國立臺灣師範大學 104 學年度碩士班招生考試試題

科目：**自動控制**　　　　　　　　　適用系所：**機電工程學系**

注意：1.本試題共 2 頁，請依序在答案卷上作答，並標明題號，不必抄題。2.答案必須寫在指定作答區內，否則不予計分。

1. A spring-mass-damper system with zero initial condition shown in figure 1. The flexure spring is represented by the spring constant k. The ground friction may behave as a coulomb damper with constant b. A displacement x(t) and velocity v(t) of mass M is generated by a input force f(t). Please describe (1) dynamic differential equation, (2) transfer function, (3) state equation, (4) if f(t)=5, M=1, b=3, and k=2, find x(t). (20 分)
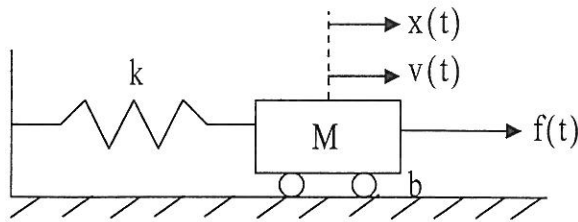

Figure 1.

2. A feedback control system shown in figure 2. Please define the overall system stability range of controller K. If the system is in a marginally stable, find the oscillation frequency. (20 分)
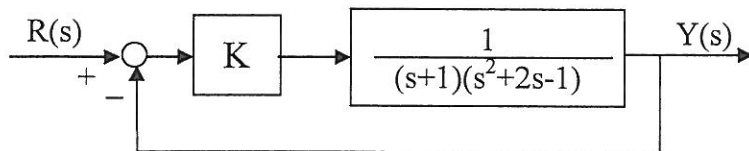

Figure 2.

3. Figure 3 shown a type-1 system. A controller D(s) is designed to meet the following specifications: (a) Damping ratio ξ =0.707, and (b)Setting time≤2 sec. Please answer the following questions.

(1)Please sketch the root locus with D(s)=K. (10 分)

(2)Show that the proportional control, D(s)=K_P, cannot meet the design specification. (5 分)

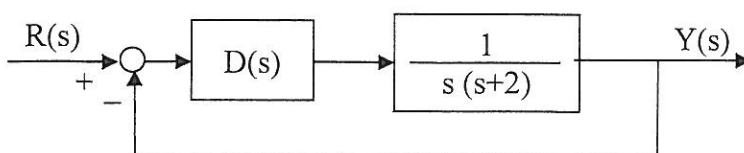(3)Show that proportional plus derivative, D(s)=K_P+K_Ds, will work. (5 分)

Figure 3.

4. A DC motor position controlled system transfer function is $G(s) = \dfrac{K}{s(\tau s + 1)}$. Figure 4(a) shown a cascade derivative error compensation scheme and figure 4(b) shown a second-order system with a secondary path feeding back the derivative of the output compensation scheme for the DC motor.

(1) Please find (a) control signal expression, (b) closed loop transfer function, (c) damping ration, (d) natural undamping frequency, of the compensated systems. (20 分)

(2) In system specification view point, please compare the difference functions between the two type compensation schemes? (10 分)
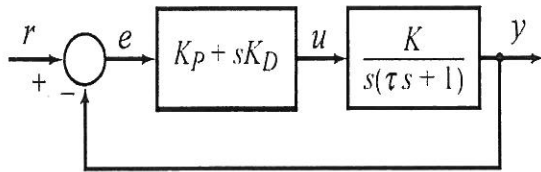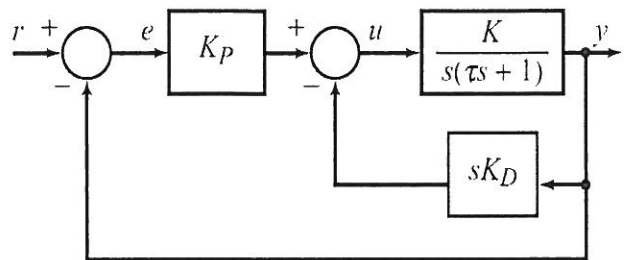

Figure 4(a)

Figure 4(b)

5. In the design of a linear system, we usually can use time-domain and frequency-domain to define a set of specifications. So that the quality of the transient response and steady state response can be described. Please describe the specifications to determine the performance of system behavior in time-domain and frequency-domain. (10 分)