TE | ExTC | Sem V | Rev
Signal & system

Con. 6361-10. **(REVISED COURSE)** **GT-6765**

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

N.B.:(1) Question No. **1** is **compulsory**.
(2) Attempt any **four** from remaining **six** questions.
(3) Assume any **suitable** data if **necessary** and state it **clearly**.

1. (a) A continuous time linear system S with input x(t) and output y(t) yields the following input output pairs : **20**

$$x(t) = e^{j2t} \xrightarrow{S} y(t) = e^{j3t}$$
$$x(t) = e^{-j2t} \xrightarrow{S} y(t) = e^{-j3t}$$

If x(t) = cos(2t), determine the corresponding output y(t) for system S.

(b) Let x[n] = u[n] – u[n –5]. Find and sketch even and odd parts of x [n].

(c) Find the Z-transform of the signal $x[n] = -a^n u[-n-1]$. Draw Pole-zero plot and show ROC.

(d) A Discrete time system has the form

$$y[n] = x[n] + \alpha x[n-D]$$

Draw the realization for this system.
Is this system IIR ? Explain.
(Assume α and D are constants)—

2. (a) The analog signal x(t) is given by— **10**

$$x(t) = 2\cos(2000\pi t) + 3\sin(6000\pi t) + 8\cos(12000\pi t)$$

Calculate :
(i) Nyquist sampling rate.
(ii) If x(t) is sampled at the rate F_s = 5KHz.
What is the discrete time signal obtained after sampling ?
(iii) What is the analog signal y(t) we can reconstruct from the samples if ideal interpolation is used ?

(b) The periodic square wave is defined as— **10**

$$x(t) = \begin{cases} 1, & |t| < T_1 \\ 0, & T_1 < |t| < \frac{T}{2} \end{cases}$$

This signal is periodic with fundamental period T and fundamental frequency

$$w_0 = \frac{2\pi}{T}.$$

Determine exponential fourier series coefficients for x(t).

3. (a) Let $x(t) = 1{\cdot}5\,t, \quad 0 \le t < 2$
$\qquad\quad = 0, \quad$ elsewhere **10**

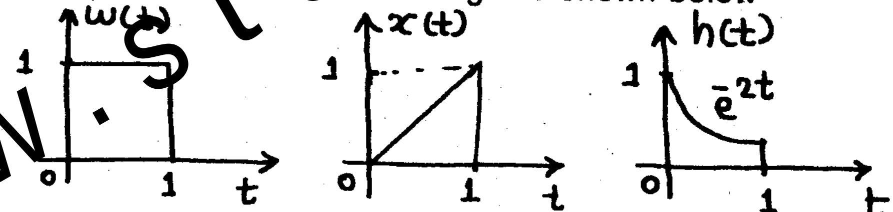
Sketch (i) $x(t)$ (ii) $f(t) = 1 + x(t-1)$ (iii) $g(t) = x(1-t)$
(iv) $h(t) = x(0{\cdot}5t + 0{\cdot}5)$ (v) $w(t) = x(-2t + 2)$

(b) The periodic impulse train is given by— **10**

$$x(t) = \sum_{k=-\infty}^{+\infty} \delta(t - KT)$$, is periodic with period T.

Find — (i) exponential fourier series coefficients a_k
(ii) fourier transform of x(t). Comment on the result.

4. (a) Find the Laplace transform of the signals shown below **10**



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(b) State and discuss the properties of the region of convergence for the z–transform.

5. (a) Solve the following difference equation using z–transform method.
$x[n+2]+3x[n+1]+2x[n] = 0$
Where the initial conditions are
$x[0] = 0$ and $x[1] = 1$.

(b) Let y[n] denote convolution of $x_1[n]+x_2[n]$ and h[n] i.e.

$$y[n] = (x_1[n]+x_2[n]) * h[n]$$

let $x_1[n] = \left(\frac{1}{2}\right)^n u[n]$ and $x_2[n] = 2^n u[-n]$

Find y[n] if $h[n]=u[n]$.

6. (a) A system is described by following difference equation—

$$y[n] = \frac{3}{4}y[n-1] - \frac{1}{8}y[n-2] + x[n] + \frac{1}{2}x[n-1]$$

Draw — (i) Direct form I realization
(ii) Direct form II realization

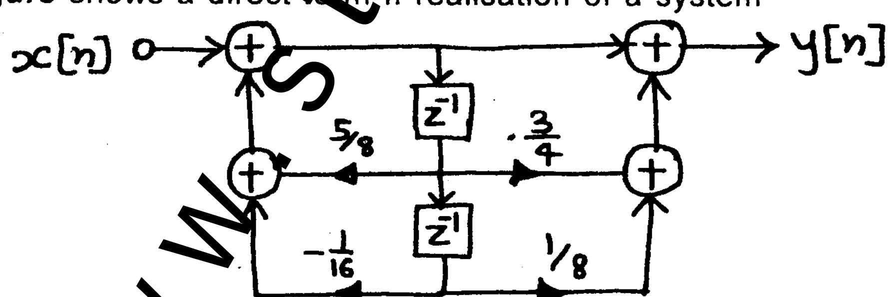
(b) Consider the state variable model of a second order system—

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 2 \end{bmatrix} u$$

$$\begin{bmatrix} x_1(0) \\ x_2(0) \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}; \; u = \text{unit step}$$

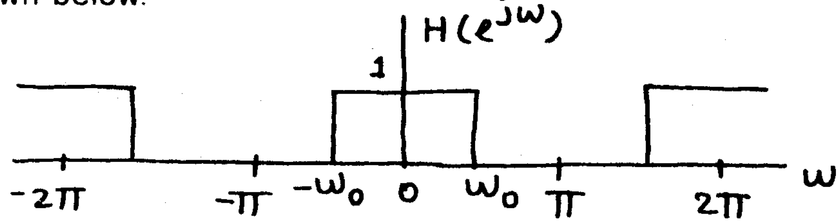
Find — (i) State transition matrix
(ii) State response $x(t)$, $t > 0$.

7. (a) **Figure** shows a direct form II realisation of a system



(i) Obtain transfer function H(z)
(ii) Draw pole zero diagram
(iii) Obtain difference equation.

(b) Consider the discrete-time ideal lowpass filter frequency response $H(e^{jw})$ as shown below.



Impulse response and frequency response of an LTI system are a fourier transform pair. Determine and sketch impulse response of the ideal LPF from the frequency response shown.