國立臺北科技大學九十五學年度碩士班招生考試

系所組別：1512 自動化科技研究所甲組

第二節 自動控制（選考）試題

填 准 考 證 號 碼

注意事項：

1. 本試題共 4 題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

1. (25%)A precision-table leveling scheme shown in figure below relies on thermal expansion of the two actuators under the table corners to raise and lower the table. Find the differential equations relating the height of the actuator d versus the applied voltage v_i, where

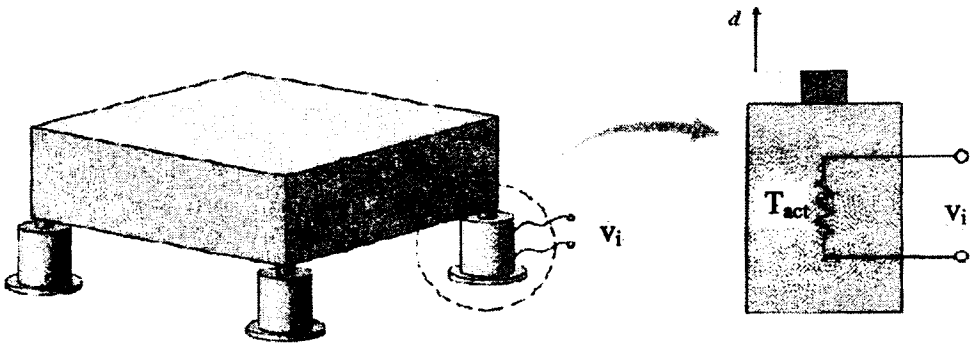
   T_{act}=actuator temperature

   T_{amb}=ambient air temperature

   R_f=heat-flow coefficient between the actuator and the air

   C=thermal capacity of the actuator

   R=resistance of the heater



The net heat-energy flow into a substance affects the temperature of the substance

according to the relation: $\dot{T} = \frac{1}{C} q$, where T is temperature(°C), C is the thermal capacity, and q is heat energy flow. (Assume that the actuator acts as a pure electric resistance, the heat flow into the actuator is proportional to the electric power input, and d is proportional to the difference between T_{act} and T_{amb})

2. (25%)Find the allowable regions in the s-plane for the poles of a transfer function of a system if the system response requirements are
Rising time $t_r \leqq 0.6$sec, overshoot $M_p \leqq 10\%$, **settling time** $\leqq 3$sec.

3. (25%)A DC-motor speed control is described by the differential equation

$$\dot{y} + 60y = 600v_a - 1500w$$

where y is the motor speed, v_a is the armature voltage, and w is the load troque. Assume the armature voltage is computed using PI control law

$$v_a = -\left(K_p y + K_i \int_0^t y d\tau\right)$$

(a) Compute the transfer function from w to y as a function of K_p and K_i
(b) Compute values for K_p and K_i so that the characterisitic equation of the closed-loop system will have roots at -60±60j

4. (25%)A simple model for a disk drive servo with one resonance mode has a transfer function given by

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

If we draw a corresponding block diagram with integrators only, assign the state as shown in figure below. Please find the state equation for the system.