1、For a plant $G_p(s)=\dfrac{\omega_n^2}{s(s+2\xi\omega_n)}$ (20%)

(a) Design a PID controller $G_c(s)$ and draw unity feedback form block diagram

(b) Give an electronic-circuit realization of the PID controller in (a) find the gains of $G_c(s)$. (Represented it by R and C in your circuit)

2、(a)In Figure 1, using capacitor voltage and inductor current as state variables, current Y(t) as output, write dynamic equation. (5%)

(b)C=1μF, L=100mH, R_1=100kΩ, R_2=10Ω, whether the system is controllable and observable? (5%)

(c)In question(b), what's the transfer function of the system? and find the poles of the system? (5%)

(d)According to Figure 2, continue with question (c), design a state feedback controller K so that the Maximum overshoot M_0=0.1%, rise time t_r=0.02 sec. (5%)

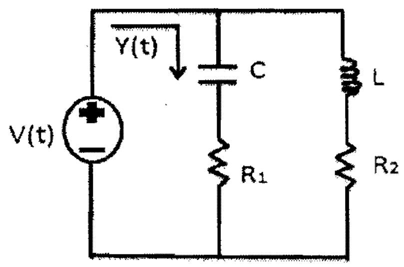

Figure 1

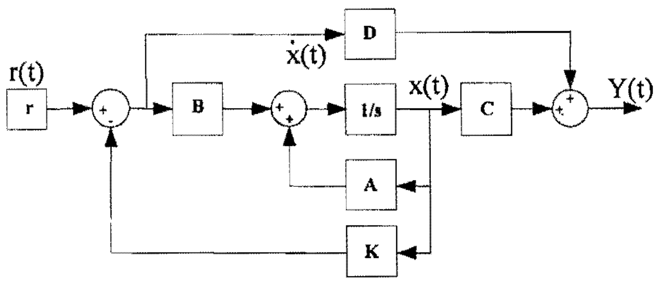

Figure 2

3. Consider a controller as given in Figure 3 (20%)

(a)Find the transfer function $V_0(s)/V_i(s)$ of the controller.

(b)What kind of the controller for R_1=100K, R_2=400K, C_1=0.3μF, and C_2=0.1μF ?

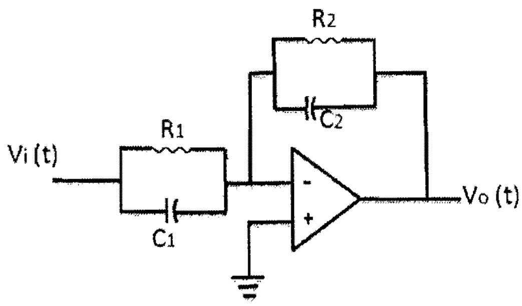

Figure 3

(背面仍有題目,請繼續作答)

4. (a)Write the force equations of the liner translational systems shown in Figure 4. (b) Draw system state diagrams and write the state equations. (c)Find the transfer function $Y_1(s)/F(s)$ and $Y_2(s)/F(s)$. (20%)

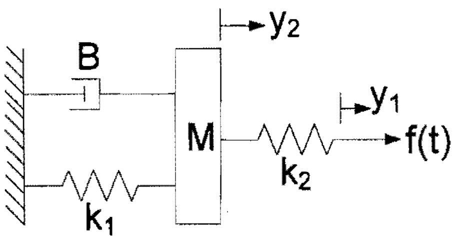

Figure 4

5. (a)For the translational mechanical system with a nonlinear spring shown in Figure 5, find the transfer function, $G(s)=X(s)/F(s)$, for small excursions around $f(t)=1$. The spring is defined by $x_s(t)=1-e^{-f_s(t)}$, where $x_s(t)$ is the spring displacement and $f_s(t)$ is the spring force. (5 %)

   (b)Given the state description matrices in control canonical form of transfer function G(s), and design a state feedback controller K so that the poles locate at -3, -5. (10 %)

   (c)Check the observability of the state space dynamic equation in (b), and find the observer gain matrix L so that the observer error poles are at -2 and -3, respectively. (5 %)

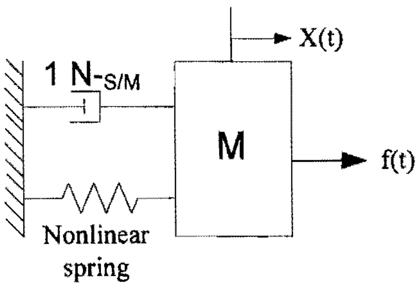

Figure 5