

Con. 2050-05.

AM-6886

(REVISED COURSE)

(3 Hours)

[Total Marks : 100

- N.B. : (1) Question No. 1 is compulsory.
(2) Attempt in all five questions.

1. (a) Find whether the following signals are energy signals or power signals. 20
 (i) $x(t) = A e^{-2|t|}$ (ii) $x(t) = A \sin wt$.
 (b) Find whether the following systems are linear or non linear.
 (i) $y(t) = x^2(t)$ (ii) $y(t) = tx(t)$.
 (c) Find whether the following systems are time variant or time invariant.
 (i) $y(t) = t x(t)$ (ii) $y(t) = e^{x(t)}$.
 (d) Find whether the following signals are periodic or non-periodic
 (i) $x(t) = \sin \frac{2\pi}{3} t$ (ii) $x(t) = \sin 3t$.
 (e) Prove the time shift property of Laplace Transform.

2. (a) Equation of a continuous time LTI system is given as— 12

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

Assuming the Initial conditions to be zero find—

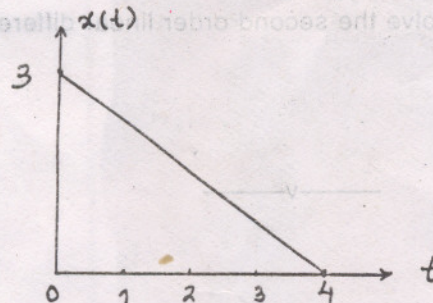
- (i) Transfer function of the system
 (ii) Impulse response of the system
 (iii) Step response of the system.
 (b) Using the Laplace Transform of $u(t)$ and the properties of Laplace Transform find the Laplace Transform of— 8
 (i) $t u(t)$ (ii) $e^{-at} u(t)$.

3. (a) Find the trigonometric fourier series expansion of— 10
 $x(t) = A$ $-\tau/2 \leq t \leq \tau/2$
 $= 0$ $\tau/2 \leq t \leq T$.

Above equation being one cycle of the periodic waveform.

- (b) Find the Fourier Transform of signum function. 10

4. (a) (i) $x(t)$ is given as— 8



Sketch and label the following signals.

- (1) $x(t-2)$ (2) $x(2t)$ (3) $x(t/2)$ (4) $x(-t)$
 (ii) $x(t) = 1$ $t > 0$
 $= 0$ $t < 0$.

Draw even and odd parts of the signal.

(b) Evaluate the following :—

$$(i) \int_{-2}^1 (t + t^2) \delta(t - 3) dt$$

$$(ii) \int_{-2}^4 (t + t^2) \delta(t - 3) dt$$

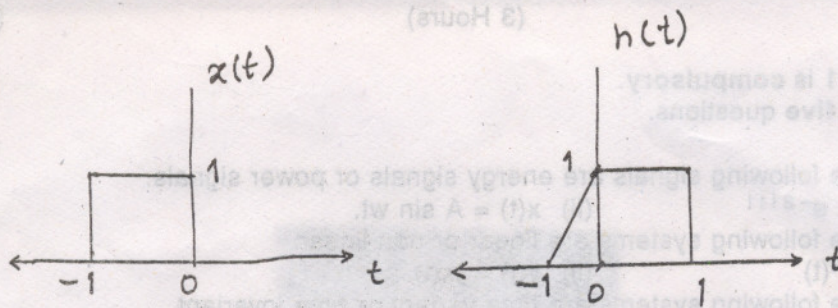
$$(iii) \int_1^2 (3t^2 + 1) \delta(t) dt$$

$$(iv) \int_{-\infty}^{\infty} e^{-t} \delta(2t - 2) dt.$$

[TURN OVER

5. (a) Convolve the following signals in time domain.

8



(b) (i) Convolve the following signals $x(t) = u(t)$; $h(t) = e^{-\alpha t} u(t)$, $\alpha > 0$.

6

(ii) Impulse Response of the system is given as—

6

$$h(t) = -3 e^{2t} u(t)$$

Find whether the system is—

Causal/non causal

With/without memory

Stable/unstable.

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

8

Find the inverse Laplace Transform for all possible R.O.C.s.

(b) (i) Plot $y(t) = r(t + 2) - 2r(t + 1) + 2r(t) - r(t - 2) - 2r(t - 3) + 2r(t - 4)$.

6

(ii) Show double sided representation of a signal $x(t) = \sin \left[20\pi t - \frac{\pi}{4} \right]$

6

7. (a) (i) Given $x(t) = \cos 500\pi t + \sin 1000\pi t + \cos 800\pi t$. What is the Nyquist rate for the above signal ?

4

(ii) Consider LTI system with—

6

$$H(s) = \frac{3s + 7}{(s + 1)(s + 2)(s + 5)}$$

Find a state representation of the system.

(b) Using the state variable method, solve the second order linear differential equation—

10

$$y''(t) + 5y'(t) + 6y(t) = x(t).$$