

**(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.
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1. Answer the following

20

a) Determine whether the following signals are energy signals or power signals and calculate their energy or power.

(1)  $x(t) = e^{-4t}u(t)$

(2)  $x(n) = \left(\frac{1}{6}\right)^n u(n)$

b) Determine if following system is memoryless, causal, linear, time invariant.

$y(t) = a^n x(n)$

c) Using properties of Fourier transform, determine Fourier transform of  $x(t)$

$x(t) = e^{-3|t-t_0|} + e^{3|t+t_0|}$

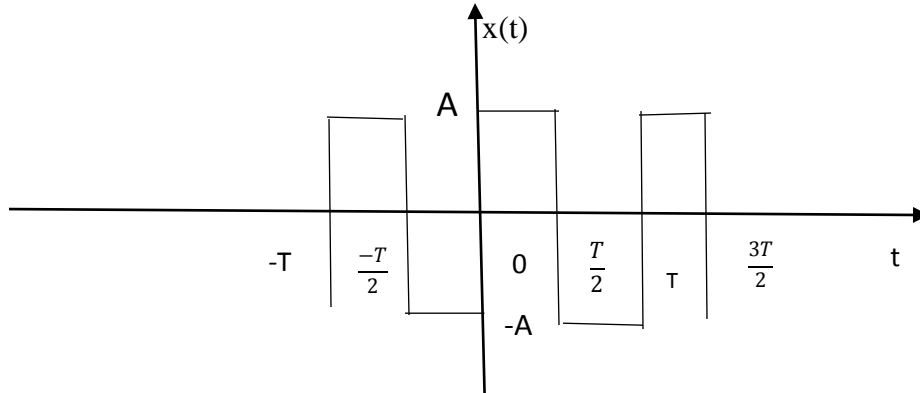
d) Find out even and odd components of following signals:

(i)  $x(n) = u(n) - u(n-5)$

(ii)  $x(t) = 5 + 7t + 9t^2$

e) Determine relation between continuous time Fourier Transform and Laplace Transform.

2. (a) Determine Fourier Series representation of following signal: 10



- (b) Find impulse response and step response of continuous time systems governed by 10  
Following transfer functions.

$$H(s) = \frac{s+3}{s^2+6s+8}$$

3. (a) A continuous time signal is defined as, 10

$$x(t) = t; 0 \leq t \leq 3$$

$$x(t) = 0; t > 3$$

Sketch waveforms of following signals:

(i)  $x(-t)$

(ii)  $x(2-t)$

(iii)  $x(3t)$

(iv)  $x(0.5t+1)$

- (b) Determine inverse z-transform of following function using long division method: 05

$$X[z] = \frac{z^2+2z}{z^3-3z^2+4z+1}; ROC; |z| > 1$$

- (c) Compute the DTFT of sequence  $x(n) = \{0, 1, 2, 3\}$ . Sketch magnitude and phase 05  
Spectrum.  $\uparrow$

Q4] (a) Using Laplace Transform determine complete response of system described by following Equation. 10

$$\frac{d^2y(t)}{dt^2} + 6\frac{dy(t)}{dt} + 8y(t) = \frac{dx(t)}{dt} + x(t); \text{ where } y(0) = 1; \frac{dy(0)}{dt} = 3, \text{ for input } x(t) = u(t)$$

(b) Find impulse response of system described by following difference equation 10

$$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) + x(n-1) \text{ where all initial conditions are zero.}$$

5. (a) For the following continuous time signals, determine Fourier Transform. 10

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

(ii)  $x(t) = \sin\omega_0(t)u(t)$

(b) Determine Fourier series representation of  $x(n) = 4\cos\frac{\pi n}{2}$  05

(c) Determine cross correlation of sequence  $x(n) = \{1,1,2,2\}$  and  $y(n) = \{1,3,1\}$  05

$\uparrow \qquad \qquad \qquad \uparrow$

6. (a) The input signal  $x(t)$  and impulse response  $h(t)$  of a continuous-time system are described as follows 10

$$x(t) = e^{-3t} u(t) \text{ and } h(t) = u(t-1). \text{ Find output of system using convolution integral.}$$

(b) Determine Z Transform and ROC of 10

(i)  $x(n) = n^2 u(n)$

(ii)  $x(n) = a^n \cos\omega_0 n u(n)$

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