Con. 7041–13. **LJ–11392**

(3 Hours) **[Total Marks : 100**

i) Question No.1 is **compulsory**.
ii) Answer any **four** questions out of remaining **six** questions.
iii) Figure to the right indicates full marks.
iv) Illustrate the answers with sketches wherever required.

Q.1 a) Determine whether the following signals are energy or power signals? Calculate their energy or power. **20M**

(i) $x(n) = u(n)$ (ii) $x(t) = A \sin t$; $-\infty<t<\infty$

b) State & prove the following properties of Fourier transform.
(i)Time shifting (ii) Differentiation in time domain

c) Check whether following systems are linear or non-linear, Time invariant or time variant causal or non causal, static or dynamic .
(i) $y(t) = x(t) \cos 100\pi t$ (ii) $y(t) = x(t + 10) + x^2(t)$

d) Compare Discrete time Fourier transform & continuous time Fourier transform.

e) State and discuss the properties of region of convergence for Z-transform.

Q.2 a) Determine the exponential form of Fourier series representation of the signal shown in below figure 2 (a). Hence determine the trigonometric form of Fourier series. **10M**

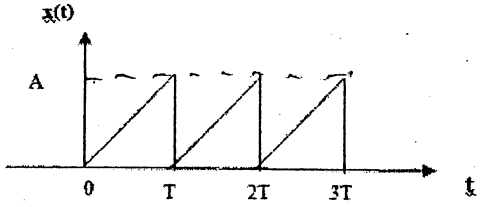


Figure 2 (a)

b) Determine whether following signals are periodic or non - periodic? If periodic find fundamental period **10M**

(i) $x(t) = \cos(t) + \sin(\sqrt{2}\, t)$ (iii) $x(n) = \cos\left(\frac{1}{2} n\right)$

(ii) $x(t) = \text{Sin}^2(t)$ (iv) $x(n) = \cos^2\left(\frac{\pi}{8} n\right)$

Q.3 a) The analog signal given below is sampled 600 samples per second **10M**
$x(t) = 2 \sin 480\pi t + 3 \sin 720\pi t$
Calculate:-
i) Minimum sampling rate to avoid aliasing.
ii) If the signal is sampled at the rate Fs = 200Hz, what is the discrete time signal after sampling.
iii) If the signal is sampled at the rate Fs = 75Hz, what is the discrete time signal obtained after sampling.

b) Determine the DT sequence associated with z-transform given below **10M**

i) $X(z) = \frac{1-(1/2)z^{-1}}{1+(1/2)z^{-1}}$; $|z| > 1/2$: ROC

ii) $X(z) = \frac{z^2+z}{z^2+2z+1}$; $|z| > 3$: ROC

[TURN OVER

Q.4 a) The transfer function of discrete time causal system is given by **10M**

$$H(z) = \frac{1 - z^{-1}}{1 - 0.2\,z^{-1} - 0.15\,z^{-2}}$$

Draw cascade & parallel realization.

b) Obtain the convolution of **10M**

$x(t) = u(t)$ & $h(t) = 1$ for $-1 \le t \le 1$

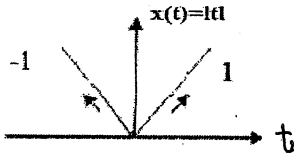
Q.5 a) Obtain the inverse Laplace transform of **10M**

i) $X(s) = \frac{5s^2 - 15s - 11}{(s + 1)(s - 2)^3}$ ii) $X(s) = \frac{S - 3}{s^2 + 4s + 13}$

b) Find the Fourier transform of **10M**

i) $e^{-2(t-1)}u(t - 1)$

ii)



Q.6 a) Determine the impulse response of DT-LTI system described by the difference equation (for $n \ge 0$) **10M**

$y[n] - 1/2\,y[n - 1] = x[n] + 1/3\,x[n - 1]$

where all the initial conditions are zero.

b) A causal LTI system has transfer function $H(z) = H_1(z) \cdot H_2(z)$ **10M**

$$H_1(z) = \frac{1 - 0.2z^{-1}}{1 + 0.5z^{-1}} \quad \& \quad H_2(z) = \frac{1}{1 + 0.3z^{-1}}$$

i) If system is stable give ROC condition.
ii) Find the impulse response.
iii) Find system response if, $X(z) = \frac{1}{1 - 0 \cdot 2z^{-1}}$
iv) Draw pole-zero diagram.

Q.7) a) Using suitable method obtain the state transition matrix STM e^{At} for the system for the system matrix. **10M**

$$\begin{bmatrix} 3/4 & 0 \\ -1/2 & 1/2 \end{bmatrix}$$

b) The transfer function of the system is given as **10M**

$$H(s) = \frac{s^2 + s + 5}{s^3 + 6s^2 + 8s + 4}$$

Obtain the state variable model.