**Experiment No.:01(Time domain analysis)**

1. Consider the following system determine the Rise time($t_r$) , Peak time($t_p$) , maximum overshoot($M_p$) and the settling time($t_s$) in the unit step response with the help of the Matlab program.

$$(a) \qquad \frac{C(s)}{R(s)} = \frac{9}{s^2 + 5s + 9}$$

$$(b) \qquad S = -3 - j5$$

2. Using Matlab, show the step response comparison for various characteristics equation-root-locations in the s-plane when $\omega_n$ is held constant while the damping ratio $\xi$, is varied from (-) ∞ to (+) ∞ for the following system (putting $\omega_n = 1.5$):

$$\frac{C(s)}{R(s)} = \frac{\omega_n^2}{s^2 + 2\xi\omega_n s + \omega_n^2}$$

3. Using Matlab, show the unit-step response, unit-ramp response, unit-Parabolic response and unit-impulse response of the following systems:

$$(a) \qquad \frac{C(s)}{R(s)} = \frac{3}{s^2 + 3s + 3}$$

$$(b) \qquad \begin{bmatrix} \dot{x}1 \\ x2 \end{bmatrix} = \begin{bmatrix} -1 & -0.5 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} x1 \\ x2 \end{bmatrix} + \begin{bmatrix} 0.5 \\ 0 \end{bmatrix} [U]$$

$$y = [1 \quad -1] \begin{bmatrix} x1 \\ x2 \end{bmatrix} + [0]\,[U]$$

**Experiment No. 02: (Root Locus)**

1. Using **" Matlab "** plot the loci of the following system:

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

(b) $$G(s)H(s)=\frac{4(s+3)}{s^3(s+1)(s+2)}$$

(c) $$G(s)H(s)=\frac{4s}{(s+1)(s+2)^2}$$

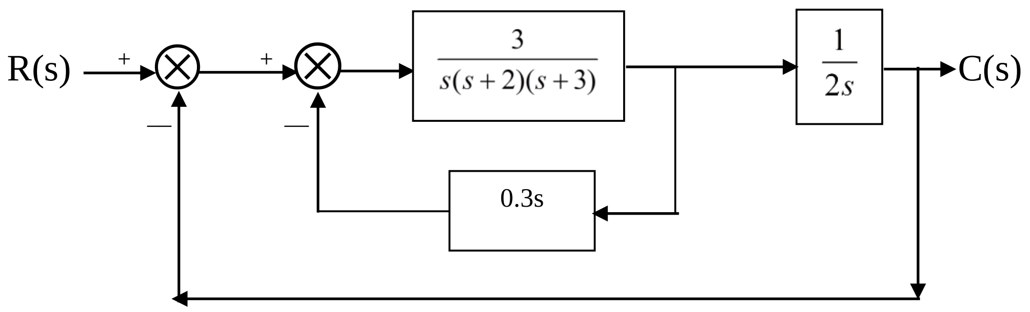
(d) $$G(s)H(s)=\frac{2(s+1)^2}{(s^2-9)(s+5)^2(s+2)}$$

(e) $$\frac{C(s)}{R(s)}=\frac{s(s+2)}{1+(s^2+2s)(s+3)}$$

(f) $$\begin{bmatrix}\dot{x}1\\ \dot{x}2\end{bmatrix}=\begin{bmatrix}-1 & -0.5\\ 1 & 0\end{bmatrix}\begin{bmatrix}x1\\ x2\end{bmatrix}+\begin{bmatrix}0.5\\ 0\end{bmatrix}[U]$$

$$y=\begin{bmatrix}1 & -1\end{bmatrix}\begin{bmatrix}x1\\ x2\end{bmatrix}+[0]\,[U]$$

(g)



**Experiment No. 03 : (Nyquist plot & Nyquist stability Criterion)**

1. Using **" Matlab "** draw the **Nyquist** plot for a unity feedback control system with the following open loop transfer functions :

$$(a)\quad G(s)=\frac{10}{(s+1)(s+2)(s+3)}$$

$$(b)\quad G(s)=\frac{6(s+2)}{s^2(s+3)(s+4)}$$

$$(c)\quad G(s)=\frac{10(s+1)}{s(s+6)(s+2)(s+5)}$$

2. Consider the following system defined by

$$\begin{bmatrix}\dot{x}1\\ \dot{x}2\end{bmatrix}=\begin{bmatrix}-1 & -1\\ 6.5 & 0\end{bmatrix}\begin{bmatrix}x1\\ x2\end{bmatrix}+\begin{bmatrix}1 & 1\\ 1 & 0\end{bmatrix}\begin{bmatrix}u1\\ u2\end{bmatrix}$$

$$\begin{bmatrix}y1\\ y2\end{bmatrix}=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}\begin{bmatrix}x1\\ x2\end{bmatrix}+\begin{bmatrix}0 & 0\\ 0 & 1\end{bmatrix}\begin{bmatrix}u1\\ u2\end{bmatrix}$$

There are four individual **Nyquis**t plot involved this system. Write a **Matlab** program to obtain these diagrams.

3. Consider the following system , draw **Nyquist** plot for only the positive frequency

$$(a)\quad G(s)=\frac{s^2+3s+1}{s^3+1.2s^2+2s+1}$$

$$(b)\quad G(s)=\frac{5(s+8)}{(s+4)(s+3)}$$

4. Consider (i) the unity negative feedback , (ii) unity positive feedback and (iii) unity positive-negative system with the help of the open loop transfer function :

$$G(s)=\frac{s^2+5s+4}{s(s^3+5s+2s+2)}$$

**Experiment No. 04 : (Bode diagram)**

1. Using Matlab program, draw the bode diagram of the following system :

(a) $G(j\omega) = \frac{1}{j\omega 4}$ (b) $G(j\omega) = j\omega 5$ (c) $G(j\omega) = (1 + j\omega 3)$

(d) $G(j\omega) = \frac{1}{3 + j\omega 5}$ (e) $G(j\omega) = \frac{1}{j\omega(1 + j\omega 7)}$

(f) $G(j\omega) = \frac{1 + j5\omega}{j\omega(2 + j\omega)(4 + j2\omega)}$

2. Using Matlab program, draw the Bode diagram of the following system:

(a) $G(s) = 1.1 + \frac{3}{s} + 2.5s$ For PID Controller

(b) $G(s) = 12(1 + \frac{5}{6s})$ For PI Controller

(c) $G(s) = 0.5(2+1.5s)$ For PD Controller

3. Using Matlab program, draw the Bode diagram of the following system:

$$\begin{bmatrix} \dot{x}1 \\ \dot{x}2 \end{bmatrix} = \begin{bmatrix} 0 & -1 \\ -3 & 4 \end{bmatrix} \begin{bmatrix} x1 \\ x2 \end{bmatrix} + \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} u1 \\ u2 \end{bmatrix}$$

$$\begin{bmatrix} y1 \\ y2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} x1 \\ x2 \end{bmatrix} + \begin{bmatrix} 0 & 0 \\ 0 & 0.1 \end{bmatrix} \begin{bmatrix} u1 \\ u2 \end{bmatrix}$$