+5]

8. (a) State & Prove the properties of the z-transform.

   (b) Find the Z-transform of the following Sequence.
   x[n] = a^n u[n] [8+8]

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Code No: X0423/R07 **Set No. 4**

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SIGNALS AND SYSTEMS
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) Explain orthogonality property between two complex functions f1(t) and f2(t) for a real variable t.
   (b) Discuss how an unknown function f(t) can be expressed using infinite mutually orthogonal functions. Hence, show the representation of a waveform f(t) using trigonometric fourier series. [6+10]

2. (a) Write short notes on "Exponential Fourier Spectrum".
   (b) Find the Fourier series expansion of the periodic triangular wave shown figure 2. [6+10]

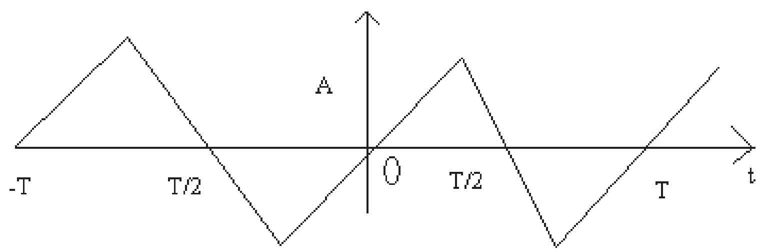

Figure 2

3. (a) Obtain the Fourier transform of the following functions:
      i. Impulse function $\delta(t)$
      ii. DC Signal
      iii. Unit step function.
   (b) State and prove time differentiation property of Fourier Transform. [12+4]

4. (a) Explain how input and output signals are related to impulse response of a LTI system.
   (b) Find the impulse response for the RL filter shown figure 4b. [8+8]

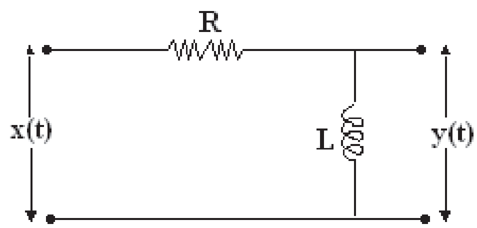

Figure 4b

5. (a) A signal y(t) given by $y(t) = C_0 + \sum_{n=1}^{\infty} C_n \cos(n\omega_o t + \theta_n)$. Find the auto correlation and PSD of y(t).

   (b) Find the mean square value (or power) of the output voltage y(t) of the system shown in figure 5b. If the input voltage PSD. $S_2(\omega) = rect(\omega/2)$. Calculate the power (mean square value) of input signal x(t). [8+8]

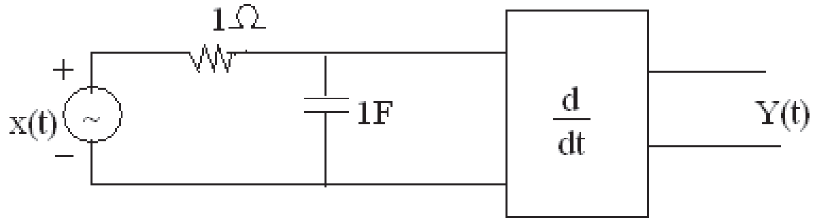

Figure 5b

6. (a) What is aliasing? Explain its effect on sampling.

   (b) State and prove sampling theorem. [8+8]

7. (a) Determine the Laplace transform and the associate region convergence for each of the following functions of time.

   i. $x(t) = 1 \qquad 0 \le t \le 1$

   ii. $x(t) = \begin{matrix} t & 0 \le t \le 1 \\ 2-t & 1 \le t \le 2 \end{matrix}$

   (b) State and prove initial value theorem of L.T. [10+6]

8. (a) Find the Z-transform of $a^n \cos(n\omega)u(n)$

   (b) Find the inverse Z-transform of $X(Z) = \frac{2+Z^3+3Z^{-4}}{Z^2+4Z+3} \qquad |Z| > 0$

   (c) Find the Z-transform of the following signal with the help of linearity and shifting properties.$x(n) = \begin{cases} 1 & for 0 \le N-1 \\ 0 & elsewhere \end{cases}$. [5+5+6]

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