題號： 348
科目：自動控制
節次： 2

國立臺灣大學 102 學年度碩士班招生考試試題

題號： 348
共 / 頁之第 / 頁

請於答案卷上作答，於試題卷上作答者，不予計分。

1. Briefly answer the following questions:
   (1) What are the sources of nonlinearities in a dc motor? 【計分：4 分】
   (2) Give the definition of the system type of a linear time-invariant system. 【計分：3 分】
   (3) What is a causal system? 【計分：3 分】

2. Consider a system described by the following set of algebraic equations:
   $X_2 = G_{12}X_1 + G_{32}X_3 + G_{42}X_4 + G_{52}X_5$, $X_3 = G_{23}X_2$, $X_4 = G_{34}X_3 + G_{44}X_4$, and $X_5 = G_{35}X_3 + G_{45}X_4 + G_{55}X_5$,
   where X_1 is the input variable and X_5 is the output variable.
   (1) Construct the signal flow graph for the system. 【計分：5 分】 (2) Find the gain of X_5/X_2. 【計分：10 分】

3. A feedback control system is shown in the figure below. Using Routh's stability criterion, determine all **values of K** for which the system is stable. 【計分：15 分】
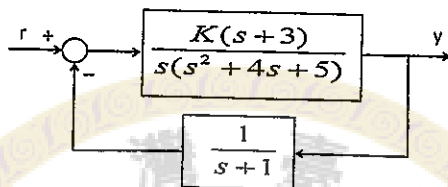

Figure for problem 3

4. Consider the system of the figure below.

(a) Sketch the root locus with respect to K for the system. 【計分：10 分】

(b) Please determine a gain K so that the steady-state error to a step input is minimized and estimate the rising time of the step response at the same time. 【計分：15 分】
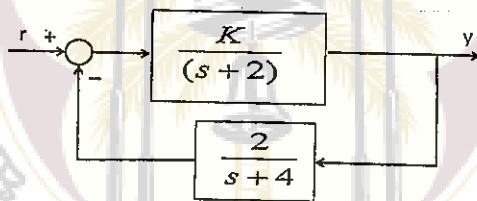

Figure for problem 4

5. Please draw the open loop Bode plot and Nyquist plot for the system of the figure below. 【計分：10 分】
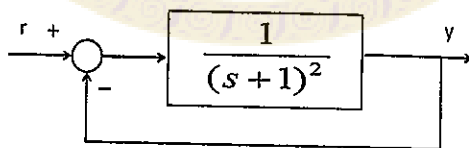

Figure for problem 5

6. The state-space representation of a linear control system is given as
$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -2 & -5 & -4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} -1 \\ 0 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + 2u$$

(1) Find the eigenvalues and the corresponding eigenvectors of the matrix A. 【計分：8 分】
(2) Find the transition matrix $\phi(t)$ of the system. 【計分：9 分】
(3) Check the controllability and observability of the system. 【計分：8 分】

試題隨卷繳回