

## 國立台灣科技大學九十七學年度碩士班招生試題

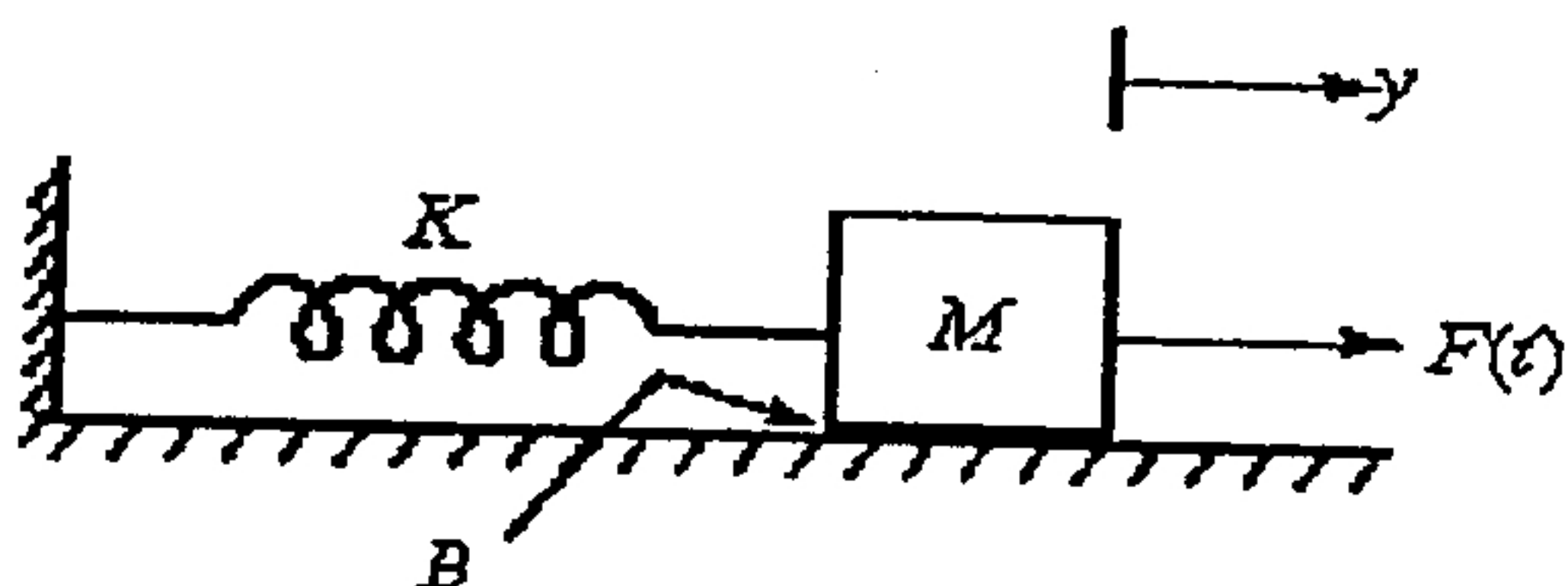
系所組別： 高分子工程系碩士班丙組

目： 控制系統

丙組：控制系統；共六大題，總分 100 分；請於答案卷內依序作答。

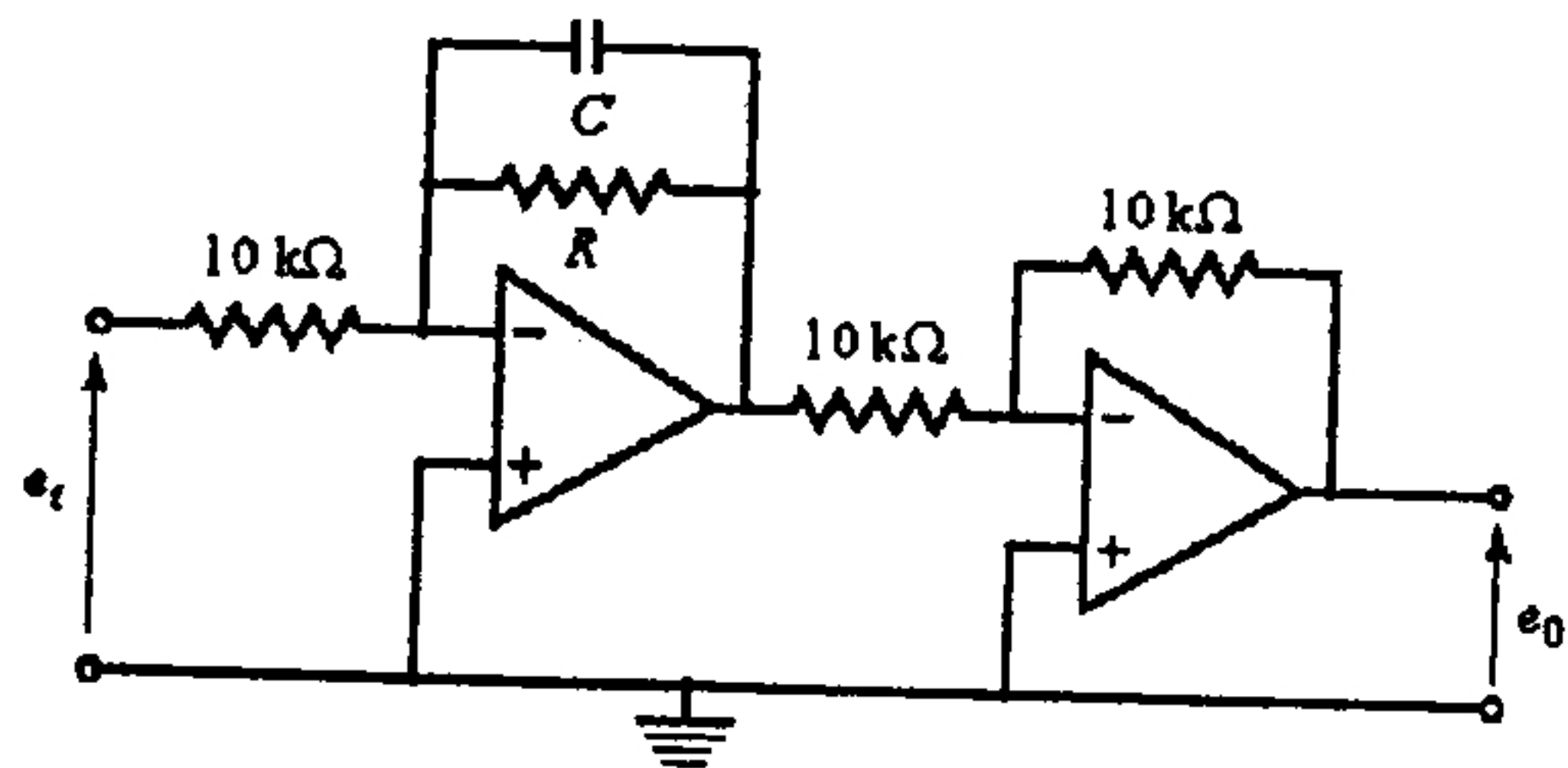
一、The parameters of the mechanical system of following figure are

$$M = 1000 \text{ kg}, \quad B = 10000 \text{ N/(m/sec)}, \quad K = 100000 \text{ N/m}$$



A step force of 1000 N is applied to the mass at  $t = 0$ . The initial conditions are  $y(0) = \dot{y}(0) = 0$ . Find the damping ratio, undamped natural frequency, damped natural frequency. Also obtain the unit step response and evaluate the time-constant. (20%)

二、Find the transfer function model for the networks, where  $e_i$  is system input and  $e_o$  is system output. (10%)



三、The unit step response of a given system is  $y = 1 - \frac{7}{3}e^{-t} + \frac{3}{2}e^{-2t} - \frac{1}{6}e^{-4t}$ . What is the transfer function of this system?

(15%)

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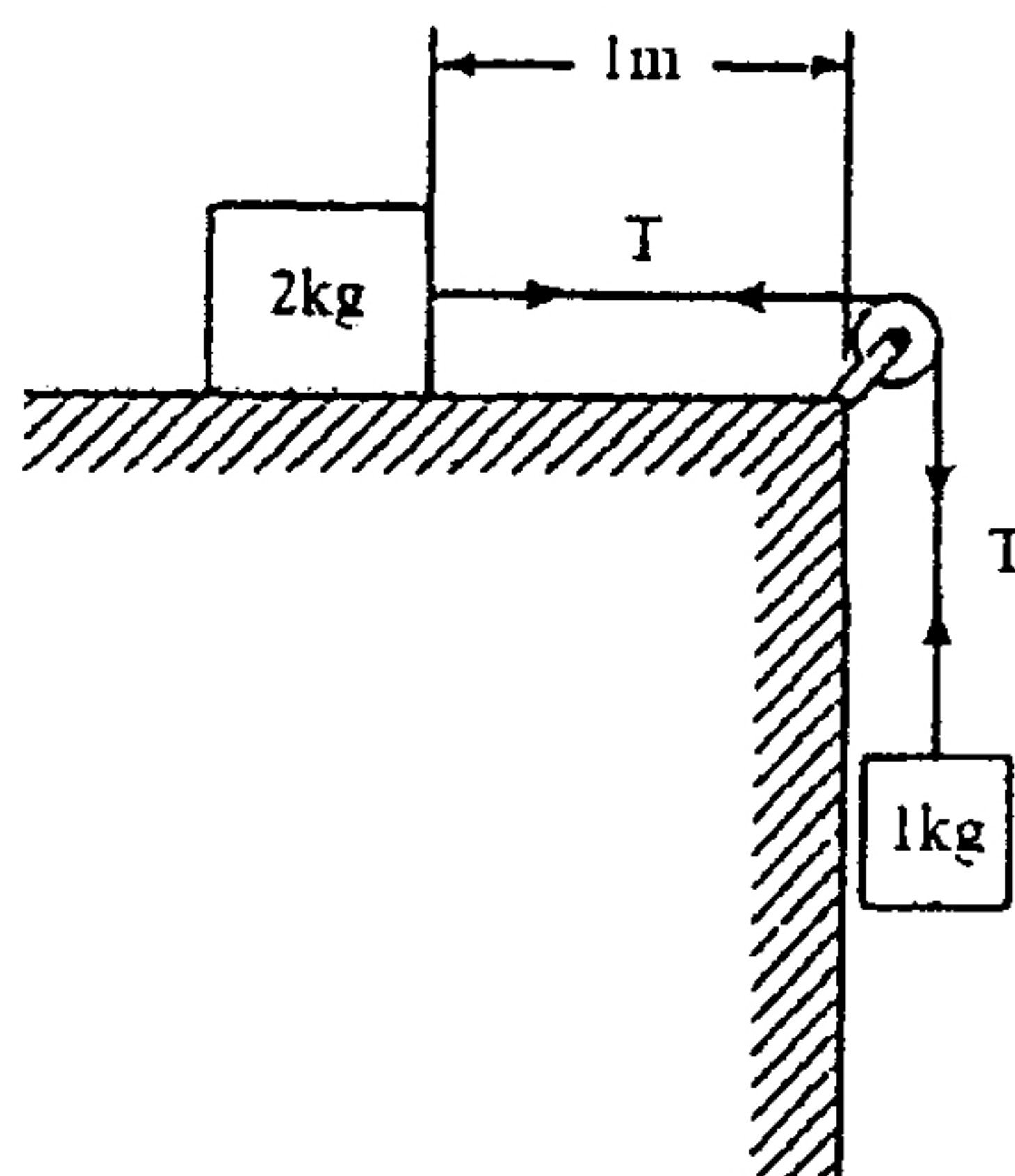
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四、

A wood block of mass 2 kg placed on a rough horizontal surface is attached to a hanging mass of 1 kg through a massless wire as shown in the Figure below. The wire passes horizontally over a frictionless pulley. Assume that the wire is inextensible. The wood block is initially held to stay at rest and the hanging mass is at rest. At  $t = 0$ , the wood block is released. Find the velocity of the block when it has moved 0.5 m. Assume that the coefficient of sliding friction between the wood block and the rough horizontal surface is 0.2.

(15%)



Hanging-mass system

五、

A closed-loop control system transfer function  $T(s)$  has two dominant complex conjugate poles. Sketch the region in the left-half  $s$ -plane where the complex poles should be located to meet the given specifications.

- (a)  $0.5 \leq \zeta \leq 0.707$ ,  $5 \leq \omega_n \leq 10$  ( $\zeta$ : Damping ratio,  $\omega_n$ : Natural frequency)

(6%)

- (b) Peak time  $< 1$  second, 2 seconds  $<$  Settling time  $< 4$  seconds

(Use a 2% settling time) (6%)

- (c)  $10\% <$  Percent overshoot  $< 20\%$ , Settling time  $< 0.5$  second

(Use a 2% settling time) (8%)

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六、

The transfer function  $G(s)$  for a unity-feedback control system is

$$G(s) = \frac{K}{s(s^2 + 8s + 20)}$$

Using Routh-Hurwitz criterion,

- (a) Determine the value of the gain  $K$  such that the characteristic equation has a pair of roots on the imaginary axis. Write the factored form of the characteristic equation for this case. (10%)
- (b) Determine the value of the gain  $K$  such that the characteristic equation has a pair of roots on the vertical axis which passes through  $-1$ . Write the factored form of the characteristic equation for this case. (10%)

