編號： 184　系所：系統及船舶機電工程學系丁組　　科目：自動控制

本試題是否可以使用計算機：☑可使用，☐不可使用　（請命題老師勾選）

#1) (20%) Reduce the following block diagram and find the closed-loop transfer function

$$G_{cl}(s) = \left.\frac{Y(s)}{R(s)}\right|_{N(s)=0} = ?$$

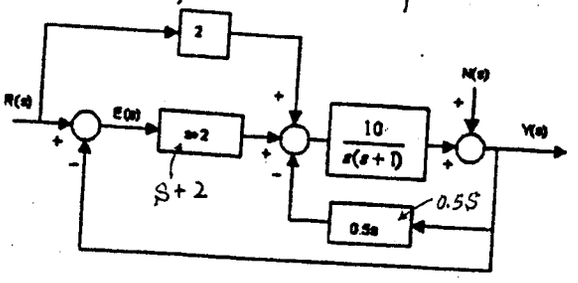

Fig.1

#2) (20%) For the system $\begin{cases} \dot{X}(t) = \begin{bmatrix} 0 & 6 & -5 \\ 1 & 0 & 2 \\ 3 & 2 & 4 \end{bmatrix} X(t) + \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} u(t) \equiv AX(t)+Bu(t) \\ y(t) = [0\ 1\ 0]X(t) \equiv CX(t) \end{cases}$ ~ ①, let $\bar{X} = P^{-1}X$,

5% a) Find the eigenvalues of A.

5% b) Find the generalized eigenvectors associated with the repeated eigenvalues

5% c) Find the modal matrix P to transform the above system to the Jodan Canonical form realization.

5% d) Find $\bar{A} = P^{-1}AP = ?$　　$\bar{C} = CP = ?$

#3) (20%) For a system described by

$$\dddot{y}(t) + 3\ddot{y}(t) + 3\dot{y}(t) + y(t) = r(t)$$

10% a) Let the state variables be defined as $x_1 = y$, $x_2 = \dot{y}$, $x_3 = \ddot{y}$. Write the state equation in the vector-matrix form. (i.e., $\dot{x} = Ax + Bu$, $y = Cx + Du$).

10% b) Find the state-transition matrix $\phi(t)$ of A. (Assume the initial time $t_0 = 0$).

#4) (20%) The closed-loop characteristic equation of a system is given by

$$s^3 + 2s^2 + (3+k)s + 2k = 0$$

Draw the Root Locus of the system for $-\infty < K < \infty$.

（背面仍有題目，請繼續作答）

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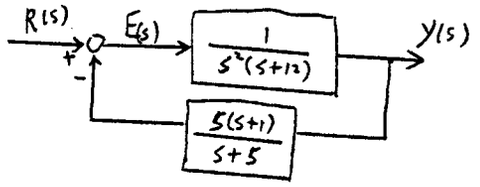
#5)

(20%) For the system shown below



let $r(t) = \mathcal{L}^{-1}\{R(s)\}$ be the reference input of the system.

$e_{ss}(t)$ represents the steady state error and $e_{ss} \equiv \mathcal{L}^{-1}\{E(s)\}$.

a) Can the system track $r(t) = 1(t)$ (unit step input)? , $e_{ss} = ?$ (7%)

b) Can the system track $r(t) = t\,1(t)$? , $e_{ss} = ?$ (7%)

c) Can the system track $r(t) = \frac{1}{2}t^2 1(t)$? , $e_{ss} = ?$ (6%)