國立屏東科技大學 九十三 學年度 碩士班暨碩士在職專班 招生考試

車輛工程系碩士班 甲組

專業科目（二）自動控制 試題

1. Find the transfer function of the following system, $G(s)=\dfrac{X_3(s)}{F(s)}$ where $X_3(s)$ and $F(s)$ are the Laplace transform of $x_3(t)$ and $f(t)$, respectively, as shown in Fig1

(20 points)

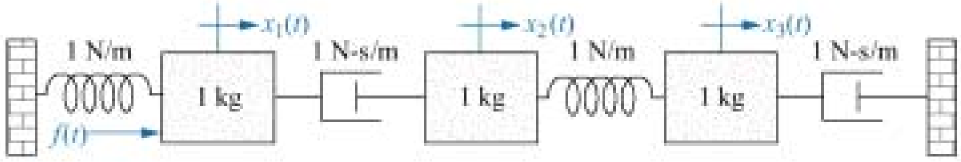

Fig1.

2. Find the transfer function $G(s)=C(s)/R(s)$ of the following system. (15 points)

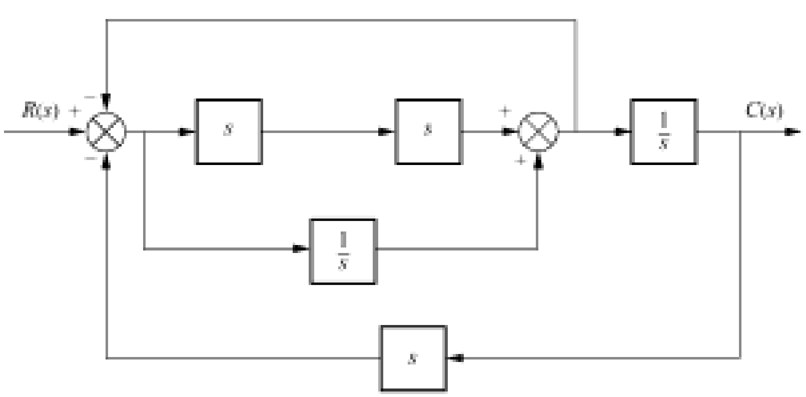

Fig2.

3. Given an unity feedback system with $G(s)=\dfrac{K(s+1)}{s(s+2)(s+3)(s+4)}$ (20 points)

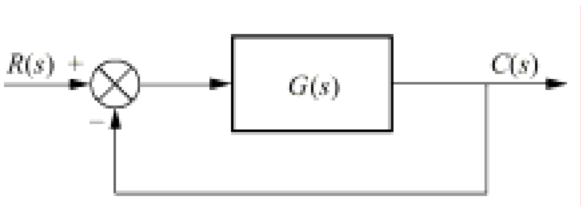

Fig3.

Please do the following:

(1) Sketch the root locus

(2) Find the intersection of asymptotes

(3) Find the value of gain that will make the system marginally stable.

(4) Find the value of gain for which the closed-loop transfer function will have a pole on the real axis at -0.5.

4. Determine the conditions on $b_1, b_2, c_1,$ and c_2 so that the following system is completely controllable and observable. (15 points)

$$\frac{dX(t)}{dt} = AX(t) + Bu(t) \qquad y = CX(t)$$

$$A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} \qquad B = \begin{bmatrix} b_1 \\ b_2 \end{bmatrix} \qquad C = \begin{bmatrix} c_1 & c_2 \end{bmatrix}$$

5. Given the dynamic equations of a time-invariant system: (15 points)

$$\frac{dx(t)}{dt} = Ax(t) + Bu(t) \qquad y = Cx(t)$$

where

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -2 & -3 \end{bmatrix} \qquad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \qquad C = \begin{bmatrix} 1 & 1 & 0 \end{bmatrix} \qquad x(t) = \begin{bmatrix} x_1(t) \\ x_2(t) \\ x_3(t) \end{bmatrix}$$

Find the matrices A_1 and B_1 so that the state equations are written as

$$\frac{d\bar{x}(t)}{dt} = A_1\bar{x}(t) + B_1 u(t)$$

where $\bar{x}^T = \begin{bmatrix} x_1(t) & y(t) & \dfrac{dy(t)}{dt} \end{bmatrix}$

6. The specifications on a second order system with the closed-loop transfer function

$$T(s) = \frac{Y(s)}{R(s)} = \frac{\omega_n^2}{s^2 + 2\xi\omega_n s + \omega_n^2}$$

are that the maximum overshoot must not exceed 10 percent, and the rising time must be less than 0.1 sec. Find the corresponding limiting values of resonant peak M_r and bandwidth B_w analytically. (15 points)