

國立臺灣科技大學

九十二學年度博士班招生考試試題

系所組別：機械工程系博士班丁組

科目：系統與控制

題目共有五題，總分一百分。

1. Please explain what are the differences between the model-based and the model-free controller design process and what are their individual advantages and disadvantages? Write down two control methods for each classification. Then describe how to design a model-based PID and model-free PID controllers. [20%]

2. Based on the Cayley Hamilton's theorem, please compute

(a) e^{At} [10%]

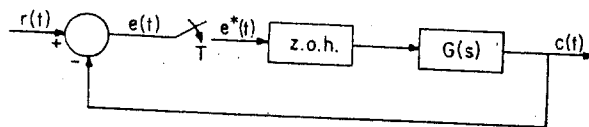
(b) A^{-1} [10%], where $A = \begin{bmatrix} 2 & 1 & 4 \\ 0 & 2 & 0 \\ 0 & 3 & 1 \end{bmatrix}$

3. Please sketch the Nyquist plot for a system with the open loop transfer function,

$$G(s)H(s) = \frac{K(s+4)}{s(s+1)(s+2)^2}$$

Then determine the value of K to obtain the damping ratio $\zeta = 0.5$ for the desired dominant poles. The relationship between damping ratio and the phase margin is $\Phi M = \tan^{-1}(2\zeta / \sqrt{-2\zeta^2 + \sqrt{1+4\zeta^4}})$ [20%]

4. Consider the following system block diagram. Let T be the sampling interval and the system transfer function is $G(s) = \frac{K}{s+1}$



The stability of this system depends on the values of K and T . Please indicate the stable range of this control system in $K-T$ plane. [20%]

5. Consider the system and the cost function as the following equations

$$\ddot{x} + x = u, \quad J = \frac{1}{2} \int_0^{\infty} [\dot{x}^2(t) + u^2(t)] dt$$

Find the optimal control law $u = k_1 x + k_2 \dot{x}$. [20%]

