1. (30%)Consider the linear time-invariant system

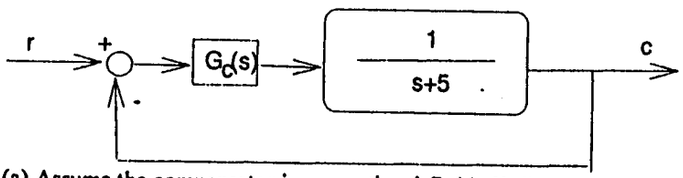
$$\dot{x} = Ax + Bu$$
$$y = Cx$$

Identify the correct or incorrect statements. If the statements are incorrect, then explain why. (此大題爲是非題，如果敘述不正確必須說明理由) (3 points each)

(a) We can check the system's stability from the information of matrix A only.
(b) If the system is controllable, then the system must be stable.
(c) If the system is uncontrollable, then we can not stablize the system through state feedback for any unstable system.
(d) If the system is stable, then the system must be controllable or observable.
(e) The controllability of the system will not change through state feedback.
(f) The observability of the system will not change through state feedback.
(g) If the order of the system's transfer function is reduced, then the system must be uncontrollable.
(h) For any controllable system, we can find certain input u to get any desired output y.
(i) For any dynamic system, through some transformation $\overline{x} = Tx$. We can diagonalize the $\overline{A} = TxT^{-1}$ matrix.
(j) If the system is controllable and observable, the the system must be stable.

2. (20 %) You are a graduate student of Biomedical Engineering at National Cheng-Kung University. You have a term project to design a PC controlled motor driving wheel chair (由個人電腦控制馬達驅動之電動輪椅). Please write down your design procedure, such as components selection, block diagram..... etc. (20 points)

3. (20%)Given the feedback control system:

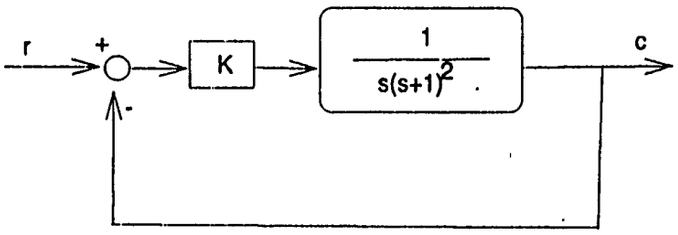


(a) Assume the compensator is proportional $G_C(s)$=K. Determine K so that the closed loop bandwidth is ω = 10 radians/second. What is the steady state error to a uint step input? (6 points)

(b) Assume the compensator is proportional plus integral, $G_c(s) = K_1 + \frac{K_2}{s}$. Select K_1 and K_2 so that ω_n = 10 radians/second and the damping ratio $\varsigma = 0.5$. (6 points)

(c) Suppose K_2=1. Using root locus, discuss if it is possible to select a value of K_1 to obtain an underdamped response for this system. (8 points)

4. (30%) Consider the control system



(a) Find the range of the gain K for stability of the closed-loop control system. (6 points)

(b) If K=2, what is the frequency (rad/sec) of oscillation for transients? (6 points)

(c) If K=1, find the steady-state error (i.e. input minus output) when the input r is a unit step function. Does this unit step response exhibit an overshoot of the steady-state output? (6 points)

(d) If K=1, find the steady-state error for a unit ramp input. (6 points)

(e) If K=1 and r(t)= 4 cos 3t, what is the steady-state response $c_{ss}(t)$? (6 points)