所　別：纖維及高分子工程技術研究所　組別：纖維乙組　科目：控制系統
學程別：

1. System identification problem.

(A) There is an unit step response of a system shown in Figure 1A, try to find the transfer function between output and reference input. (10%)

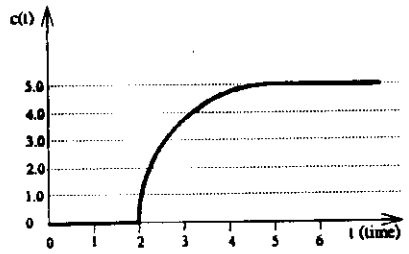

Figure 1A

(B) Figure 1B(a) shows a mechanical vibratory system. When 2 lb force (step input) is applied to the system, the mass oscillates, as shown in Figure 1B(b). Determine m, b, and k of the system from this response curve. The displacement x is measured from the equilibrium position. (***hint:*** maximum percent overshoot $= e^{-(\zeta\omega_n/\omega_d)\pi}$ (15%)

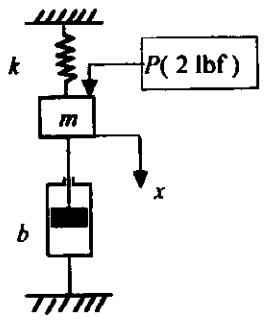

Figure 1B(a)

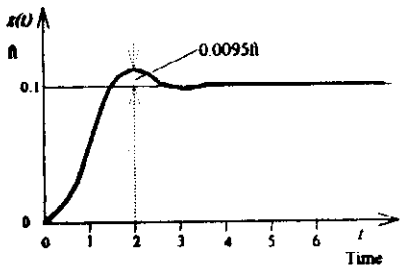

Figure 1B(b)

2. Consider the system shown in Figure 2

(A) Sketch the root loci for the system (10%)

(B) Find the value of K to let damping ratio $\zeta = 0.5$ (5%)

(C) Determine the range of K to ensure the system be stable. (10%)

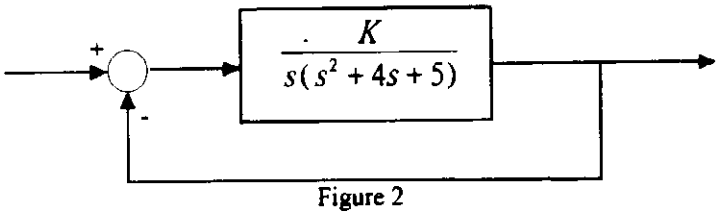

Figure 2

3. The system shown in Fig 3. represents a dynamic absorber, where a relatively small mass m_1 is attached to a main mass m via spring k_1 and damper c_1 to reduce vibrations x due to force f. Assume that m and m_1 both move to the right from the zero positions, m farther and faster than m_1. Derive the transfer function X(s)/F(s). (15%)

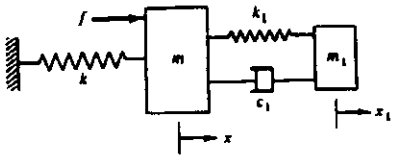

Figure 3. Dynamic absorber.

4. In Fig. 4. with G(s) = (s+1)/[s(s+3)]:
   (a) Find K so that the dominating system time constant will be 2 sec, and find for this K the second system pole. (7%)
   (b) What are the resulting steady-state errors following unit step and unit ramp inputs? (7%)
   (c) Calculate the unit step response from the results in part (a). (6%)

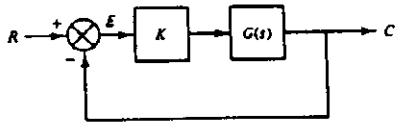

Figure 4.

5. Design a controller $G_c(s)$ (you pick the form of the controller and the design technique) which will stabilize the plant

   $G(s) = 1/(s^2 - 2s + 6)$

   and simultaneously causes its corresponding closed-loop system to have a zero at s = 2. (15%)

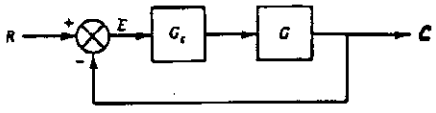

Figure 5.