National Institute of Technology, Delhi

End Semester Examination

Branch	: B.Tech (ECE, CSE, EE)	Semester	: III
Title of the Course	: Signal and Systems	Course Code	: ECB 204
Time	: 3 Hours	Maximum Marks	: 50

All questions are compulsory
Assume any data suitably if found missing

Q1   (i)   Calculate the power of a signals   **5**

      (a) $x(t) = A \, Sint$
      (b) $x(t) = U(t)$, [where U(t) is a unit step function]

      (ii)   Determine whether or not each of the following signals is periodic. If a signal is periodic, specify its fundamental period.

      (i) $4\cos\pi t + 3Sin2\pi t + 2Sin3\pi t$
      (ii) $4 + \cos^2 4\pi t$

Q2   Find the Even and Odd components of the following signals   **5**
      (i) $x(t) = 1+t+3t^2 +5t^3 +9t^4$
      (ii) $x(t) = (1+t^3) . \cos^3 (10t)$

Q3   Determine the Fourier transform of the following signals   **5**

      (a) $x(t) = e^{-2|t|}$

      (b) $x(t) = \dfrac{1}{2}[\delta(t-1)+\delta(t+1)]$

Q4   Consider a causal and stable LTI System S whose input x[n] and output y[n] are related   **1+4**
through the second order difference equation
$$y[n] - \frac{3}{4}y[n-1] + \frac{1}{8}y[n-2] = 2\,x[n]$$

      (a) Determine the frequency response $H(e^{jw})$ or $H(z)$ for the system S

      (b) What is the response of this system S if $x(n) = \left(\dfrac{1}{4}\right)^n u(n)$

Q5 Determine the laplace transform of the following signal 5

   (a) $x(t) = \sin \omega_o t$

   (b) $x(t) = e^{-2t} u(t) + e^{-t}(\cos 3t) u(t)$

Q6 Let $x(t) = \text{rect}(t - \frac{1}{2})$ 5

   (Where rect(t)=1 for $-\frac{1}{2} \leq x \leq \frac{1}{2}$ and zero otherwise). Then sinc(x)=sin(πx)/πx, then determine the Fourier transform of x(t)+x(-t)?
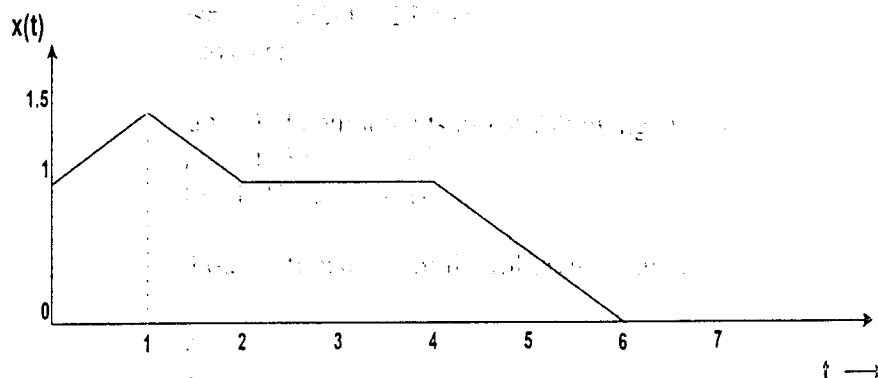
Q7 Let x(t) be a signal with Nyquist rate w_0. Determine the Nyquist rate for the following given 1+4
   signals.

   1. x(t)+x(t-1)
   2. x(t)cos($w_0 t$)
   3. $\frac{\partial x(t)}{\partial t}$

Q8 Calculate the Laplace transform of the following signal 5

Q9 Determine the impulse response H(s) for the LTI system having the following information 3+2
   1. The system is causal.
   2. The system function is rational and has only two poles, s = -2, and 4.
   3. If x(t) = 1, then y(t) = 0.
   4. The value of impulse response at t=0$^+$ is 4.

Q10 $X(z) = 1 - 3z^{-1}, Y(z) = 1 + 2z^{-2}$ are Z- transform of two signals x[n], y[n] respectively. A 5
   linear time invariant system has the impulse response h[n] defined by these two signals as
   h[n]=x[n-1]*y[n]. where * denotes discreate time convolution. Then output of the system
   for the input δ[n-1].