(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) Prove that:

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

(c) If $x_1(n)$ & $x_2(n)$ are two periodic sequences given below, find the convolution between them.
$X_1(n) = (1,-2,0,1)$ & $x_2(n) = (2,1,1,0)$
    ↑   ↑

(d) Find initial & final value of

$$F(s) = \frac{0.8}{s(s^2 + 0.6s + 0.2)}.$$
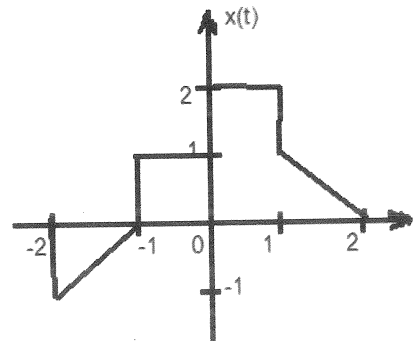
(e) Find the Fourier transform of Signum function.

2. (a) $\frac{d^2y(t)}{dt^2} - \frac{dy(t)}{dt} - 6y(t) = x(t)$
10   Find a) H(s) (b) h(t) and (c) step response of the system.

(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 the system response without using Laplace transform if input   **10**
x(t) & impulse response h(t) are as follows:
$x(t) = te^{-2t}u(t)$
$h(t) = u(t)$

(b) Check whether following signals are power or energy or neither signals. Find energy and power of signals.   **6**
i. $X[n] = n$ $n \geq 0$

            0     $n < 0$

ii. $X(t) = Ae^{-5t} u(t)$

TURN OVER

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

    i. $X(t) = 2\cos\left(\frac{9\pi t}{2}\right)$

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

4. (a) Find Z.T. and R.O.C. of the following.   10

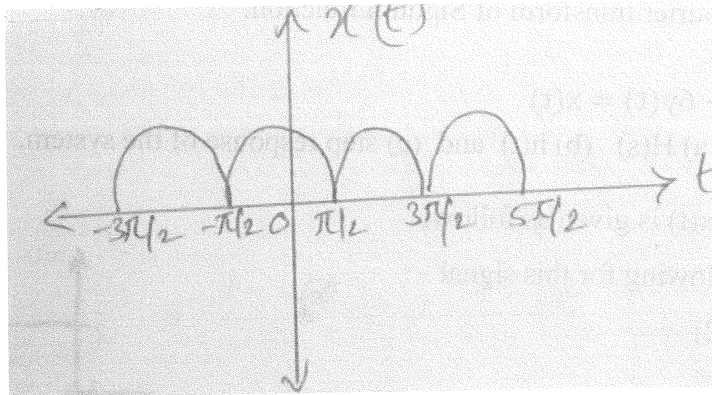   i. $X[n] = (0.6)^n u[n] + 0.9^n u[n]$

    ii. $X[n] = (2/3)^n u[n+2]$

(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. $y[n] = 2x(2^n)$

    ii. $\frac{dy(t)}{dt} + t\,y(t) = x(t)$

5. (a) Find exponential form of Fourier series of following signal   10

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

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

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

6. (a) Find out impulse response of   10

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

(b) Find odd and even part of given signal.   04

$x(t) = (1+t^3)(\cos^3 10\,t)$

(c) State and prove Parseval's theorem.   06