

(3 Hours)

[ Total Marks : 80

- N.B. : (1) Question no.1 is compulsory.  
 (2) Attempt any three questions out of the remaining five.  
 (3) Assume suitable data wherever necessary.

1. (a) Determine the fundamental period of the following signals. 20

(i)  $x(t) = 14 + 40\cos(60\pi t)$                       (ii)  $x[n] = \cos^2\left[\frac{\pi}{4}n\right]$

- (b) Compare the nature of ROC of Z transform and Laplace transform.  
 (c) For the given system, determine whether it is,  
 (i) memory less            (ii) causal  
 (iii) linear                    (iv) time-invariant

$$y[n]=x[-n]$$

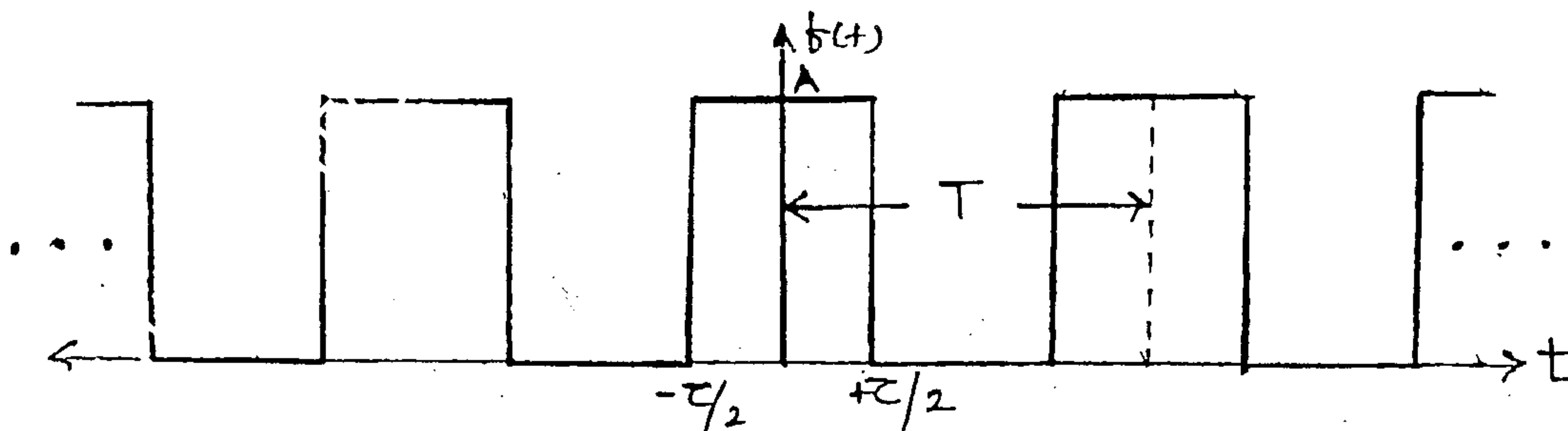
(d) Find out even and odd component of the following two signals.

(1)  $x(t) = \cos^2 \frac{\pi t}{2}$                       (2)  $x(t) = \begin{cases} t \dots \dots \dots & 0 \leq t \leq 1 \\ 2-t \dots \dots \dots & 1 < t \leq 2 \end{cases}$

(e) Determine whether the signals are power or energy signals. Calculate energy/power accordingly.

(i)  $x(t) = Ae^{-\alpha t}u(t) \dots \dots \dots \alpha > 0$                       (ii)  $x[n] = u[n]$

2. (a) Expand the periodic gate function as shown in the figure by the exponential Fourier Series. Also plot the Fourier spectrum (Magnitude and phase spectrum). 10



(b) Find the inverse Laplace Transform of the following. 10

(i)  $X(S) = \frac{s-3}{s^2+4s+13}$

(ii)  $X(S) = \frac{5s^2-15s-11}{(s+1)(s-2)^3}$

3. (a) Obtain inverse Laplace transform of the function 10

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

Write down and sketch possible ROCs. Find out inverse Laplace for all the possible ROCs.

- (b) Using the z transform method, solve the difference equation 10

$$y[n] - 4y[n-1] + 4y[n-2] = x[n] - x[n-1]$$

$$\text{When } y[-1] = y[-2] = 0$$

4. (a) Explain Gibbs phenomenon. Also explain conditions necessary for the convergence of Fourier Series. 5

- (b) Find out Fourier Transform of  $f(t) = 10 \delta(t-2)$ . Sketch its amplitude and phase spectrum. 5

- (c) Perform convolution of

(i)  $2u(t)$  with  $u(t)$  2

(ii)  $e^{-2t} u(t)$  with  $e^{-5t} u(t)$  4

(iii)  $tu(t)$  with  $e^{-5t} u(t)$  4

5. (a) Convolve  $x[n] = \left(\frac{1}{3}\right)^n u[n]$  with  $h[n] = \left(\frac{1}{2}\right)^n u[n]$  using Fourier transform. 10

- (b) A system is described by the following difference equation. 10

$$y[n] = \frac{3}{4}y[n-1] - \frac{1}{8}y[n-2] + x[n]$$

Determine the following

(i) The system Transfer function  $H(z)$

(ii) Impulse response of the system  $h[n]$

(iii) Step response of the system  $s[n]$

6. (a) A discrete time signal is given by  $x[n] = \{1, 1, 1, 1, 2\}$ . Sketch the following signals. 10

(a)  $x[n]$  (b)  $x[n-2]$  (c)  $x[n] \cdot u[n-1]$

(d)  $x[3-n]$  (e)  $x[n-1] \cdot \delta[n-1]$

- (b) For the periodic signal  $x[n]$  given below, find out Fourier series coefficient. 10

$$x[n] = 1 + \sin\left(\frac{2\pi}{N}n\right) + 3\cos\left(\frac{2\pi}{N}n\right) + \cos\left(\frac{4\pi}{N}n + \frac{\pi}{2}\right)$$