S.E (ELECTRONICS TELECOMMUNICATION) (SEM IV (REV)) EXAMINATI[...]
may 2007
Signals and Systems

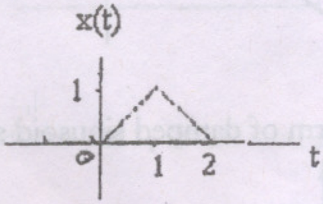
Con. 2553–07. **(REVISED COURSE)** **ND–972**

5 Jun 2007

(3 Hours) **[Total Marks : 100**

N. B. (1) Question No.1 is compulsory
(2) Attempt any four questions out of remaining six questions.
(3) Assume suitable data if required

1 (a) Find even and parts of the signal (20)



(b) Determine whether or not each of the following signals is periodic. If periodic , determine its fundamental period.

(i) $x(t) = \left[\cos\left(2t - \frac{\pi}{3}\right)\right]^2$

(ii) $x(n) = \sin\left(\frac{6\pi}{7}n + 1\right)$

(c) For each of the following input-output relationships, determine whether the corresponding system is linear, time invariant or both.

(i) $y(t) = t^2 x(t-1)$

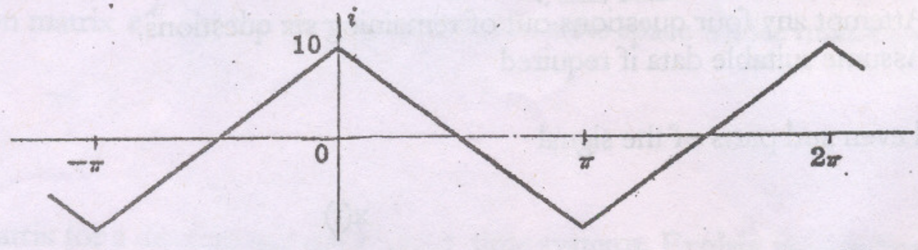
(ii) $y(n) = x(n+1) - x(n-1)$

(d) Show that the necessary and sufficient condition for a relaxed LTI system to be stable under Bounded Input and Bounded Output sense is

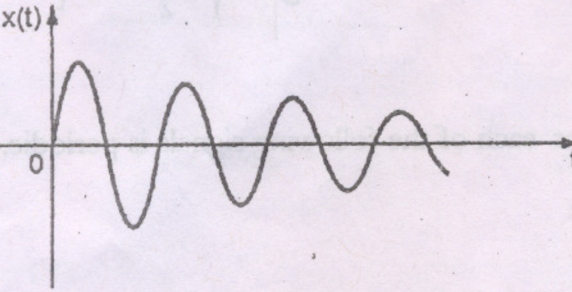
$$\sum_{n=\infty}^{n=\infty} |h(n)| < \infty$$

(e) Impulse function has uniform spectral density over the entire frequency interval. Justify.

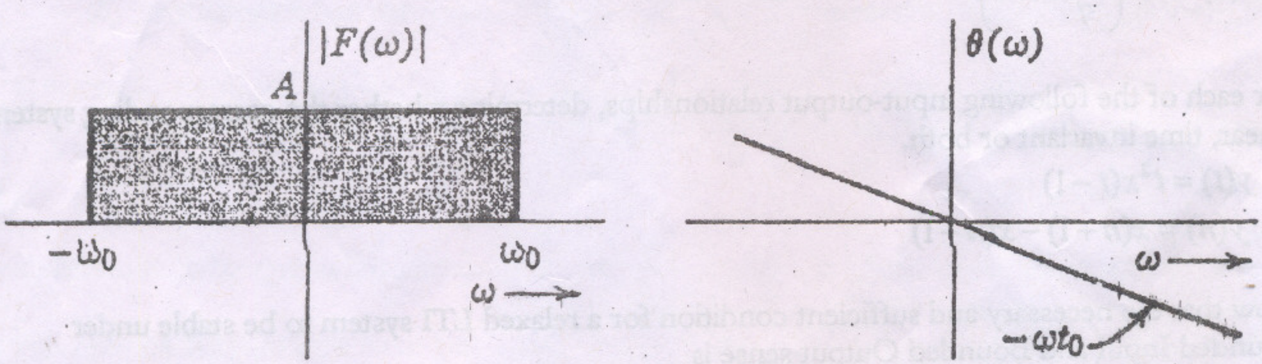
2 (a) The current in an inductance L = 0.01H has a waveform as shown in Fig. Obtain the trigonometric series for v_L, the voltage across the inductance. $\omega = 500$ rad/s. (8)



(b) Find out the Fourier transform of damped sinusoid shown in fig. (6)

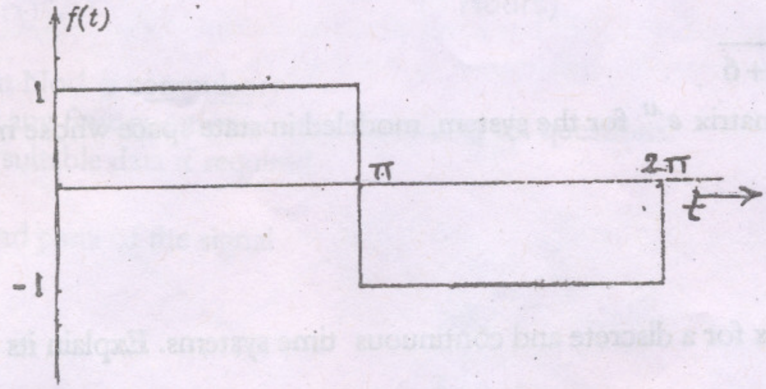


(c) Determine the function f(t) where Fourier Transform is shown in fig. (6)



3 (a) A rectangular function f(t) is defined by

$$f(t) = \begin{cases} 1, & (0 < t < \pi) \\ -1, & (\pi < t < 2\pi) \end{cases}$$ (10)



Approximate this function by a waveform sin t, sin 2t and sin 3t.. Also determine the mean square error.

(b) Determine the steady state and transient responses of the system characterized by the difference equation y(n) = 0.5y(n-1) + x(n) , when the input signal is, x(n) = 10 cos(πn/4) u(n). The system is initially at rest. (10)

4. (a) Convolve $x(n)=\left(\frac{1}{3}\right)^n u(n)$ with $h(n)=\left(\frac{1}{2}\right)^n u(n)$ and verify your answer using z transform.(8)

(b) Derive the relationship between Laplace Transform and Fourier Transform. (6)

(c) Explain the relationship between Discrete Time Fourier Transform and z transform (6)

5. (a) For a LTI discrete time system if the system impulse response is h(n) and the input sequence is x(n) show that the output is given by the discrete time convolution sum as

$$y(n)=\sum_{k=-\infty}^{\infty} x(k)h(n-k) \quad (6)$$

(b) State and prove the expression for normalized power and normalized energy of continuous time signal x(t). Periodic signals are always power signals. Justify (9)

(c) Prove that for discrete time signal to be periodic, its frequency must be a rational number. What is the minimum and maximum range for discrete time sinusoidal frequency? What is its unit? (5)

6. (a) Find Laplace Transform of $f(t)=e^{-4t}u(-t)+e^{-6t}u(t)$. Does the Laplace Transform exist? Show the ROC. (8)

(b) If $F(s)=\frac{1}{(s+2)(s+3)}$ (8)

(i) Determine the final value by application of final value theorem.

(ii) Verify the results by finding f(t)

(c) List properties of Laplace Transform (4)

7 a) Obtain the state variable model of the following system.

$$\frac{Y(s)}{U(s)} = \frac{6}{s^3 + 6s^2 + 11s + 6}$$ (8)

(b) Find the state transition matrix e^{At} for the system, modeled in state space whose matrix is given by

$$A = \begin{bmatrix} \frac{3}{4} & 0 \\ -\frac{1}{2} & \frac{1}{2} \end{bmatrix}$$ (8)

(c) Define state transition matrix for a discrete and continuous time systems. Explain its significance. (4)
