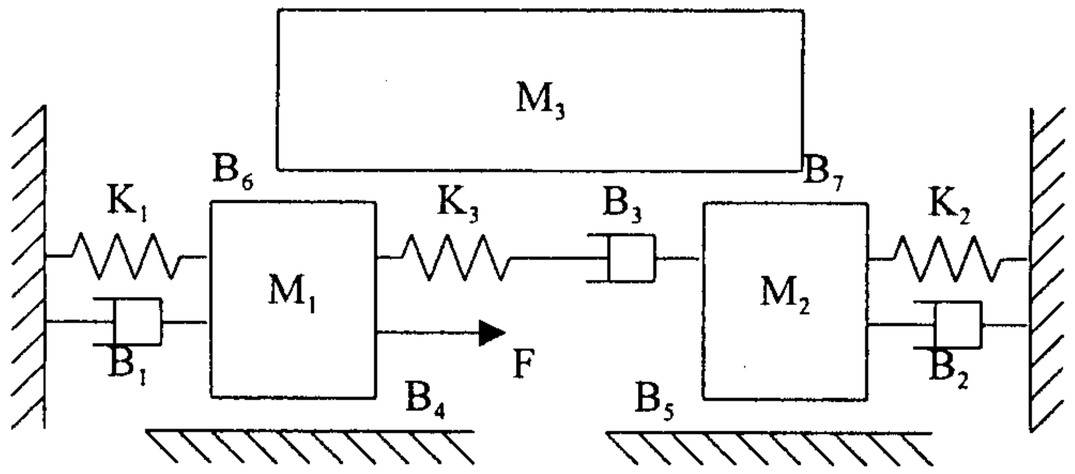
國立臺灣科技大學
八十九學年度碩士班招生考試試題

系所組別： 機械工程系丁組
科　目： 線性系統控制

1. Answer the following questions briefly:
   (A) State basic assumptions for a dynamic system to have a transfer function representation. (5%)
   (B) Give a practical example of a non-minimum phase system and explain the reason. (5%)
   (C) Give a practical application of an unstable system and explain the reason. (5%)
   (D) What is the physical meaning of stabilizability of a dynamic system? Is it the same as controllability? Why? (5%)

2. Define appropriate state variables and find the state equation for the system shown below. Note that B_6 and B_7 are friction coefficients between M_3 and M_1 and between M_3 and M_2, respectively. (20%)



3. Consider a mass-spring-damper system with all its parameters given. A control force F is acting on the mass.
   (A) Find F so that the motion of the mass approaches the equilibrium point under critical-damping dynamics for any given initial condition. (10%)
   (B) Find F so that the motion of the mass tracks a desired trajectory represented by the triple $\{x_d(t),\ \dot{x}_d(t),\ \ddot{x}_d(t)\}$ asymptotically where $x_d(t)$ is the desired displacement, and $\dot{x}_d(t)$ and $\ddot{x}_d(t)$ are its velocity and acceleration, respectively. (10%)

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4. Model reference control of LTI systems:

(A) Given a known LTI system $\dot{y} = ay + bu,\ b \neq 0$ and y is measurable. You are asked to design the control u so that y approaches to y_m asymptotically, where y_m is the state of a known dynamic system $\dot{y}_m = a_m y_m + b_m r,\ b_m \neq 0$ and with r a proper signal. (10%)

(B) Given a known 2nd order LTI system

$$\begin{bmatrix} \dot{y}_1 \\ \dot{y}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -a_1 & -a_2 \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

where y_1 and y_2 are measurable states. Find u so that the states track the system

$$\begin{bmatrix} \dot{y}_{m1} \\ \dot{y}_{m2} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -a_{m1} & -a_{m2} \end{bmatrix} \begin{bmatrix} y_{m1} \\ y_{m2} \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} r$$

where a_{m1} and a_{m2} are known and r is a proper signal. (10%)

5. Construct a control system whose states are partially accessible and design a full order observer for the system. Implement the controller with the observer in C language. You may have proper assumptions if needed. (20%)