(3 Hours) **Total Marks: 80**

N.B. : (1) Question No. **1** is compulsory.
(2) Solve any **Three** questions from question no. 2 to question no. 6.
(3) Assume suitable data if required.

1. Solve any **four** questions . **20**

(a) Write all the properties of the Fourier transform and derive differential, convolution property and frequency shift property.

(b) Find initial & final value of

$$F(s) = \frac{0.8}{s(s^2 + 0.6s + 0.2)}.$$

(c) State relationship between Laplace and Fourier transform.

(d) Sketch a signal : x(t) = u(t) - r(t-1) + 2r(t-2) - r(t-3) +u(t-4) -2u(t-5)

(e) Prove that:

$$\int_{-\infty}^{\infty} x^2(t)dt = \int_{-\infty}^{\infty} x_e^2(t)dt + \int_{-\infty}^{\infty} x_0^2(t)dt$$

2. (a) Perform convolution of following signals. **10**

(1) $x(t) = e^{-t}u(t)$

$h(t) = e^{-2t}u(t)$

(2) $x(t) = u(t) - u(t-2)$

$h(t) = u(t)$

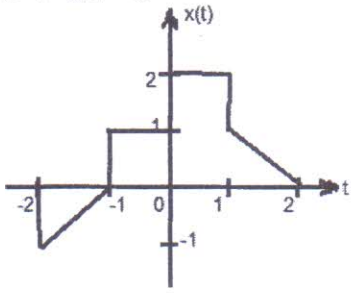
(b) A C.T. signal x(t) is given as follows: **10**

Sketch the following for this signal

i) x(4 - t/2)

ii) x(2t+1)

iii) x(t) . u(t)



3. (a) Find out impulse response of **10**

$$H[z] = \frac{5z^2}{(z-0.1)(z-0.5)}$$

(b) Determine whether following systems are static or dynamic, linear or non-linear, time variant or invariant, causal or non causal & stable or unstable. **10**

i. y(t) = t . x(t)

ii. y(n) = x(- n)

4. (a) Check whether following signals are power or energy or neither signals. Find energy and power of signals. 6

i. $X[n] = n \quad n \geq 0$

$0 \quad n < 0$

ii. $X(t) = e^{-2t}\, u(t)$

(b) Determine whether signals are periodic or not. Find out fundamental period. 4

i. $x(t) = 2\cos\left(\frac{t}{4}\right)$

ii. $X[n] = \cos\frac{n\pi}{2} - \sin\frac{n\pi}{8} + 3\cos\left[\frac{n\pi}{4} + \frac{\pi}{3}\right]$

(c) Find inverse Z.T. of following signal for all possible ROC conditions. 10

$$X(z) = \frac{10\,z}{(z-1)(z-2)}$$

5. (a) Find inverse Laplace transform for all possible ROCS. 10

i. $X(S) = \frac{5S-10}{9S^2-16}$

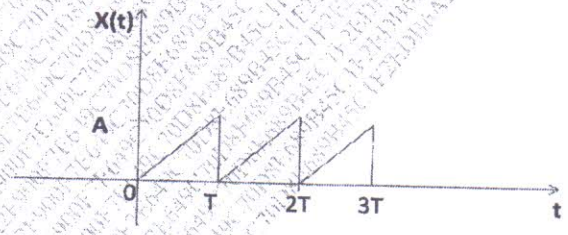
ii. $X(s) = \frac{s+3}{s^3+3s^2+6s+4}$

(b) Determine Fourier transform of following continuous time domain signals. 10

i. x(t) = Gate impulse signal

ii. $x(t) = t\, e^{-2t} u(t)$

6. (a) Determine the trigonometric form of the Fourier series of the ramp signal shown in fig. below: 10



(b) $\frac{d^2y(t)}{dt^2} - \frac{dy(t)}{dt} - 6y(t) = x(t)$ 10

Find a) H(s) (b) h(t) and (c) step response of the system.