(Time: 3 Hours) **[Total Marks: 80]**

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of remaining five.
(3) All questions carry equal marks.
(4) Assume Suitable data, if required and state it clearly.

Q1. Answer any 4 questions from the given questions: 20

a. Explain the application of Signals and System in Multimedia Processing.
b. Find the fundamental period of the signal

$$x(t) = \sin\left(\frac{2\pi}{6}\, t\right) - \cos(\pi t)$$

c. Test the given system for linearity, causality, stability, memory and time variant.

$$y(t) = x(t^2)$$

d. Find x(-2t) and x(3t+2)

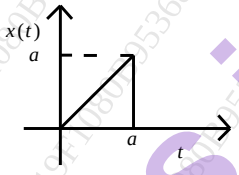

Fig. 1

e. Explain the conditions for the existence of Fourier transform
f. If system matrix $A = \begin{bmatrix} -3 & 1 \\ -2 & 0 \end{bmatrix}$ find the sate transition matrix.

Q2.a. Sketch the following signals for the given signal shown in Fig. 2 10

a) x(-t)
b) x(2t+5)
c) x(2t)
d) x(t/2)
e) -2x(t)

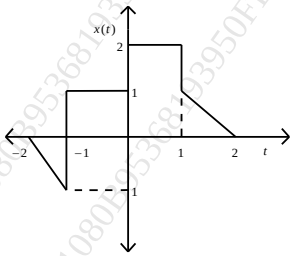

Fig. 2

b. Using unilateral Laplace transform find the output of the system given by 10
$\frac{d^3}{dt^3}y(t) + 6\frac{d^2}{dt^2}y(t) + 11\frac{d}{dt}y(t) + 6y(t) = x(t)$: where $x(t) = e^{-4t}\,u(t)$ and $y(0^-) = 1$,

$$\left.\frac{dy(t)}{dt}\right|_{t=0^-} = 1, \quad \left.\frac{d^2y(t)}{dt^2}\right|_{t=0^-} = 1,$$

Q3.a. Find inverse Z Transform of X(z), 10

$$X(z) = \frac{z^2 + 2Z + 1}{z^2 - \frac{3}{2}z + \frac{1}{2}}$$

b. Given DT sequence: 10

$x(n) = 0.4\delta(n+2) + 0.2\delta(n+1) + 0.1\delta(n) + 0.2\delta(n-1) + 0.4\delta(n-2)$.

Determine the following;

i. $X(e^{j\omega})$

ii. $\left|X(e^{j\omega})\right|$

iii. $phase\ \{X(e^{j\omega})\}$

iv. $\int_0^{2\pi}\left|X(e^{j\omega})\right|^2$

Q4.a. Determine the state model of the system governed by the equation 10

y[n] = -2y[n-1]+3y[n-2]+0.5y[n-3]+2x[n]+1.5x[n]+1.5x[n-1]+2.5x[n-2]+4x[n-3]

b. Find the Fourier transform of $x(t) = \begin{cases} \cos \pi t\ ; & -\frac{1}{2} \le t \le \frac{1}{2} \\ 0; & otherwise \end{cases}$ 10

i. From the definition of Fourier transform

ii. Using the convolution theorem of Fourier transform

Q5.a Determine DTFS for the sequence x(n)= $\cos^2((\pi/8)n)$ 8

b. i. Find Laplace transform of $\frac{d}{dt} sin(t)\, u(t)$. 4

ii. Find the Z Transform of signal $cos(\omega_0 n)\, u[n]$ 4

c. Find the canonic (direct form II) realization of $H(z) = \frac{1-\left(\frac{7}{4}\right)z^{-1}-\left(\frac{1}{2}\right)z^{-2}}{1+\left(\frac{1}{4}\right)z^{-1}-\left(\frac{1}{8}\right)z^{-2}}$ 4

Q6. Answer the following:

a. Find the autocorrelation function $R_{xx}(\tau)$ of sine wave signal 8

$$x(t) = A\sin(\omega_0 t + \varphi)\,, \omega_0 = \frac{2\pi}{T}$$

b. Explain the concept ROC in Z-Transform and Laplace Transform. 6

c. Discuss application of signals in Control system 6

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