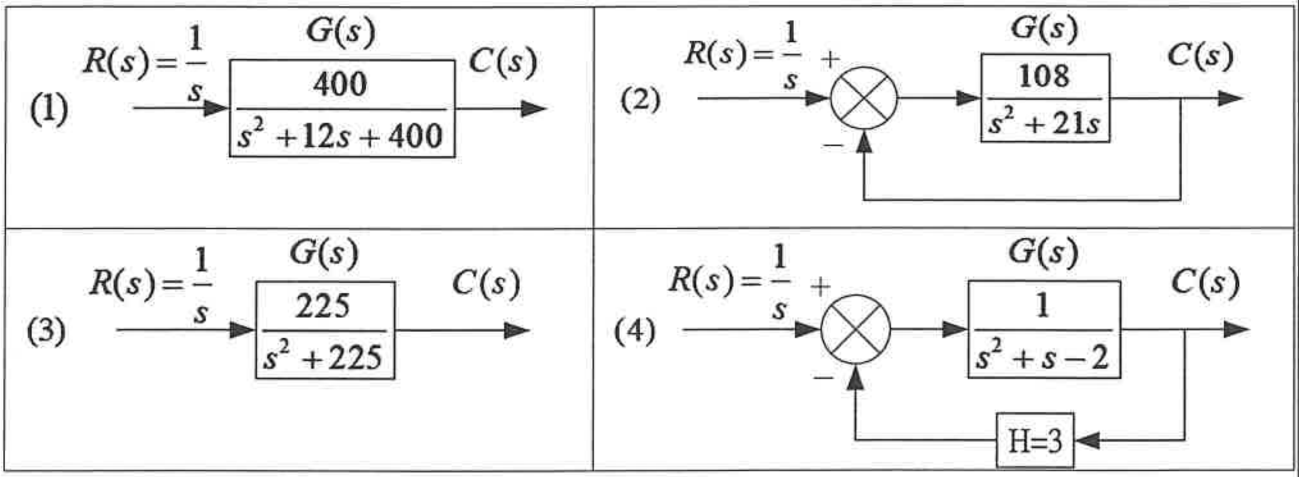
臺灣綜合大學系統 108 學年度學士班轉學生聯合招生考試試題

科目名稱	自動控制	類組代碼	D39
		科目碼	D3992

※本項考試依簡章規定各考科均「不可以」使用計算機　　　　本科試題共計 3 頁

1. For each of the following transfer functions: (a) Draw Poles-Zeros in the S-plane; (b) Find the natural frequency (ω_n) and damping ratio (ζ); (c) Roughly draw the time responses of these transfer functions based on the locations of Poles and Zeros; (15%)



2. Please verify that how many roots of the following polynomial are in the right-half S plane, in the left-half S plane, and on the $j\omega$-axis: (10%)

$$p(s)=s^5+6s^3+5s^2+8s+10$$

3. Find out the range of K which stabilizes the system as shown in Figure 1. (15%)

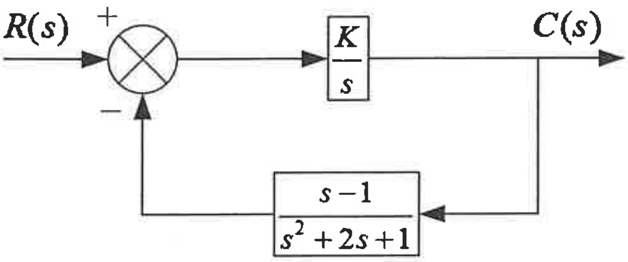


Figure 1

4. A feedback system is illustrated as Figure 2. Please calculate values of K_1 and K_2 which let the closed-loop system with a step input $R(s)$ satisfy the following two specifications: 1. Peak time $T_p=0.8\text{s}$, and 2. Settling time $T_s=1.5\text{s}$; (20%)

Hint: $T_p=\frac{\pi}{\omega_n\sqrt{1-\zeta^2}}$; at $e_{ss}=\pm 2\%$, and $T_s=\frac{4}{\zeta\omega_n}$

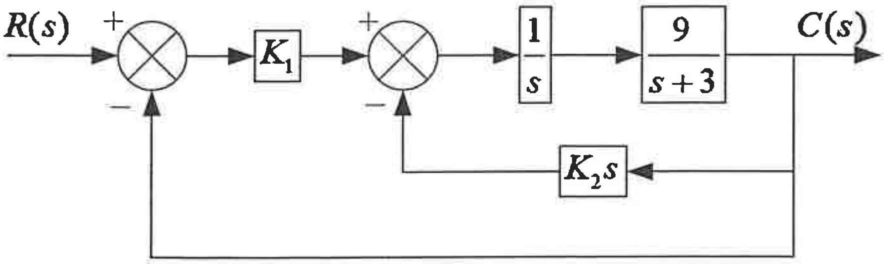


Figure 2

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5. (a) $E(s)$ is the error function of this system and derive $E(s)$ as a function of $G(s)$ and $R(s)$.
   (b) If $R(s)=\frac{1}{s}$, and $G(s)=\frac{1}{s^2+3s+1}$, please find e_{ss}.; (c) If $R(s)=\frac{1}{s}$, and $G(s)=\frac{1}{s^2-3s+1}$, please find the steady sate error e_{ss}. (15%)

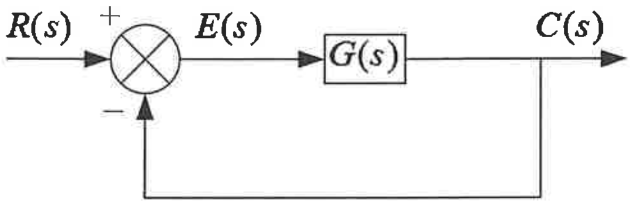

Figure 3

6. (a) Find the transfer function ($\frac{V_o(s)}{V_s(s)}$) of Figure 4.
   (b) Find damped ratio (ζ) and natural frequency (ω_n) of the transfer function in (a).
   (c) Based on the answers of (b), please calculate the following specifications: settling time (T_s), rising time (T_r), peak time (T_p) and maximum overshoot ($\%OS$). When giving V_s as a unit step function, please find the steady state output ($\lim_{t\to\infty} v_o(t)$). (15%)

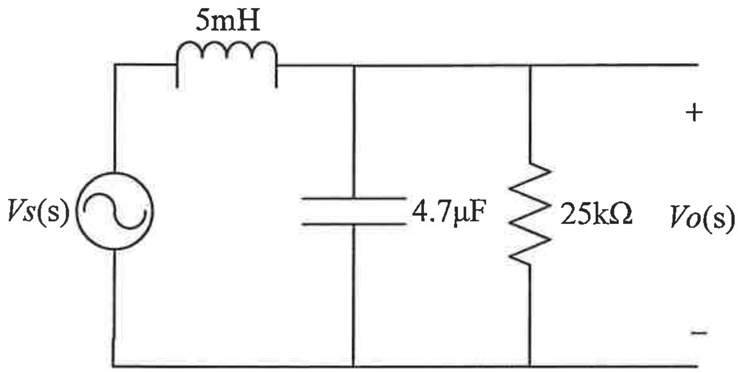

Figure 4

Hint：Impedance of inductor is sL

Impedance of conductor is $\frac{1}{sC}$

$T_r \cong \frac{1.8}{\omega_n}$、$\lim_{t\to\infty} v_o(t)=\lim_{s\to 0} sV_o(s)$、$\%OS=e^{(-\zeta\pi/\sqrt{1-\zeta^2})}\times 100$

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7. Consider the following system

$$\dot{X} = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & -1 \\ 2 & 0 & 0 \end{bmatrix} X + \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} u$$

$$y = \begin{bmatrix} 3 & 1 & 2 \end{bmatrix} X$$

Design a state feedback controller such that the desired closed-loop poles are at -1, -2 and -3. (10 %)