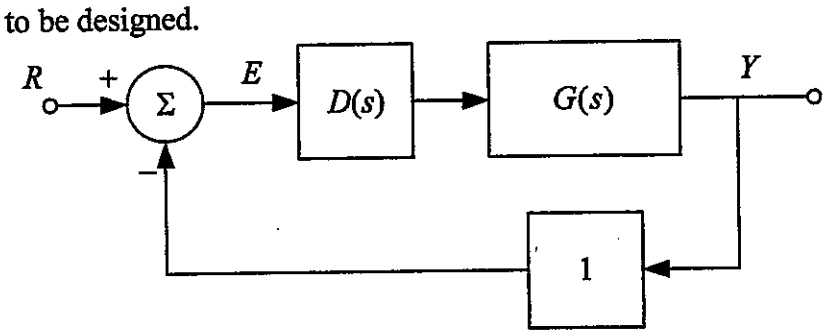
Problem (100%). Consider a unit feedback control system with a plant transfer function

$$G(s)=\frac{250}{s(s+0.25)(s+5)(s+150)}$$

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



(a) (15%) Draw a Bode plot of $G(s)$, with asymptotes, slopes, and critical frequencies clearly indicated (10%). Determine the stability margins on the Bode plot drawn (5%).

(b) (15%) Draw a Nyquist plot of $G(s)$ (10%). Determine the system closed-loop stability from the Nyquist plot drawn (5%).

(c) (40%) Design $D(s)$ so that the closed-loop system satisfies all the specifications below (30%).

- Phase margin $\geq 50°$, gain margin ≥ 6 db,
- Gain crossover frequency is equal or larger than that of the uncompensated plant,
- Steady-state error for step inputs = 0.

To verify the design, draw a Bode plot of $D(s)G(s)$, with asymptotes, slopes, and critical frequencies clearly indicated (5%). Determine the stability margins on the Bode plot drawn. (5%)

(d) (30%) Draw a positive root locus plot for the closed-loop system with $D(s)$ designed in (c) (20%). Determine the gain needed for the closed-loop system to become unstable (10%).

試題隨卷繳回