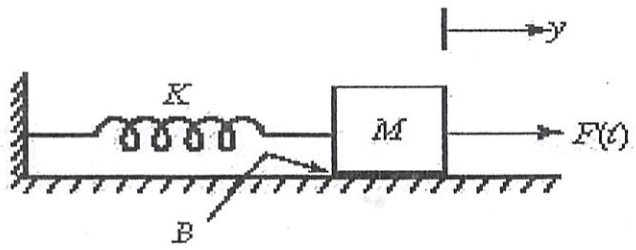
國立臺灣科技大學103學年度碩士班招生試題

系所組別： 材料科學與工程系碩士班乙組

科　　目： 控制系統

（總分為100分）

1. The parameters of the mechanical system are
$M = 1000$ kg, $B = 10000$ N/(m/sec), $K = 100000$ 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 and damped natural frequency. (15%)

2. 一個系統由以下微分方程式所描述

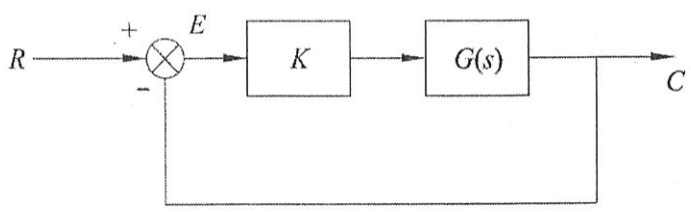
$$\ddot{y}(t) + 7\dot{y}(t) + 6y(t) = 6r(t);\ y(0) = \dot{y}(0) = 0$$

找出系統對輸入 $r(t)=\sin 2t$ 的穩態響應。 (15%)

3. 對以下的特性方程式，畫出根軌跡圖。 (20%)

$$1 + \frac{K}{s(s^2 + 6s + 10)} = 0;\ K \geq 0$$

4. In the Figure shown below with $G(s)=1/[(s+1)(s+7)]$:



(1) Find the lowest value of K that will minimize the settling time. (5%)

(2) Find K and the corresponding steady-state error for a unit step to obtain a system damping ratio of about 0.7. (5%)

(3) Compare the settling times of parts (1) and (2). Which is the best to minimize rise time, and why? (5%)

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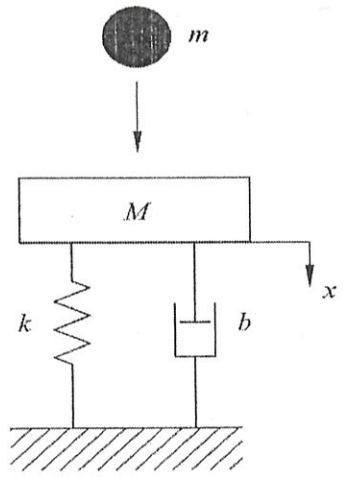
5. For a unity feedback motor position servo with loop gain function

$$G(s) = \frac{K}{s(0.25s+1)(0.1s+1)}$$

(1) Sketch the loci of the closed-loop system poles for varying K. (8%)
(2) Find K for a damping ratio 0.5 of the dominating pair. (7%)

6. Referring to the Figure shown below, where k is the spring constant, b is the damping coefficient. A man drops a steel ball of mass m onto the center of mass M from a height d and catches it on the first bounce. Assuming that the system is initially at rest, what is the motion of mass M after it is hit by the steel ball? Assume that the impact is perfectly elastic. In addition, assume that the numerical values of M, m, b, k and d are given as M=1 kg, m=0.1 kg, b=4 N-s/m, k=125 N/m, and d=1 m. The displacement x of mass M is measured from the equilibrium position before the ball hits it. The initial conditions are $x(0) = 0$ and $\dot{x}(0) = 0$. (10%)



7. Consider the spring-mass system as shown below, k is the spring constant. The system is initially at rest, or $x(0) = 0$ and $\dot{x}(0) = 0$. At t=0 a force $p(t) = P\cos\omega t$ is applied to the mass m. When the numerical values of m, k, P, and ω are given as m=1 kg, k=100 N/m, P=50 N, and ω=5 rad/sec, find the solution $x(t)$. (10%)