BENHA UNIVERSITY

Faculty of engineering

Automatic control

Mechanical engineering department

4th year (Power) 2013/2014

Assignment (4)

1) Consider a system described by the block diagram shown in figure (1) is subjected to unit ramp input, determine the output response of the system and calculate also the steady state error e_{ss}.

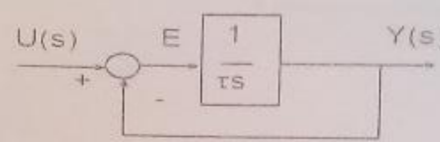


Figure (1)

2) A unity feedback system whose open loop transfer functions of $G(s) = \dfrac{K}{s\,(s+10)}$

Determine the gain K so that the system will have a damping ratio of 0.5. For this value of K determine the rise time, peak time, maximum overshoot, and settling time (to 0.95) for a unit step input.

3) Measurements conducted on a servomechanism show the system response to be; $c\,(t) = 1 + 0.2\ e^{-60t} - 1.2\,e^{-10t}$ when subjected to a unit step input.

a) Obtain the expression for the closed loop transfer function.

b) Determine the undamped natural frequency and damping ratio of the system.

3) Find the transfer function of the second order system whose time to peak is $t_p = \dfrac{\pi}{12}$, and maximum overshoot of $M_p = 0.095$.

4) The closed loop transfer function is $\dfrac{C(s)}{R(s)} = \dfrac{25\ K}{s^2 + (5 + 500\,K_t)s + 25\ K}$

Find the value of K and K_t, so that the maximum overshoot of the output is approximately 20 % and the peak time is 0.05 s. what is the steady state response and steady state error due to unit step, hence find the logarithmic decrement.

5) Figure (2-a) shows a mechanical vibrator system, whose a step input force of 2 N is applied to the system, the mass oscillates as shown in figure (2-b)

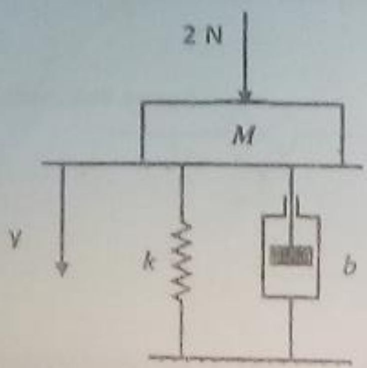


Figure (2-a)

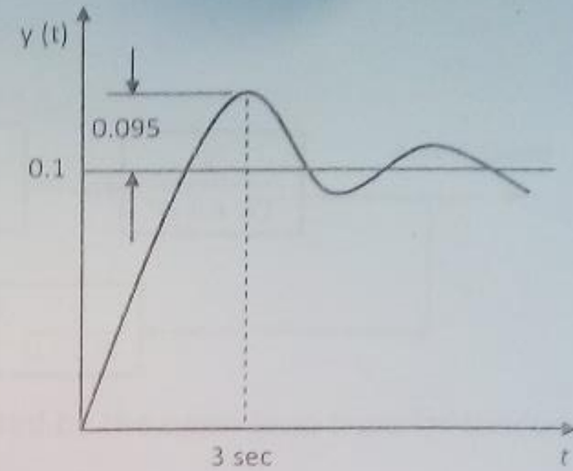


Figure (2-b)

6) Determine the step, ramp, and parabolic error constants of the following unity-feedback control systems. The forward path transfer functions are;

a- $G(s) = \dfrac{1000}{(1+0.1\,s)\,(1+10\,s)}$

b- $G(s) = \dfrac{100}{s(s^2+10s+100)}$

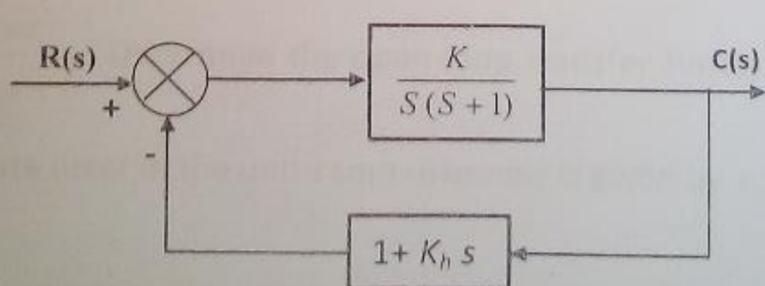
c- $G(s) = \dfrac{K}{s\,(1+0.5\,s)\,(1+0.1\,s)}$

d- $G(s) = \dfrac{100}{s^2\,(s^2+10s+100)}$

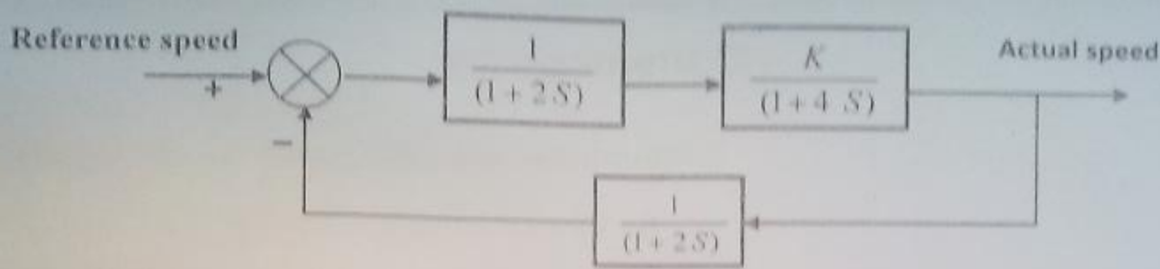
e- $G(s) = \dfrac{1000}{s\,(10+s)\,(100+s)}$

f- $G(s) = \dfrac{K(1+2s)(1+4s)}{s^2\,(s^2+s+1)}$

7) For the system shown in figure (3) determine the values of gain K, and the velocity feedback constant K_h, so that the maximum overshoot in the unit step response is 0.2 and the peak time is 1 s. with these values of K and k_h obtain the rise and settling time (to 0.95).



8) A simplified control system for a speed setting of a gasoline engine is shown in figure (4). If the steady state position error of 10 % of the reference setting is desired, what must the gain K be?



9) A unity feedback system is characterized by the open loop transfer function

$$G(s) = \frac{1}{s\,(1+0.5\,S)\,(1+0.2\,S)}$$

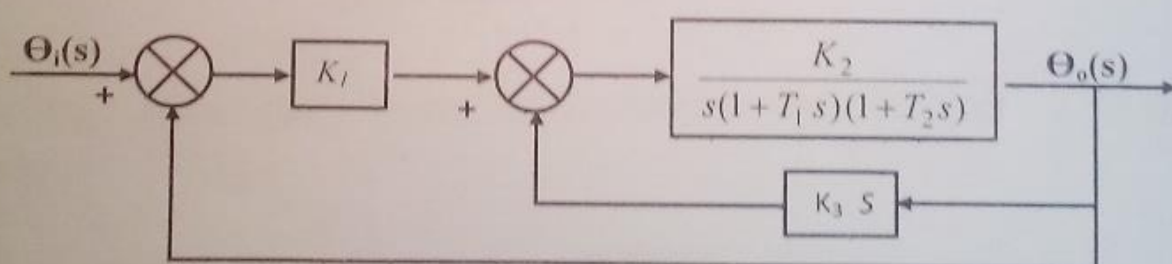
Determine the steady state error for the unit step and unit ramp.

A block diagram model of a DC-position servomechanism system which is used to adjust the rotation angle shown in figure.

(I) Drive an overall transfer function;

(II) Obtain $\theta_o(t)$ if $\theta_i(t)$ is a unit-step input, assume T_1=0, T_2=0.04, K_1=80, K_2=0.5, K_3=1;

(III) Calculate also the maximum overshoot and the peak time.



10) Consider a unity feedback control system with the closed-loop transfer function

$\frac{C(s)}{R(s)} = \frac{K\,s+b}{s^2+as+b}$, Determine the open-loop transfer function G(s), and show that the steady-state error in the unit-ramp response is given by $e_{ss} = \frac{1}{K_v} = \frac{a-K}{b}$