Con. 5172-07.

(3 Hours) [Total Marks : 100

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

1 (a) Sketch the single-sided and double spectra of (20)

$$x(t) = 10\cos\left[2\pi t + \frac{\pi}{4}\right] + 3\sin\left[6\pi t + \frac{2\pi}{3}\right]$$

(b) What is Gibb's phenonmenon

(c) Determine whether the following signals are energy signals or power signals and evaluate their normalized energy and power

(i) $x(t) = rect\left(\frac{t}{T_0}\right)$

(ii) $x(t) = \cos^2(\omega_0 t)$

(d) Determine which of the following signals are periodic.

(i) $x_1(t) = \sin 15\pi t$ (ii) $x_2(t) = \sin 20\pi t$ (iii) $x_3(t) = x_1(t) + x_2(t)$

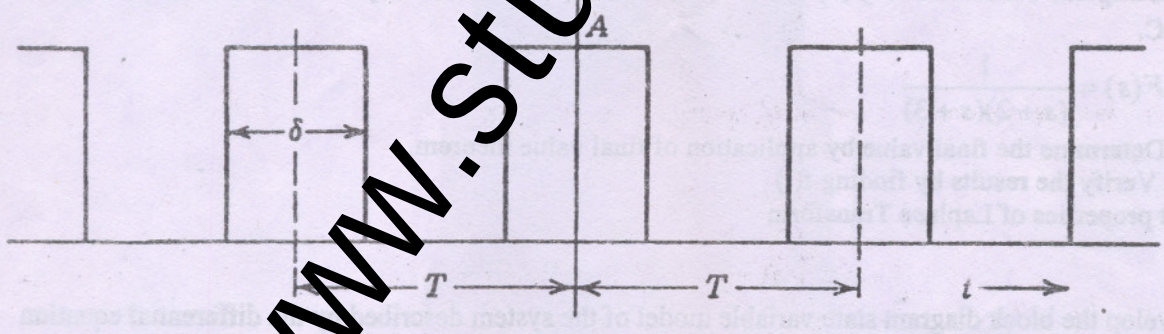
(e) Sketch the following signals

(i) $x(t) = \Pi(2t+3)$ (ii) $x(t) = 2\Pi\left(t - \frac{1}{4}\right)$

(iii) $x(t) = \cos(20\pi t - 5\pi)$ (iv) $x(t) = r(-0.5t + 2)$

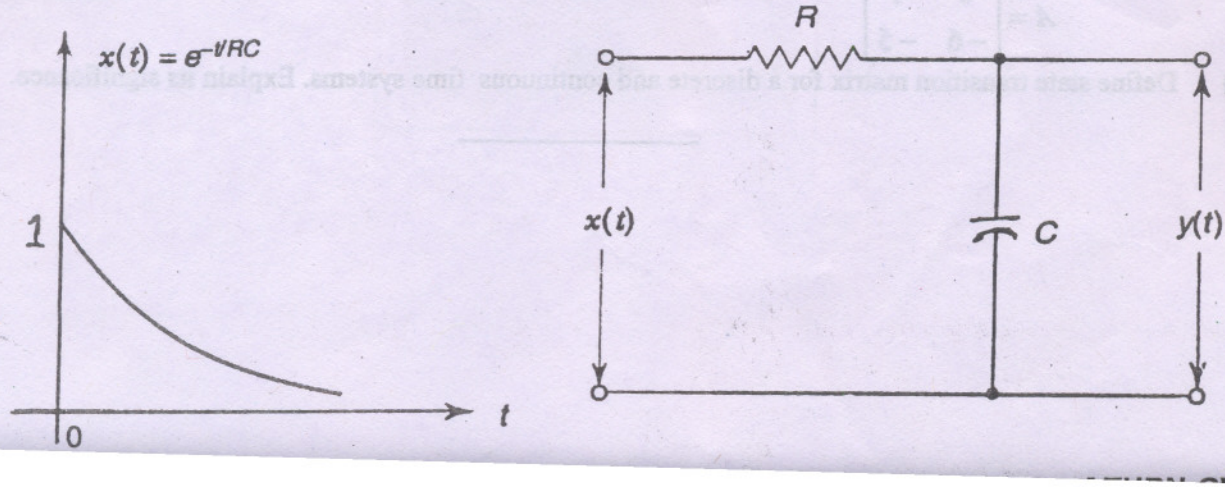
2 (a) Show that the sequence $e^{j\frac{2\pi kn}{N}}$ is an orthogonal sequence, periodic in N. (8)

(b) Expand the periodic gate function shown in fig by the exponential Fourier series and plot the frequency and power spectrum. (8)



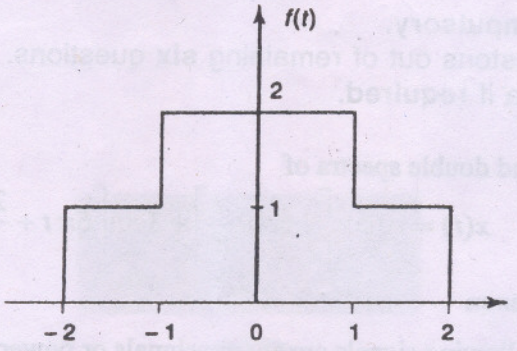
(c) In the above example (Q. No. 2 (b)), what is the effect on the spectrum if period T becomes larger and larger. (4)

3 (a) Determine the output response of the low-pass RC network due to an input $x(t) = te^{-\frac{t}{RC}}$ by convolution. (8)



(b) Find amplitude and phase spectrum of the time shifted impulse signal $f(t) = 10\delta(t-2)$ (6)

(c) Find the Fourier Transform of the signal shown in fig. (6)



4. (a) Obtain inverse z – transform of the following $X(z)$ (8)

$$X(z) = \frac{z+2}{2z^2 - 7z + 3}$$

if the ROC's are (i) $|z| > 3$ (ii) $|z| < \frac{1}{2}$ (iii) $\frac{1}{2} < |z| < 3$

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

(c) Compare Discrete Time Fourier Transform and Z transform (6)

5 (a) A DSP system is described by the linear difference equation (6)

$y(n) = 0.2\,x(n) - 0.5\,x(n-2) + 0.4\,x(n-3)$

Given that the digital input sequence { - 1, 1, 0, - 1 } is applied to the DSP system, determine the corresponding digital output sequence.

(b) Prove that Linear Time Invariant system is stable if its impulse response is absolutely summable. (7)

(c) A discrete time signal is given by $x(n) = A\cos\left(n\frac{4\pi}{21}\right)$. Determine the period of the sequence and sketch the sequence for the variable n for two periods. (7)

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 result by finding f(t)

(c) List properties of Laplace Transform (4)

7 (a) Develop the block diagram state variable model of the system described by the differential equation (8)

$$\frac{d^2y(t)}{dt^2} + \frac{3dy(t)}{dt^2} + 2y(t) = u(t)$$

where $y(t)$ is the output and $u(t)$ is the input

(b) Find the state transition matrix e^{At} for the system, modeled in state space whose matrix is given by (8)

$$A = \begin{bmatrix} 0 & 1 \\ -6 & -5 \end{bmatrix}$$

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