國立臺北科技大學九十六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

注意事項：
1. 本試題共 6 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. (30%) Please give the following meanings:
(a)BIBO stable and Asymptotic stable (6%)
(b)Bandwidth (6%)
(c)Minimum phase and Non-minimum phase transfer functions (6%)
(d)Nyquist path and Nyquist plot (6%)
(e)Vandermonde matrix (6%)

2. (20%) Find the inverse Laplace transform of the following transfer functions:

(a) $G(s)=\dfrac{2s^2+2\alpha s+\alpha^2}{s^3+2\alpha s^2+\alpha^2 s}$ (4%)

(b) $G(s)=\dfrac{\omega_n^2}{s(s^2+2\zeta\omega_n s+\omega_n^2)}$, $\zeta<1$ (4%)

(c) $G(s)=\dfrac{\omega_n^2(s+\alpha)}{s^2+\omega_n^2}e^{-Ts}$ (4%)

(d) $G(s)=\dfrac{\omega_n^2\alpha^2}{s^2+2\zeta\omega_n\alpha s+\omega_n^2\alpha^2}$, $\zeta<1$ (4%)

(e) $G(s)=\dfrac{\omega_n}{(s+\alpha+\beta)[s^2+2\beta s+(\beta^2+\omega_n^2)]}$ (4%)

3. (10%) Let $F_1(s)$ and $F_2(s)$ be the Laplace transforms of $f_1(t)$ and $f_2(t)$, respectively, and $f_1(t)=0$, $f_1(t)=0$, 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.

4. (10%) Let $F_1(s)$ and $F_2(s)$ be the Laplace transforms of $f_1(t)$ and $f_2(t)$, respectively, and $f_1(t)=0$, $f_1(t)=0$, for $t<0$. Show that:

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

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

5. (15%) 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.

6. The block diagram of a control system is shown in Fig. 1.

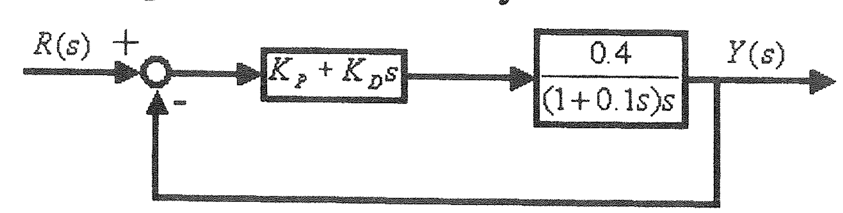

Fig. 1.

(a) (5%) Construct the loot loci of the characteristic equation for $K_P\geq 0$ when $K_D=0$.
(b) (5%) Construct the loot loci of the characteristic equation

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for $K_D \geq 0$ when $K_P = 1$.

(c) (5%) Plot the Bode diagram of $G(s) = \dfrac{Y(s)}{R(s)}$ when $K_P = 1$ and $K_D = 0.1$.