國立臺灣科技大學
九十二學年度碩士班招生考試試題
系所組別：高分子工程系碩士班丙組
科　目：控制系統

總分100分，選擇題答案務必寫於答案卷上，並注明題號。

選擇題：共 4 題，8 分/題，總計 32 分
說明：每題皆為四選一之選擇題，空白者零分計算，選錯一題則倒扣 2 分。

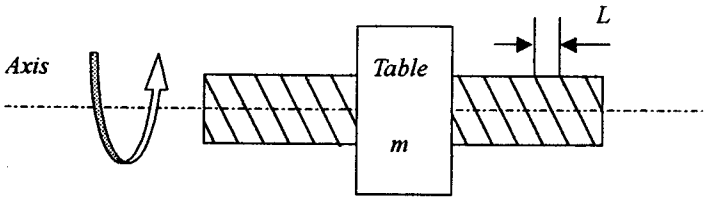
1. $F(s)=\dfrac{6s+11}{s^2+6s+34}$, find the Laplace inverse transform of $F(s)$.

   (a) $6e^{-3t}\cos 5t-1.4e^{-3t}\sin 5t$　　(b) $4e^{-2t}\cos 5t-1.2e^{-2t}\sin 5t$
   (c) $5e^{-t}\cos 4t-1.4e^{-t}\sin 4t$　　(d) $6e^{-6t}\cos 3t-2.4e^{-6t}\sin 3t$

2. The role of a controller is twofold. It must bring the system's operating condition to the desired value and it must maintain the desired condition in the presence of variations caused by the external environment. Which system dose not meet these requirements.

   (a) The float in a toilet.
   (b) A car's cruise control system.
   (c) A traffic light.
   (d) An anti-lock braking system.

3. Find the equivalent inertia of the table of the lead screw shown in follow figure. The mass of the table is m.



   (a) $\dfrac{mL}{4\pi^2}$　　(b) $\dfrac{mL^2}{4\pi^2}$　　(c) $\dfrac{mL}{\pi^2}$　　(d) $\dfrac{mL^2}{\pi^2}$

4. The system model equation is $\ddot{x}+7\dot{x}+6x=10$, How long it will take to reach steady-state ?

   (a) 7s　　(b) 6s　　(c) 5s　　(d) 4s

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5. A certain system is described by the model (17%)

$$\ddot{x} + c\dot{x} + 4x = f$$

Set the value of the damping constant c so that both of the following specifications are satisfied. Give priority to the overshoot specification.

(1) Maximum percent overshoot as small as possible and no greater than 20%.

(2) Peak time as small as possible and no greater than 3.6.

6. Determine the range of K values that will give a time constant of less than 1/2 for a system with the following characteristic equation: (16%)

$$s^3 + 10s^2 + 31s + K = 0$$

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7. A simple robot is shown in Figure 1(a). An actuator at the base provides the torque T to rotate the robot through the angle θ. Another actuator in the arm provides the force f to extend the boom. The mass of the rotating base is m_1; its center of mass is at r_1, which is constant. The mass of the extendable boom is m_2, and its mass center is at r_2, which is variable. The lumped parameter representation is shown in Figure 1(b). Obtain the equations of motion for θ and r_2 as outputs, with T and f as given input function of time. (20%)

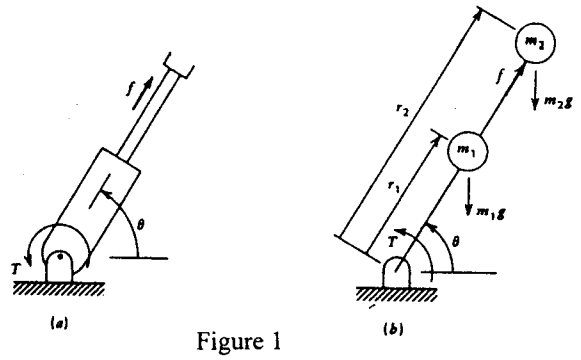

Figure 1

8. In Figure 2, let G be a hydraulic servo with transfer function $G(s) = \dfrac{\omega_n^2}{s^2 + \omega_n^2}$.

(a) Can a compensator $G_c = K$ be used? (5%)

(b) Use root loci to investigate the use of a compensator $G_c = K(s + a)$, $a > 0$. (5%)

(c) Similarly, examine the use of $G_c = K(s^2 + a^2)$ with a larger than ω_n. (5%)

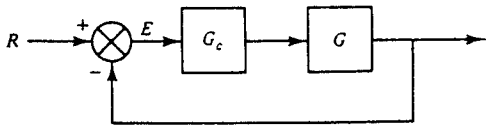

Figure 2