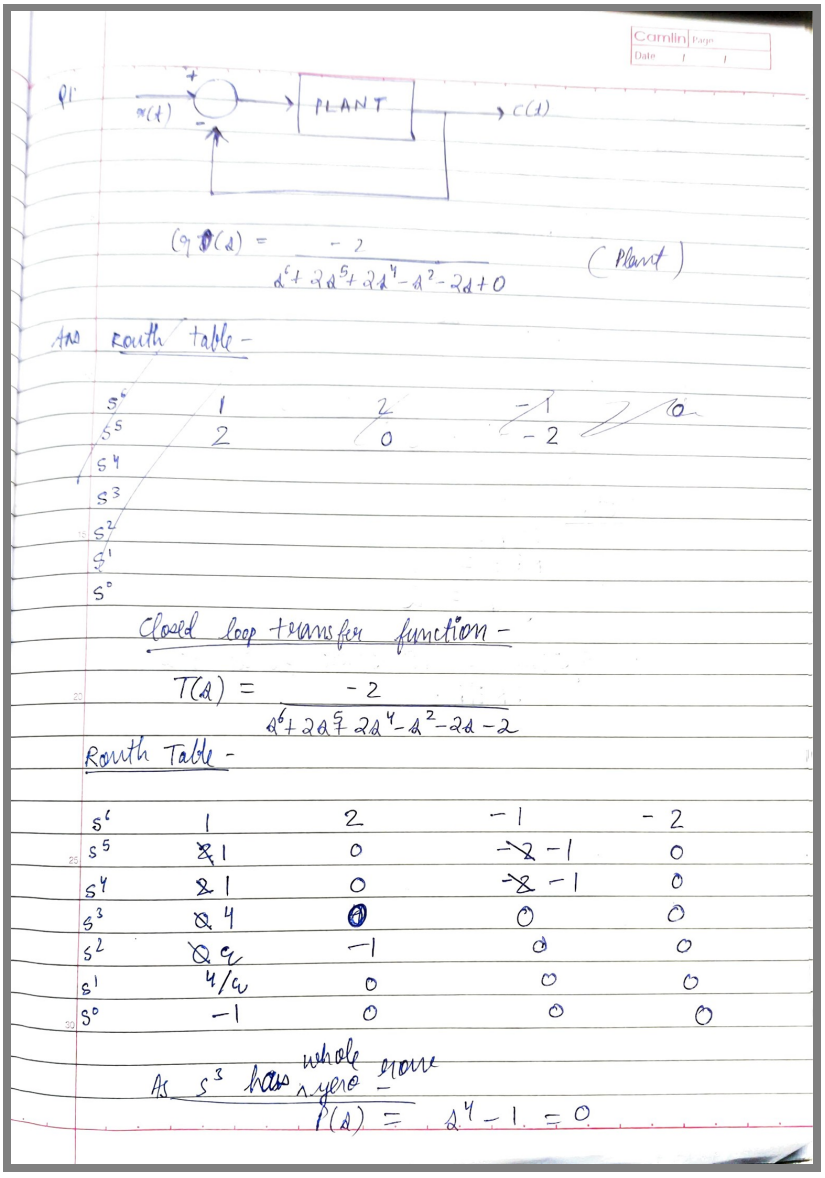
Lab6-Report

RollNo-190020021

Kushagra Khatwani

Answers-

Q1



$\frac{dP(s)}{ds} = 4s^3 + 0$

for P(s) -

sign changes = 1 (as $s > 0$)

so

RHP = LHP = 1

$j\omega p = 2$

for T(s) -

sign changes uptil $s^4 = 0$

so LHP = 2

so

Total -

LHP = 3

RHP = 1

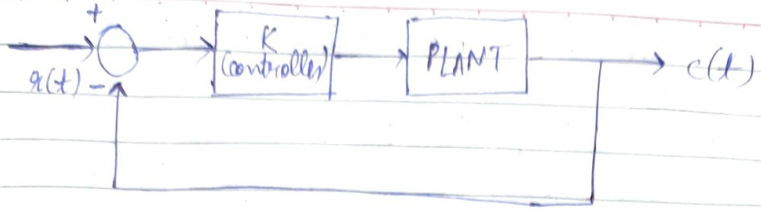
$j\omega p = 2$

The system is not stable as it has 1 RHP.

Q2

Given -

Q2 -



$$P(s) = \frac{s^2}{s^3 + 9s + 18}$$

Ans closed loop transfer function -

$$T(s) = \frac{Ks^2}{s^3 + Ks^2 + 9s + 18}$$

Routh table -

s^3	1	9
s^2	K	18
s^1	$\frac{-18 + 9K}{K}$	0
s^0	18	0

(a) If,

$K = 2$

then s^1 will be row having only zeroes.

so

If $K = 2$

s^3	1	9
s^2	2	18
s^1	0	0
s^0	9	0

$$P(s) = s^2 + 9$$

$$\frac{dP(s)}{ds} = 2s + 0$$

So we can see P(s) does not change sign

so two roots on jw axis and rest will on left side as no sign change in routh table.

So $K = 2$, we will get the system as marginally stable.

So

$$T(s) = \frac{2s^2}{s^3 + 2s^2 + 9s + 18}$$

$$= \frac{2s^2}{s^2(s+2) + 9(s+2)} = \frac{2s^2}{(s+2)(s^2+9)}$$

pole in LHP

oscillations due to s^2+9.

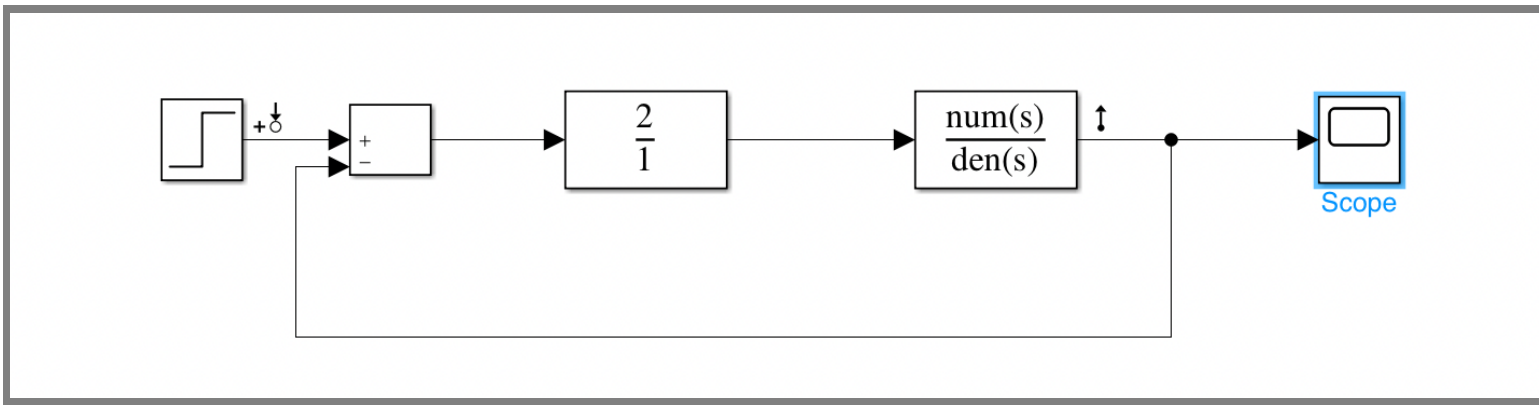
So $\omega_n^2 = 9$

$\omega_n = 3$

So

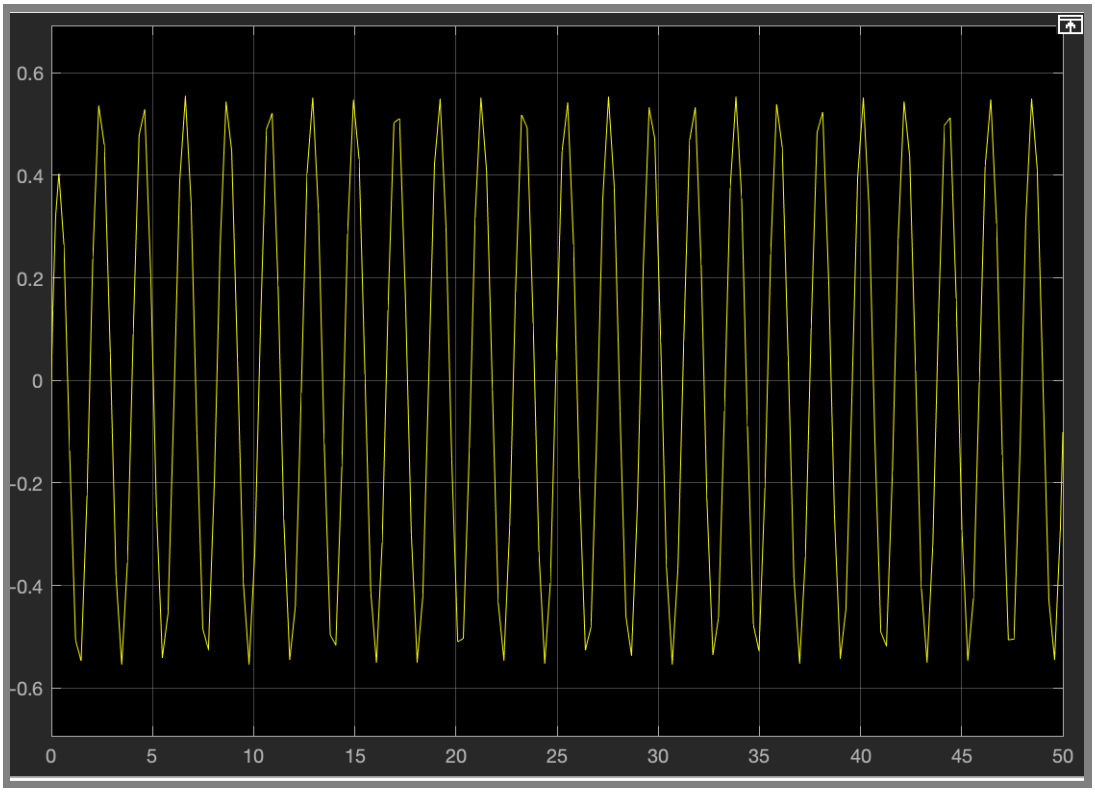
$$T = \frac{2\pi}{\omega_n} = \frac{2 \times 3.14}{3} = 2.09 \text{ s}$$

Simulink Model-



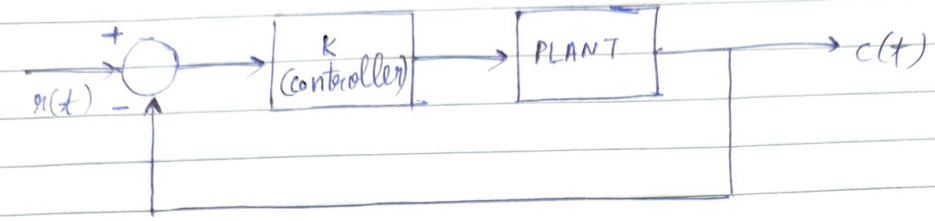
Output Plot-

K=2



Q3

Q3. Given -



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

Ans closed loop transfer function -

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

Routh table -

s^3	1	5
s^2	4	$(2+2K)$
s^1	$18-2K/4$	0
s^0	$(2+2K)$	0

For BIBO stable -
there should be no poles lying in RHP so,

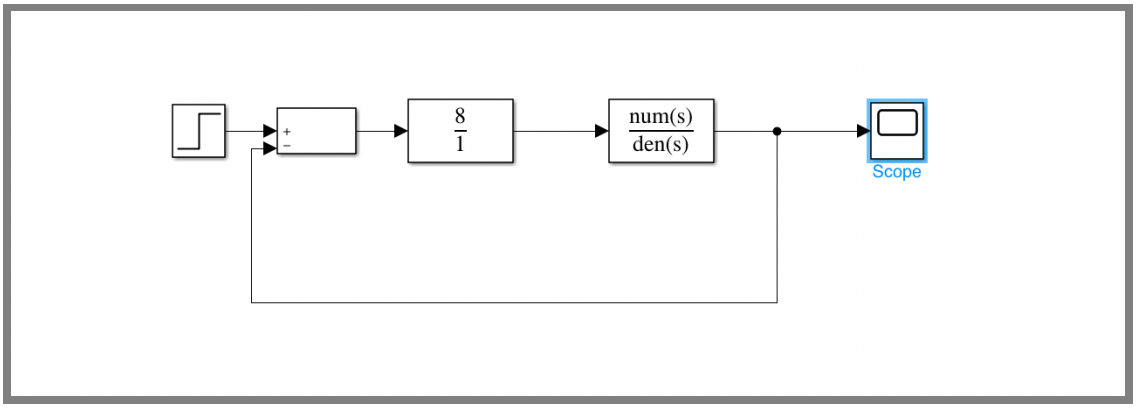
$$\frac{18 - 2K}{4} > 0$$

$$K < 9$$

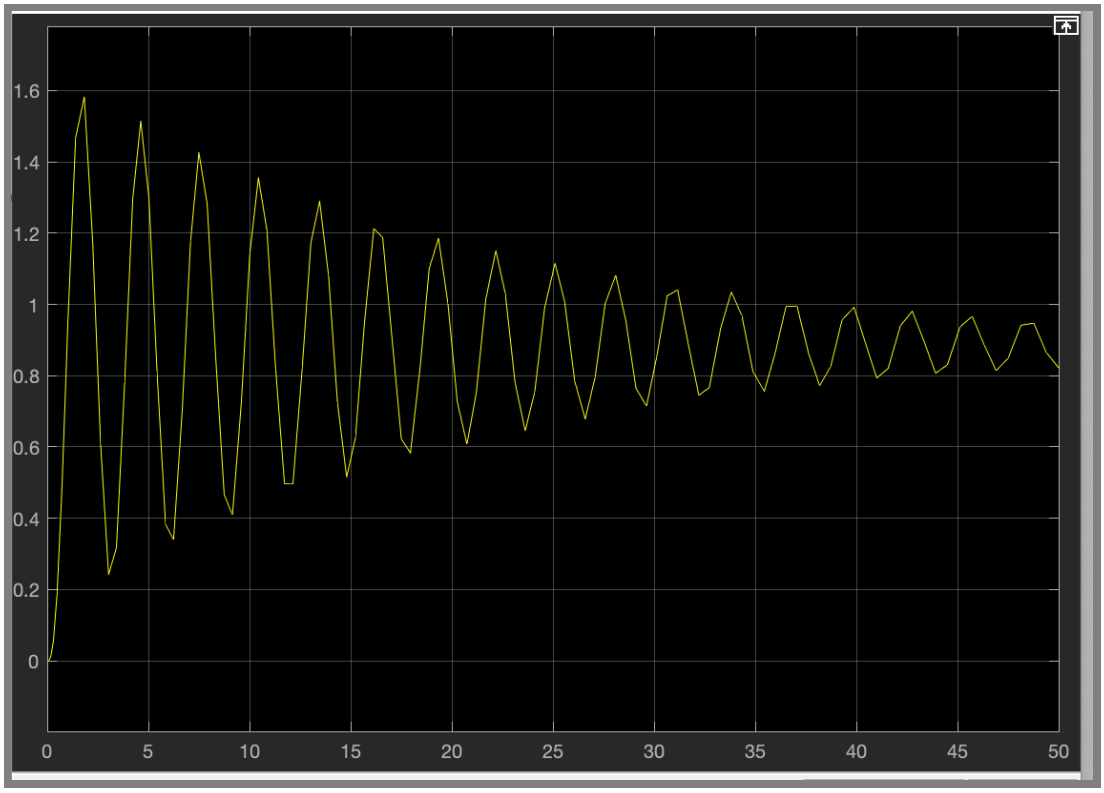
so, let $K = 8$
then there will be no sign change and system will be BIBO stable.

Simulink Model-(BIBO stable)

K=8

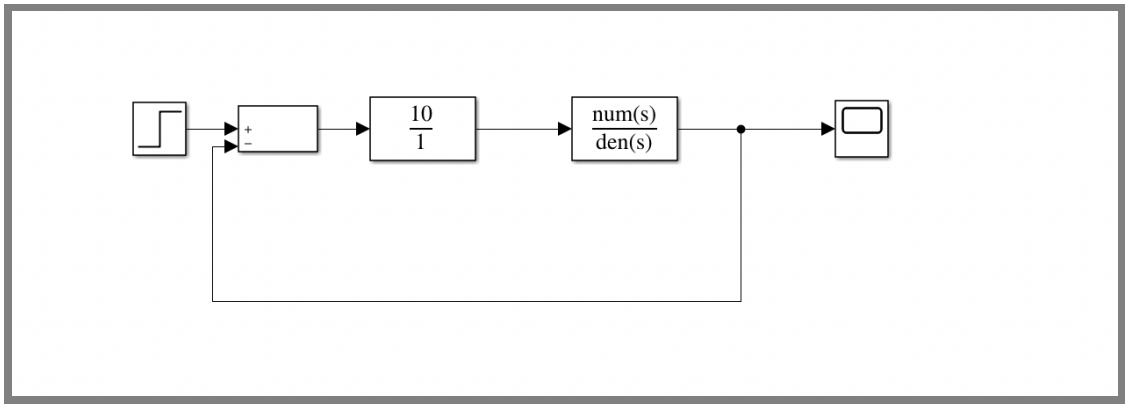


Output Plot-



Simulink Model-(Unstable)

K=10



Output Plot-