HW - 2

MCE 541/441

(1) $\frac{0.313\,(s+0.8)}{(s+0.6)\,(s^2+4s+5)}$

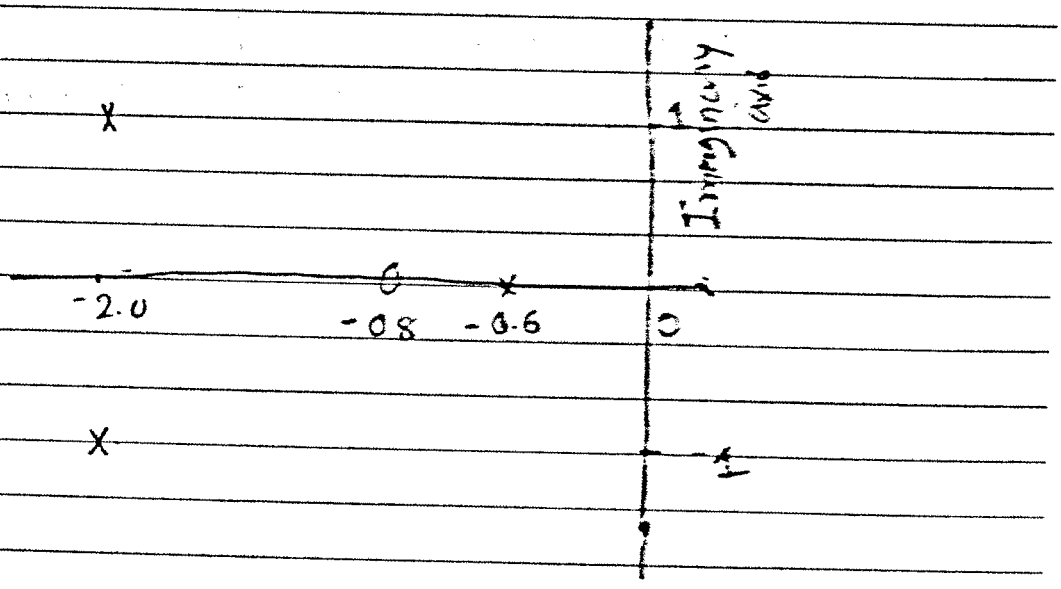
From matlab

$$T(s) = \frac{-0.0106 - 0.147i}{s-(-2+i)} + \frac{-0.0106 + 0.147i}{s-(-2-i)} - \frac{0.6}{s+0.6}$$

(very small) (very small)

$$\therefore T(s) = \frac{0.313(s+0.8)}{s+0.6}$$

Therefore it is in first order and therefore there is no any overshoot.



Real axis

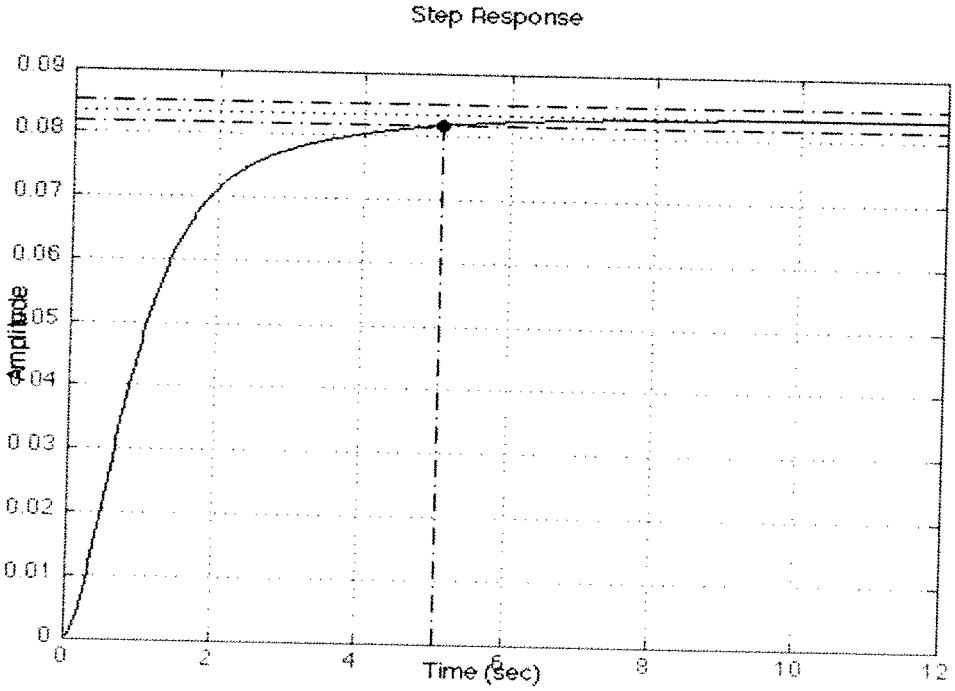
Ans 1

```
>> num=conv([0.313],[1 0.8]);
>> den=conv([1 0.6],[1 4 5]);
>> sys=tf(num,den);
>> pole(sys)
ans =
 -2.0000 + 1.0000i
 -2.0000 - 1.0000i
 -0.6000

>> [r,p,k]=residue(num,den)

r =
 -0.0106 - 0.1417i
 -0.0106 + 0.1417i
  0.0211
p =
 -2.0000 + 1.0000i
 -2.0000 - 1.0000i
 -0.6000
k =
   []

>> step(sys)
```



(2) $T(s) = \dfrac{500}{(s+10)(s^2+10s+50)}$

$F.V. = 1 \times \dfrac{500}{(10)(50)} = 1$

from matlab

$s = -10$, $\tau = 0.1$

$s = -5 + 5i$, $\tau = 0.2$

now, $T_{req} = \dfrac{500\,(1/10)}{s^2+10s+50}$

$= \dfrac{50}{s^2+10s+50}$

$\therefore 2\xi\omega_n = 10$

$\xi\omega_n = 5$

$\omega_n = \sqrt{50}$

$= 7.07$

$\xi = \dfrac{5}{7.07}$

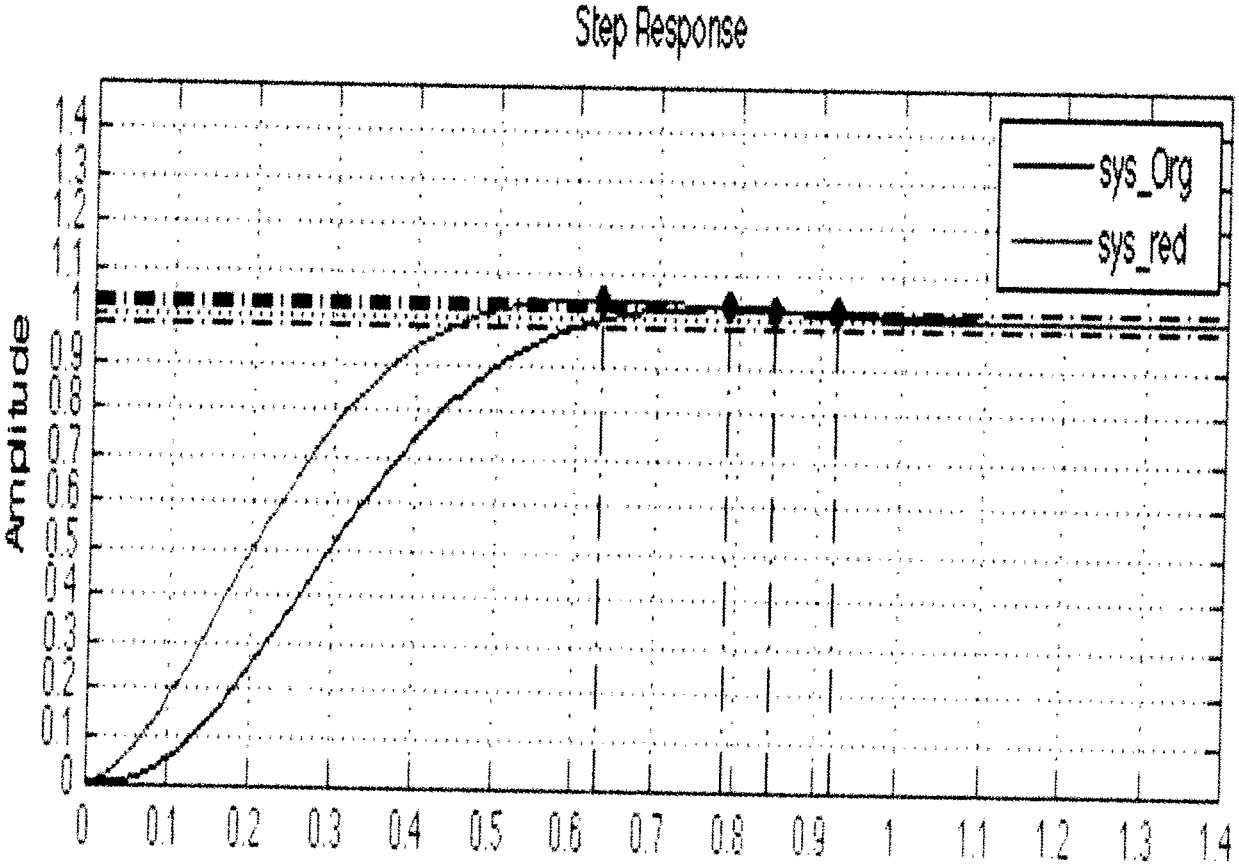
$\xi = 0.707$

$F.V. = 1 \times \dfrac{50}{50} = 1 \times 1 = 1$

$T_{set} = \dfrac{4}{\xi\omega_n} = \dfrac{4}{5} = 0.8$ sec

Ans 2

```
>> num=500;
>> den=conv([1 10],[1 10 50]);
>> sys_Org=tf(num,den);
>> pole(sys_Org)
ans =
 -10.0000
  -5.0000 + 5.0000i
  -5.0000 - 5.0000i
>> step(sys_Org)
>> hold on
>> num=50;
>> den=[1 10 50];
>> sys_red=tf(num,den);
>> step(sys_red)
```



(3) (a) $T(s) = \dfrac{96(s+3)}{(s+8)(s^2+8s+36)}$

F.V. $= 1 \times \left(\dfrac{96 \times 3}{8 \times 36}\right) = 1$

$a = 3$

$2\xi\omega_n = 8$ $\qquad \omega_n = 6$

$\xi = \dfrac{4}{6}$

$\xi = 2/3 = 0.67$

$T_{set} = \dfrac{4}{\xi\omega_n}$

$= \dfrac{4}{6 \times 0.67}$

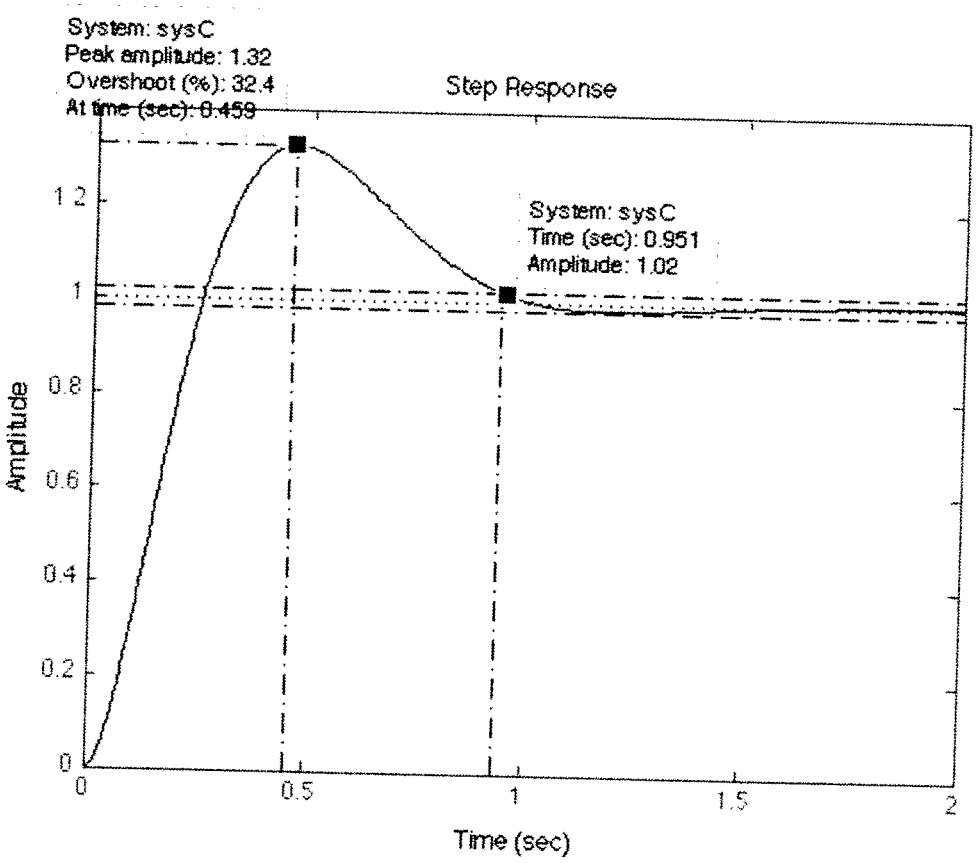
$T_{set} = 0.99$ sec.

From the the fig 5.13

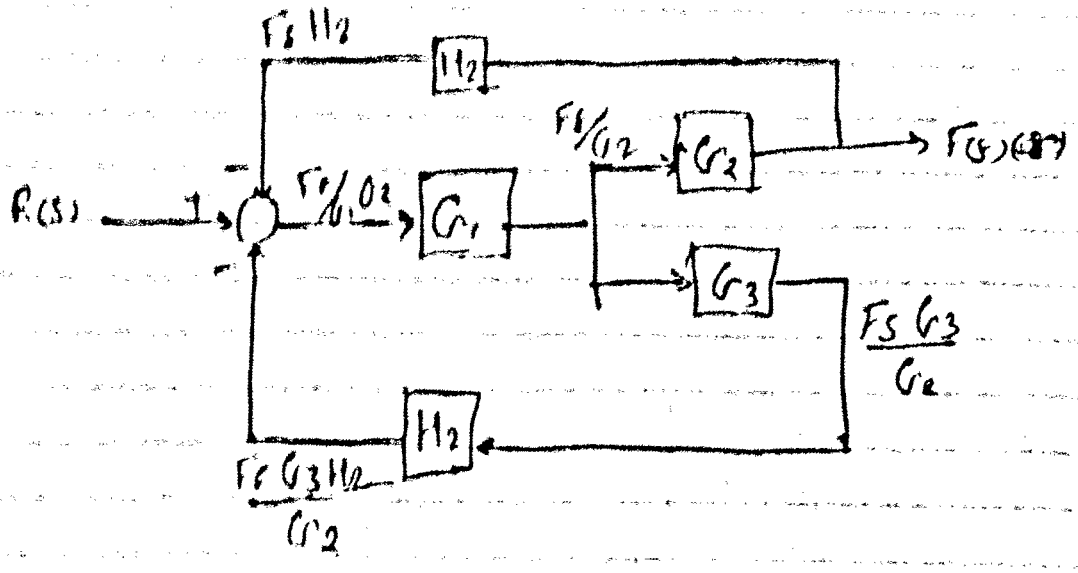
P.O. = 5 0 %.

Ans 3

```
>> num=conv([96],[1 3]);
>> den=conv([1 8],[1 8 36]);
>> sys0=tf(num,den);
>> step(sys0)
```



(1)



$$R(s) - F_5 H_2 - \frac{F_5 G_3 H_2}{G_2} = F_1/G_1 G_2$$

$$\therefore R(s) = F(s)\left(H_2 + \frac{G_3 H_2}{G_2} + \frac{1}{G_1 G_2}\right)$$

$$\therefore R(s) = F(s)\left(\frac{G_1 G_2 H_2 + G_1 G_2 H_2 + 1}{G_1 G_2}\right)$$

$$\frac{F_1(s)}{R(s)} = \frac{F(s)}{R(s)} = \frac{G_1(s) \cdot G_2(s)}{G_1(s) G_2(s) H_2(s) + G_1(s) G_3(s) H_2(s) + 1}$$