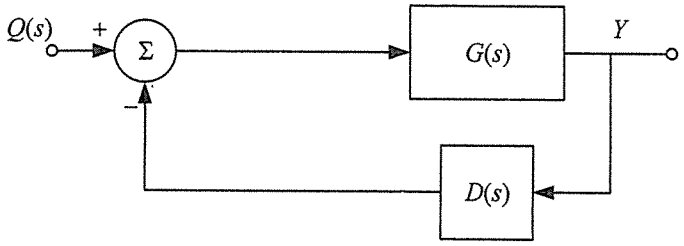
Problem I (100%). Consider a feedback control system shown below with a plant transfer function

$$G(s)=\frac{1}{s^2-100}$$

and a compensator $D(s)$ to be designed.




(a) (10%) Carefully sketch a positive root locus plot for $D(s) = K$, where $K$ is a positive scalar number.
(b) (10%) Carefully sketch a negative root locus plot for $D(s) = K$, where $K$ is a negative scalar number.
(c) (20%) Using root-locus techniques, design a lead or a lag compensator $D(s)$ that will places the dominate poles corresponding to an undamped natural frequency close to 8 rad/sec, and a damping ratio close to 0.707
(d) (10%) Carefully sketch a Bode plot of $G(s)$, with asymptotes, slopes, and critical frequencies clearly indicated.
(e) (30%) Use Bode plotting techniques to design a lead-lag compensator $D(s)$ to meet the following design specifications:
    a. Steady-state output of less than 0.002 to a constant unit input
    b. Phase margin ≥ 45°
    c. Closed-loop bandwidth close to 6 rad/sec
(f) (10%) Carefully sketch a Nyquist plot of the system with the compensator $D(s)$ designed in (e).
(g) (10%) Determine the system closed-loop stability from the Nyquist plot drawn in (f).

**試題隨卷繳回**