國立臺北科技大學九十七學年度碩士班招生考試

系所組別：1512 自動化科技研究所甲組

第二節　自動控制（選考）試題

填 准 考 證 號 碼

注意事項：

1.本試題共 5 題，配分共 100 分。
2.請標明大題、子題編號作答，不必抄題。
3.全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. (26%) A mass-spring-damper system is shown in Figure 1(a), where *m*, *c*, *k* are the mass, spring constant and damping coefficient, respectively. A force *f(t)* = 2 *Newton* is applied to this system, the mass displacement of *y(t)* is plotted in Figure 1(b).

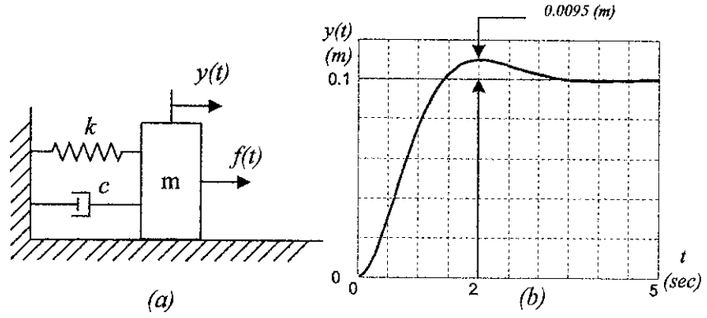

Figure 1

(1) (8%) Derive the dynamic equation of motion of the system and find the transfer function

$$G(s)=\frac{Y(S)}{F(s)}$$

(2) (8%) Determine the natural frequency ω_n and damping ratio ς from this response curve in Figure 1(b).
(3) (4%) Determine the parameters *m*, *c*, *k*.
(4) (6%) If input force $f(t)=2\sin(t)$, find the steady state response $y_{ss}(t)$.

2. (20%) Design a 3th order controller, using state feedback control $u = -\boldsymbol{K}x$, whose three roots are located at the following locations: $-1\pm 2j$, -12. The transfer function of the plant to be controlled is given by

Atb-1

3. (24%) For the control system as shown in Figure 2, its plant model is expressed as

$$\dot{x}=-10x+2u-d$$
$$y=x$$

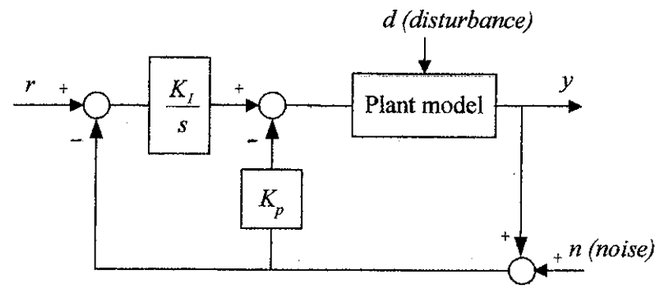

Figure 2

(1) (8%) Find the parameters K_p and K_I of the controller to let the closed loop poles be located at -10 and -8.
(2) (8%) Find the following closed loop transfer functions:

(a) $\left.\frac{y}{r}\right|_{d=0,n=0}$; (b) $\left.\frac{y}{d}\right|_{r=0,n=0}$; (c) $\left.\frac{y}{n}\right|_{r=0,n=0}$

(3) (8%) Find the steady-state value of *y* due to unit-step input *r* and unit-step disturbance change of *d*.

4. (16%) A system is formed by two sub-systems H_1 and H_2, as shown in Figure 3. The unit step response of the sub-systems H_1 and H_2 are $3e^{-t}u(t)$ and $e^{-4t}u(t)$, respectively.

(1) (8%) What is the transfer function of the whole system, $H(s)=V_0(s)/V_{in}(s)$?

(2) (8%) What is the unit step response of the whole system?

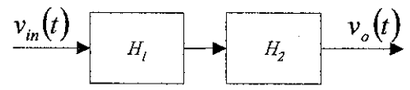

Figure 3

5. (14%) Consider that the open-loop transfer function of a control system with unit feedback is given by

$$G(s)=\frac{10}{s(s+0.02s)(s+0.2s)}$$

Please draw the Bode diagram of this transfer function. Using this approximated Bode diagram to determine the gain margin and phase margin.