

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：1112 機電整合研究所甲組

第二節 自動控制 (選考) 試題

填准考證號碼

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第一頁 共二頁

注意事項：

1. 本試題共六題，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. (10%) Let $F_1(s)$ and $F_2(s)$ be the Laplace transforms of $f_1(t)$ and $f_2(t)$, respectively, and $f_1(t) = 0$, $f_2(t) = 0$, for $t < 0$. Show that:

$$L\{f_1(t) * f_2(t)\} = F_1(s)F_2(s)$$

where $L\{\bullet\}$ is the Laplace transform operator and the symbol $*$ denotes convolution in the time domain.

2. (10%) Let $G(s)$ denote the transfer function of a single-input, single-output system with input $u(t)$, output $y(t)$, and impulse response $g(t)$. Show that:

$$G(s) = L\{g(t)\}$$

where $L\{\bullet\}$ is the Laplace transform operator.

3. (20%) Given a linear time-invariant state equation as

$$\frac{dx(t)}{dt} = Ax(t) + Bu(t) + Ew(t)$$

Let the initial time be represented by t_0 and the corresponding initial state by $x(t_0)$, and assume that the input $u(t)$ and the disturbance $w(t)$ are applied at $t \geq 0$. Show that

$$x(t) = \phi(t - t_0)x(t_0) + \int_{t_0}^t \phi(t - \tau)[Bu(\tau) + Ew(\tau)] d\tau, \quad t \geq t_0$$

where $\phi(t)$ is the state-transition matrix.

4. Figure 1 shows a unity feedback control system with a proportional control gain K .

(a) (17%) Construct the root loci of the characteristic equation for $K \geq 0$.

(b) (3%) Find the range of K that makes the system stable.

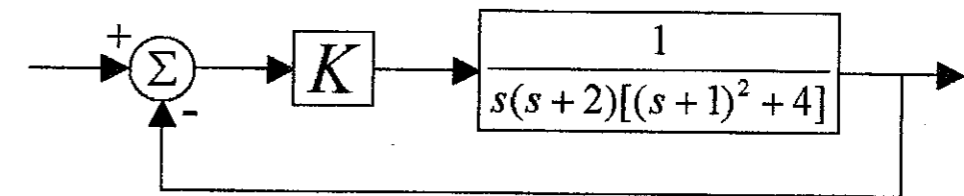


Figure 1

5. The forward-path transfer function of a unity-feedback control system is $G(s) = \frac{10}{s(s^2 + 0.4s + 4)}$.

(a) (12%) Plot the Bode diagram of $G(j\omega)$.

(b) (8%) Find the gain margin, gain-crossover frequency, phase margin, and the phase-crossover frequency of the feedback control system.

6. The forward-path transfer function of a unity-feedback control system is $G(s) = \frac{5}{s(s+1)(s+5)}$. Figure 2 shows the

gain-phase plot of the transfer function $G(j\omega)$ on the Nichols chart. Find the following performance characteristics of the system.

(a) (5%) Gain margin.

(b) (5%) Phase margin.

(c) (5%) Resonance peak.

(d) (5%) Bandwidth of the closed-loop system.

注意：背面尚有試題

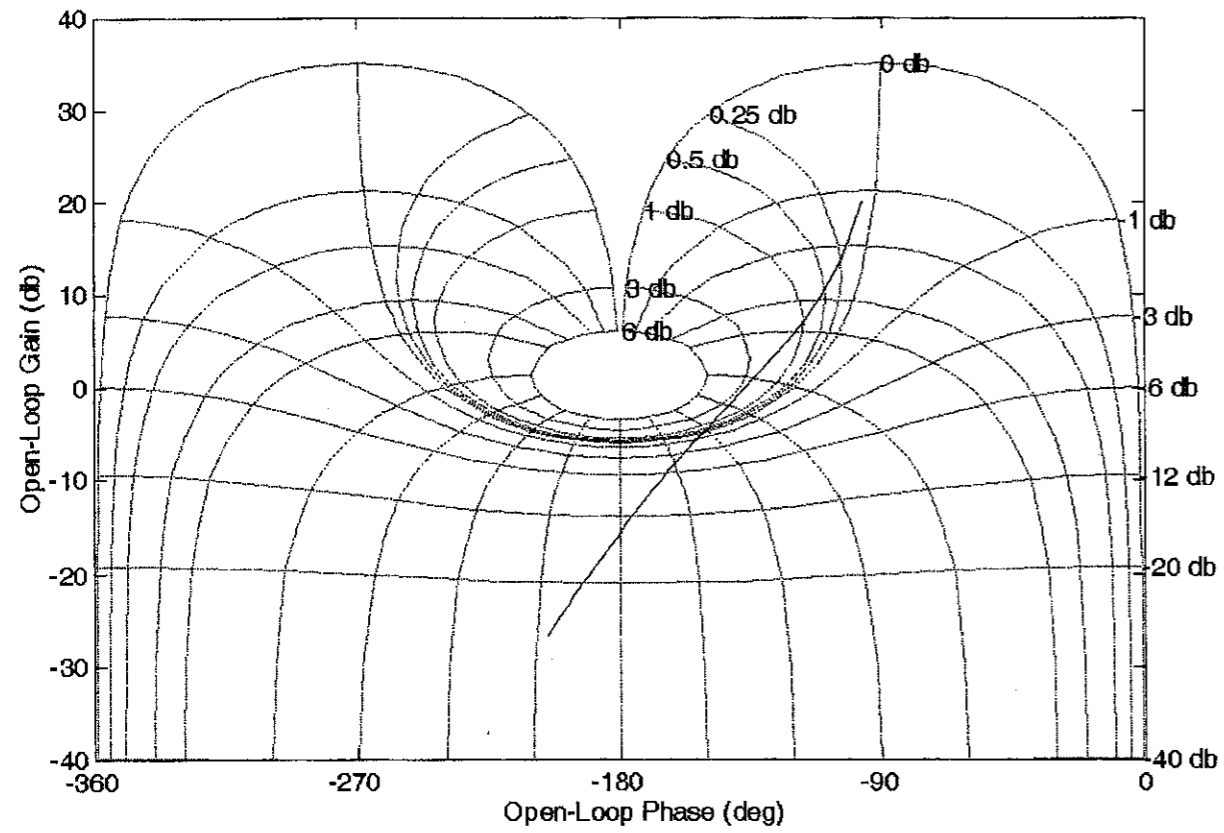


Figure 2