

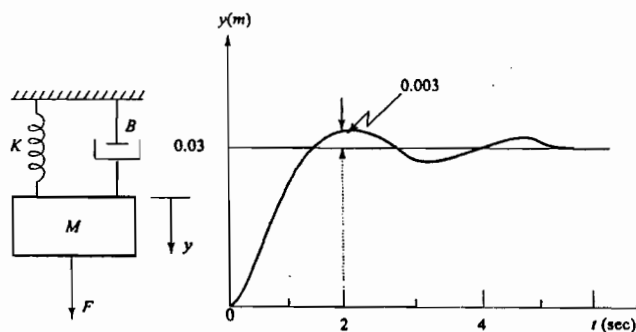
國立台灣科技大學九十五學年度博士班招生試題

系所組別： 高分子工程系博士班丙組、在職教師丙組

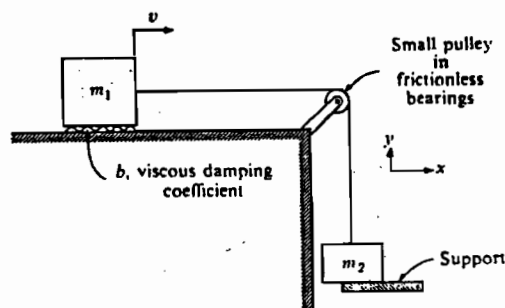
科 目： 控制工程

共 6 大題，請依序作答。 總分 100 分

1. The figure below shows a mechanical vibrating system. If the system is at rest and let the displacement of the mass measured relative to static equilibrium position. When 9 Newton of force is applied to the system, the mass oscillates as shown. Determine the parameters M , B and K of the system from the response. (10%)



2. A system consisting of two masses, m_1 and m_2 , connected by a flexible but inelastic cable (i.e., cable stiffness is very large) is originally held in equilibrium by having a support under the mass m_2 , as shown in the figure below. (15%)



Draw a simple lumped parameter model of this system involving translational elements which move in the x direction only. Include an input to this system which is equivalent to removing the support in the real system. Then, find v as a function of time after the support is removed. Make a clearly labeled sketch of this system response, showing all its salient features.

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3. Given the following system of equations, (10%)

$$a_{11}x_1 + a_{13}x_3 = b_1u$$

$$a_{21}x_1 + a_{22}x_2 = 0$$

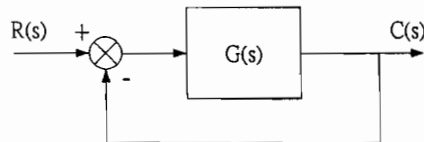
$$a_{31}x_1 + a_{33}x_3 = 0$$

- (1) Draw a signal flow graph or a block diagram showing u as the input and x_2 as the output.
 (2) Use Mason's rule to determine the transfer function relating x_2 and u .

4. Given the unity feedback system with (15%)

$$G(s) = \frac{4}{s(s^6 - 2s^5 + 2s^4 - 4s^3 - s^2 + 2s - 2)}$$

Using the Routh table, find out how many poles of the closed-loop transfer function lie in the right half-plane, the left-plane, and on the $j\omega$ -axis.



5. A second-order control system has the closed-loop transfer function

$$T(s) = Y(s)/R(s). \text{ The system specifications for a step input follow: (20\%)}$$

- (1) Percent overshoot $< 5\%$
 (2) Settling time < 4 seconds (Use a 2% settling criterion)
 (3) Peak time < 1 second

Sketch the region in the s -plane in which the poles of $T(s)$ should be located in order to achieve the desired response. Also determine the closed-loop transfer function $T(s)$ when the percent overshoot is 5%, the peak time is 1 second, and the steady-state error is 0.1 for a unit step input, where $E(s) = R(s) - Y(s)$.

6. Find the frequency response of the following system. (30%)

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