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

II B.Tech I Semester Supplementary Examinations, May 2010

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

⋆⋆⋆⋆⋆

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) Use the defining equation for the Fourier Series Coefficients to evaluate the Fourier series representation for the following signals.
   i. x(t) = Sin(3πt) + Cos(4πt)
   ii. $x(t) = \sum_{m=-\alpha}^{\alpha} \delta(t - m/3) + \delta(t - 2m/3)$ [5+5]

   (b) Determine the time domain signal represented by the following coefficients. [6]

   $C_n = -j\delta(n-2) + j\,\delta(n+2) + 2\,\delta(n+3) + 2\,\delta(n+3)\,,\ \omega_0 = \pi$

3. (a) Define Hilbert Transform. What is its significance?

   (b) What is the Hilbert Transform of the signal x(t) = cost 3t? [8+8]

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]

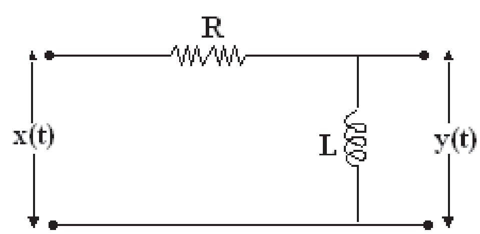

Figure 4b

5. (a) State the relations between convolution and correlation.

   (b) State the properties of power spectral density.

(c) $R(\tau) = \underset{T\to\infty}{Lt}\ \frac{1}{T}\int\limits_{-T/2}^{T/2} v(t)v(t+\tau)\ dt$ Prove that $R(0) \geq R(\tau)$. [5+5+6]

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) State the properties of the ROC of L.T.

   (b) Determine the function of time x(t) for each of the following laplace transforms and their associated regions of convergence. [8+8]

      i. $\frac{(s+1)^2}{s^2-s+1}$ $\quad$ $\mathrm{Re}\{S\} > 1/2$

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

8. (a) Determine inverse Z transforms of $x(z) = \frac{1}{2-4z^{-1}+2z^2}$ by long division method when

      i. $ROC: \quad |z| > 1$

      ii. $ROC: \quad |z| < \frac{1}{2}$

   (b) Find Z transform of the following: [8+8]

      i. $(1/4)^4 u(n) - \cos(n\pi/4)\, u(n)$

      ii. 2^nu(n-2)

⋆ ⋆ ⋆ ⋆ ⋆

Code No: X0423/R07 **Set No. 2**

II B.Tech I Semester Supplementary Examinations, May 2010
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
⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Sketch the following signals
   i. $\Pi\left(\frac{t-1}{2}\right) + \Pi(t-1)$
   ii. $f(t) = 3u(t) + tu(t) - (t-1)u(t-1) - 5u(t-2)$
   (b) Evaluate the following Integrals [8+8]
   i. $\int_{0}^{5} \delta(t) Sin 2\Pi t$dt
   ii. $\int_{-\alpha}^{\alpha} e^{-\alpha t^2} \delta(t-10)dt$

2. (a) State the properties of Complex Fourier series.
   (b) Determine the Fourier series of the function shown in figure 2. [6+10]

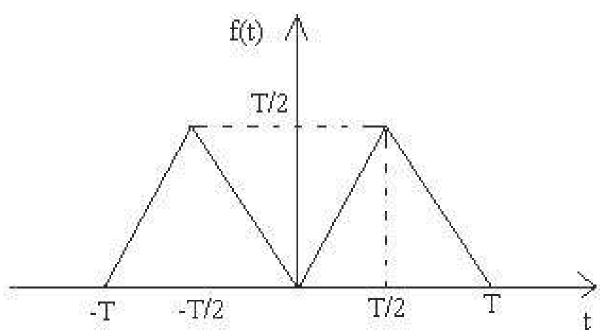

Figure 2

3. (a) Find the Fourier Transform of the following time function f(t) = $e^{-at} \cos w_0$t u(t)
   (b) State and prove frequency differentiation and integration properties of Fourier Transform. [8+8]

4. (a) 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).

(b) Differentiate between linear and non-linear system. [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]

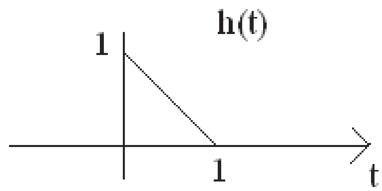

Figure 5b

6. (a) With the help of graphical example explain sampling theorem for Band limited signals.

   (b) Explain briefly Band pass sampling. [8+8]

7. (a) State and prove the properties of Laplace transforms.

   (b) Derive the relation between Laplace transform and Fourier transform of signal. [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]

⋆⋆⋆⋆⋆

Code No: X0423/R07

Set No. 3

II B.Tech I Semester Supplementary Examinations, May 2010
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
⋆⋆⋆⋆⋆

1. (a) Define orthogonal signal space and bring out clearly its application in representing a signal.
   (b) Obtain the condition under which two signals f1(t) & f2 (t) are said to be orthogonal to each other. Hence, prove that Sin nω_0t and Cos mω_0t are orthogonal to each other for all integer values of m,n. [6+10]

2. (a) Find the exponential Fourier series for the saw tooth waveform shown in Figure 2a Plot the magnitude and phase spectrum.

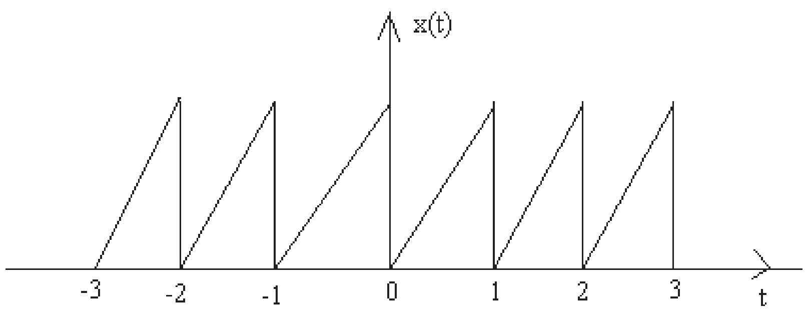

Figure 2a

   (b) Write short notes on "Line Spectrum". [10+6]

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 the difference between the following systems.
      i. Time invariant and time invariant systems.
      ii. Causal and non-causal systems.
   (b) Consider a stable LTI system characterized by the differential equation $\frac{d^2y(t)}{dt^2} + 4\frac{dy(t)}{dt} + 3y(t) = \frac{dx(t)}{dt} + 2x(t)$. Find its impulse response and transfer function. [8+8]

5. (a) State the relations between convolution and correlation.

(b) State the properties of power spectral density.

(c) $R(\tau) = \underset{T\to\infty}{Lt} \frac{1}{T} \int\limits_{-T/2}^{T/2} v(t)v(t+\tau)\ dt$ Prove that $R(0) \geq R(\tau)$. [5+5+6]

6. (a) Consider the signal $x(t) = \left(\frac{\sin 50\Pi t}{\Pi t}\right)^2$ which to be sampled with a sampling frequency of $\omega_s = 150\Pi$ to obtain a signal g(t) with Fourier transform G(jω). Determine the maximum value of ω_0 for which it is guaranteed that $G(j\omega) = 75 \times (j\omega)\ for\ |\omega| \leq \omega_0$ where $X(j\omega)$ is the Fourier transform of x(t).

(b) The signal $x(t) = u(t + T_0) - u(t - T_0)$ can undergo impulse train sampling without aliasing, provided that the sampling period T< $2T_0$. Justify.

(c) The signal x(t) with Fourier transform $X(j\omega) = u(\omega + \omega_0) - u(\omega - \omega_0)$ can undergo impulse train sampling without aliasing, provided that the sampling period $T < \pi/\omega_0$. Justify. [6+5+5]

7. (a) State the properties of the ROC of L.T.

(b) Determine the function of time x(t) for each of the following laplace transforms and their associated regions of convergence. [8+8]

i. $\frac{(s+1)^2}{s^2-s+1}$ Re $\{S\} > 1/2$

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

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]

⋆ ⋆ ⋆ ⋆ ⋆

Code No: X0423/R07

Set No. 4

II B.Tech I Semester Supplementary Examinations, May 2010
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
⋆⋆⋆⋆⋆

1. (a) Write short notes on "Orthogonal Vector Space".
   (b) A rectangular function f(t) is defined by [6+10]
   $$f(t) = \begin{cases} 1 & (0 < t < \Pi) \\ -1 & (\Pi < t < 2\Pi) \end{cases}$$
   Approximate the above function by a finite series of Sinusoidal functions.

2. (a) State the three important spectral properties of periodic power signals.
   (b) Assuming $T_0 = 2$, determine the Fourier series expansion of the Signal shown in figure 2. [6+10]

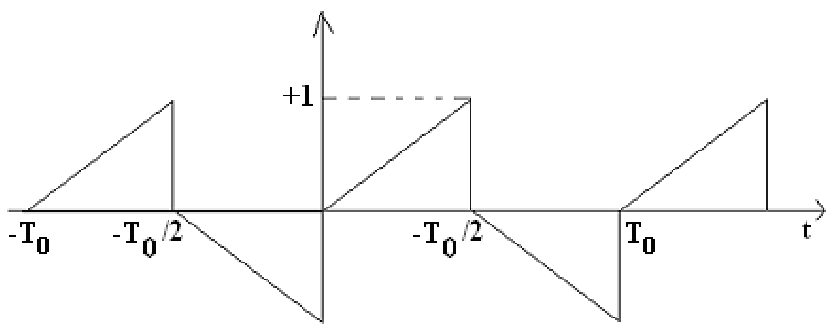

Figure 2

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 the difference between a time invariant system and time variant system? Write some practical cases where you can find such systems. What do you understand by the filter characteristics of a linear system. Explain the condition for causality of a LTI System?
   (b) Differentiate between linear and non-linear system. [12+4]

5. Using Parseval's theorem

   (a) Show that $\int\limits_{-\infty}^{\infty} \sin c^2(kx)dx = \pi/k$

   (b) Generalize Parseval's theorem to show that for real, Fourier transformable signals g_1(t) and g_2(t). [8+8]

   $$\int\limits_{-\infty}^{\infty} g_1(t)g_2(t)dt = \frac{1}{2\pi}\int\limits_{-\infty}^{\infty} G_1(-\omega)G_2(\omega)d\omega$$
   $$= \frac{1}{2\pi}\int\limits_{-\infty}^{\infty} G_1(\omega)G_2(-\omega)d\omega$$

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) State and prove the properties of Laplace transforms.

   (b) Derive the relation between Laplace transform and Fourier transform of signal. [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] = $\begin{cases} a^n & 0 \le n \le N-1,\ a > 0 \\ 0 & otherwise \end{cases}$

   Find X[Z].

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

⋆⋆⋆⋆⋆