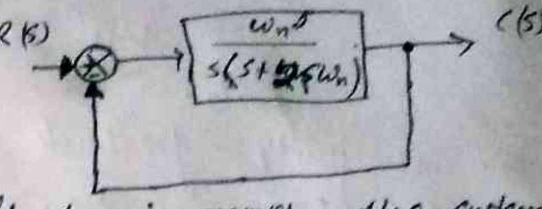
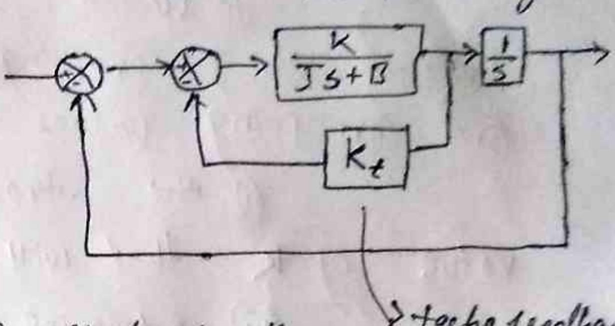
Tutorial: 2:

1. Derive the time domain transient specifications for second order system shown below. [ specifications. $M_p$, $t_r$, $t_p$, $t_s$ ].
[ input is step ].



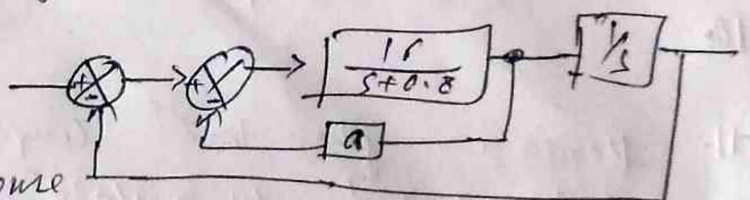

2. Explain why velocity (tachogenerator) feedback improves the system performance. Use dc motor model for your explanation.
Hint: Tachogenerator feedback

[ obtain transfer function for both cases (with and without) and Compare $\xi$ ]

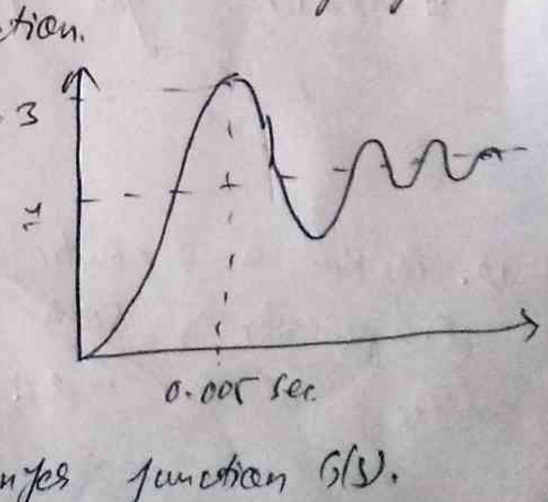



3. What are dominant closed loop poles? What is the effect of system dynamics due to these poles?.

4. The following system shows block diagram for a system. Determine the value of a such that the damping ratio $\xi = 0.5$ then obtain the rise time $t_r$, peak time $t_p$, $M_p$ and $t_s$ in the unit step response.




5. A step motor gives step response as shown in figure. Find a linear second-order transfer function to model the motor for this operation.




6. Consider a unity feedback control system with closed-loop transfer function.

$$\frac{C(s)}{R(s)} = \frac{Ks+b}{s^2+as+b}$$

Determine the open-loop transfer function G(s).
Show that steady state error in the unit ramp response is given by, $e_{ss} = \frac{1}{K_v} = \frac{a-K}{b}$

7. Consider following characteristics equation

$$s^4 + 2s^3 + (4+k)s^2 + 9s + 25 = 0$$

Use R-H criteria, determine the range of k for stability.

8. A unity feedback control system has an open loop transfer function

$$G(s) = \frac{k}{s^2(s+2)(s+5)}, \quad H(s) = 1$$

(i) sketch root locus diagram for the system. Indicate the crossing points of the loci on the $j\omega$ axis and corresponding values of k and $\omega$ at these points

(ii). ~~the transfer function~~ Determine the marginal value of k that will cause instability.

(iii) Determine the value of k when the system is critically damped.

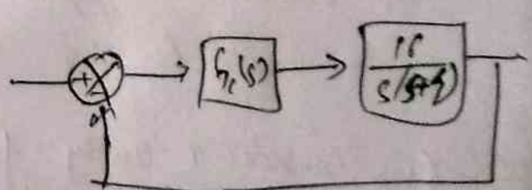
9. The closed loop transfer function of a feedback control system is given by

$$G(s) = \frac{C(s)}{R(s)} = \frac{1}{(1+0.01s)(1+0.05s+0.01s^2)}$$

Draw bode plot and obtain gain and phase margin.

10.

11. Design a phase lead compensator $G_c(s)$ such that damping ratio $\xi$ and $\omega_n$ are 0.5 and 2 rad/sec, and $k_v$ = 20 $sec^{-1}$ for following system




12. Consider a control system shown below. Design a compensator such that closed-loop dominant poles lies at $s = -2 \pm j2\sqrt{3}$ and $k_v = 50\ sec^{-1}$

$$G(s) = \frac{10}{s(s+2)(s+5)}$$

$$H(s) = 1$$

12. Consider a system shown below, design a compensator such that the closed loop system will satisfy the requirement. $K_v = 4\ \text{sec}^{-1}$, phase margin $= 45^\circ$, gain margin $\geq 8\ dB$

[lead]

$$G(s) = \frac{10}{s(s+1)(0.1s+1)}$$

$$H(s) = 1.$$

13. Consider the system shown below, design a lag compensator such that $k_v = 20\ \text{sec}^{-1}$, $\phi_m = 60^\circ$, $G.M \geq 10\ dB$.

$$G(s) = \frac{1}{s(s+1)(s+5)}$$

$$H(s) = 1.$$

Optional

14. Check out old questions