

※ 考生請注意：本試題 可 不可 使用計算機

1. (25%) A unity feedback system has a plant transfer function

$$G(s) = \frac{4(s^2 + as + b)}{s(s^2 + s + 2)(s^2 + 3s + 6)}$$

(i, 5%) Determine the angles of the asymptotes of the root loci.

(ii, 10%) It is known that the asymptotes centered at -1 , what is the coefficient a ?

(iii, 10%) For the value a in the above, determine b such that the closed-loop steady-state error with respect to a ramp input is minimized.

2. (25%) The loop transfer function of a unity feedback system is given by

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

(i, 5%) Sketch the Bode phase diagram of $G(j\omega)$ for frequencies from 0.1 rad/s to 10 rad/s.

(ii, 10%) Find the state space representation of $G(s)$ in Jordan canonical form.

(iii, 10%) Design an output feedback compensator to stabilize the system.

3. (25%) For the schematic diagram of a phase shift oscillator shown in Fig. A, use the Routh-Hurwitz stability criterion to obtain the oscillation condition and the oscillation frequency.

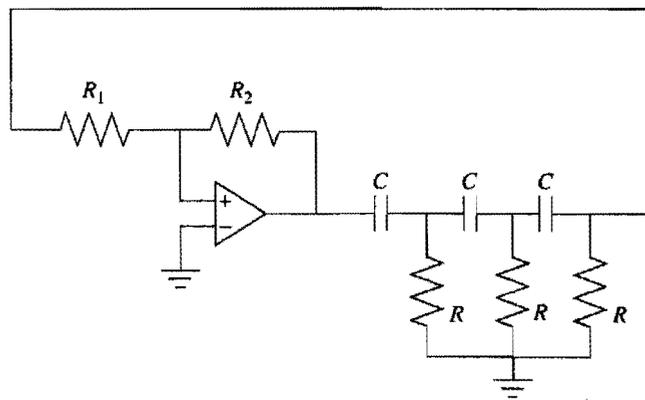


Fig. A

4. (25%) For the unity feedback system with an open-loop transfer function

$$G(s) = \frac{K}{(s+1)(s+4)}$$

design a PID controller that will yield a peak time of 1.047 seconds and a percent overshoot of 1.5%, with zero error for a step input.