1. Find the steady state error of a unit feedback

15% system with the forward path gain S^{-4} when a unit

step input is used. Why?

2. Consider a plant: $\dot{x} = \begin{bmatrix} -3 & 1 \\ -2 & 0 \end{bmatrix} x + \begin{bmatrix} 1 \\ -2 \end{bmatrix} u$

$y = \begin{bmatrix} 1 & 0 \end{bmatrix} x.$

5% (a) Is the plant observable? why?

15% (b) Design a full-dimensional state estimator with

eigenvalues at -3 and -4.

3. Consider a unit feedback system with the plant

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -5 & -3 & -2 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 5 \end{bmatrix} u$$
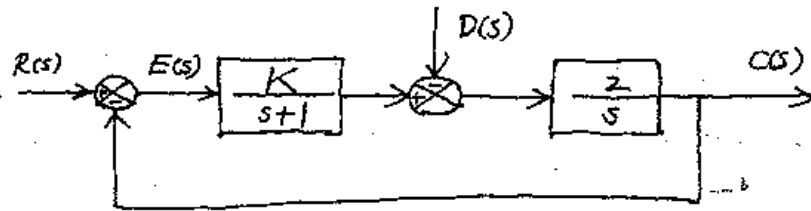
15% $y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} x$

and a proportional controller in the forward path.

Find the margin of the controller for closed-loop stability.
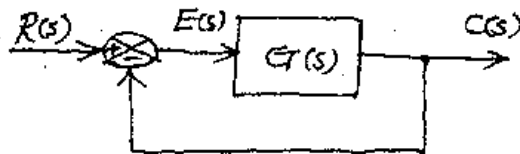
4. As shown in the following figure, try to find

   (a) the steady-state error, ess, for a unit step input, $r(t)=U(t)$ with $K=10$. (10%)

   (b) the steady-state error, ess, for a unit disturbance step input, $d(t)=U(t)$ with $K=10$ (10%)

5. Determine if the feedback control system shown in the figure is stable for the following transfer functions:

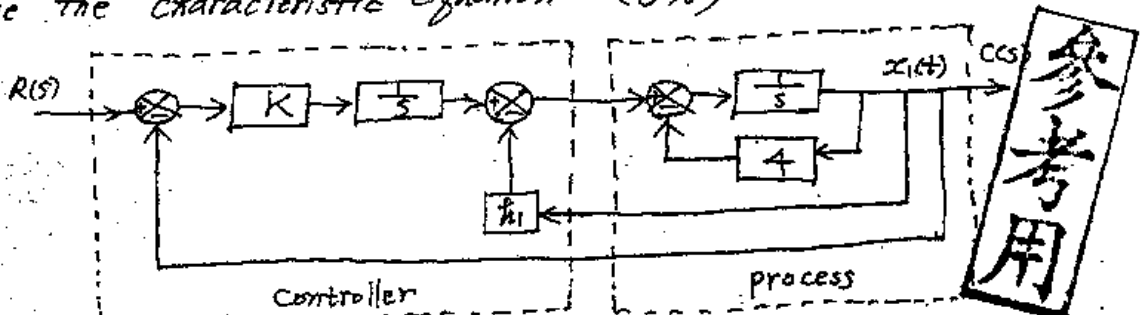   (a) $G(s)=\dfrac{3s+1}{s^2(300s^2+600s+50)}$ (10%)

   (b) $G(s)=\dfrac{100}{s(s^2+8s+24)}$ (10%)

6. A control system including a controller and a process are given in the following block diagram

   (a) Determine the state equations of this control system (5%)

   (b) Determine the characteristic equation (5%)