國立彰化師範大學 97 學年度碩士班招生考試試題

系所：車輛科技研究所碩士班　　科目：自動控制

☆☆請在答案紙上作答☆☆　　

1. (a) Write the force equation of the linear system shown in Figure 1 in terms of x_i, M_i, T_i, K_j, and B_j (i=1,2,3; j=1,2), where x_i and T_i are the displacement and the force applied to each vehicle in the specified direction, M_i, K_j, and B_j are the mass, the spring constant (stiffness), and the viscous frictional coefficient of each vehicle, respectively. (15%)

   (b) Write the state equation of this system. (5%)

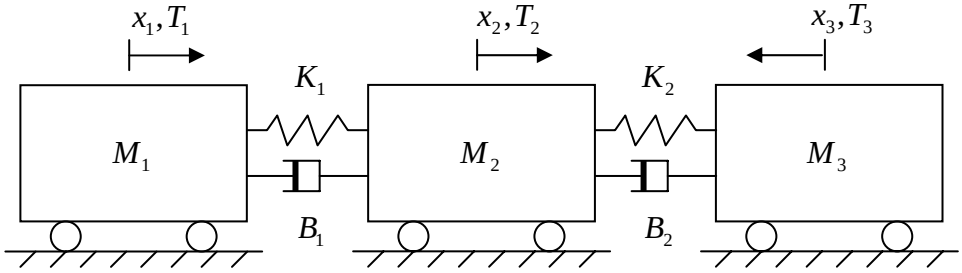

Figure 1.

2. An open-loop transfer function is

$$G(s)H(s)=\frac{K(s+1)}{s(s-1)(s+2-j2\sqrt{3})(s+2+j2\sqrt{3})}.$$

Sketch the root loci with. The root loci should include

(a) root loci on the real axis; (2%)

(b) the abscissa of the interception and the angles of the asymptoes if they have; (4%)

(c) the breakaway and break-in points if they have; (4%)

(d) the values of K at which they cross the imaginary axis, and the crossing points with different K's, respectively; (4%)

(e) find the range of K such that the open-loop system is stable; (2%)

(f) find the angles of departure or arrival of the root loci from the complex poles. (4%)

3. A closed-loop transfer function is $\frac{K}{s(s^2+s+1)(s+2)+K}$. Determine the range of K for stability. (10%)

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4. $H(s)=\dfrac{\omega_n^2}{s^2+2\zeta\omega_n s+\omega_n^2}$ is the transfer function from *u* to *y*.

   (a) Derive the time response of $y(t)$ as $0<\zeta<1$, $y(0)=0$, and $\dot{y}(0)=0$ if *u* is a unit step function at *t*=0. (10%)

   (b) Find the resonant peak magnitude and the resonant peak frequency. (10%)

   (c) Are the systems BIBO stable as $\zeta=-0.5$, 0, and 0.5? Show your conclusions, respectively. (10%)

5. Plot the Bode diagram and find the gain margin and the phase margin for the following open-loop transfer function (20%)

$$G(s)=\frac{10}{s(s+1)(s+5)}.$$