※ 考生請注意：本試題 ☑可 ☐不可 使用計算機

1. (25%) The unity feedback system of Fig. 1, where $G(s)=\dfrac{K(s+\alpha)}{(s+\beta)^2}$ is to be designed to meet the following specifications: 5% steady-state error; 10% maximum overshoot; 1*sec* settling time (±2%). Find K, α, and β.

2. (25%) The unity feedback shown in Fig. 1 with $G(s)=\dfrac{K}{s^2}$ is to be designed for a settling time of 1.667 seconds (±2%) and a 16.3% maximum overshoot. If the compensator zero is placed at -1, find the compensator pole and the system gain.

3. (20%, 10%) For the system shown in Fig. 1 with $G(s)=\dfrac{K(s+4)}{(s-2)(s^2+4s+13)}$, determine the Nyquist plot and apply the Nyquist criterion (a) to determine the values of K (positive and negative) for which the closed-loop system will be stable, and (b) to determine the number of roots in RHP for those values of K for which the closed-loop system is unstable.

4. (20%) Please show the theorem. If the n-dimensional state equation in $\dot{\mathbf{x}}_{n\times 1}=\mathbf{A}_{n\times n}\mathbf{x}_{n\times 1}+\mathbf{b}_{n\times 1}\mathrm{u}$ and $\mathrm{y}=\mathbf{C}_{1\times n}\mathbf{x}_{n\times 1}$ is controllable, then by state feedback $u=r-\mathbf{kx}$, where $\mathbf{k}$ is a $1\times n$ real constant vector, the eigenvalues of $\mathbf{A}-\mathbf{bk}$ can arbitrarily be assigned provided that complex conjugate eigenvalues are assigned in pairs.

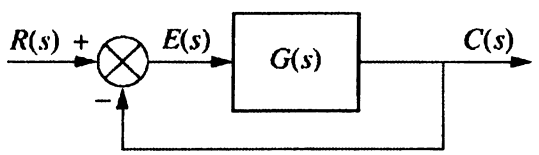

Fig. 1