國立中山大學100學年度碩士班招生考試試題

科目：控制系統【電機系碩士班乙組】

Problem 1 (20%) A circuit made of a non-inverting amplifier and a device G is displayed in Fig. 1, and the device G has the Nyquist plot in Fig. 2. Assume the op-amp is ideal. Determine R to make the circuit stable with the gain margin of 20 dB.

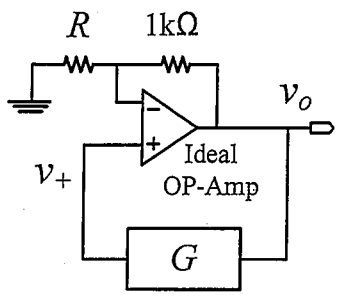

Fig. 1

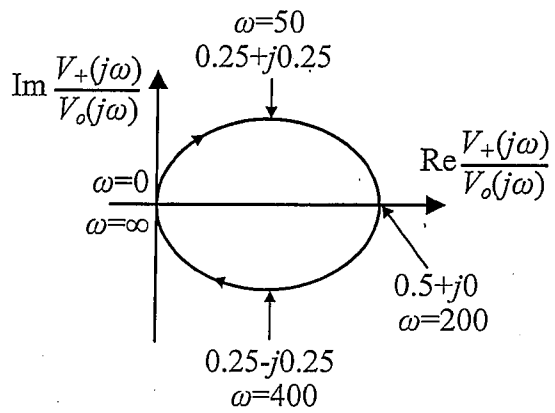

Fig. 2

Problem 2 (45%) Figure 3 shows a circuit to control the angular position θ of the motor. The position θ is measured and converted to the voltage of equal magnitude, and fed back through the circuit. Assume that the op-amp is ideal, and that the frequency response $P(j\omega)$ of the motor from the current i to the position θ is plotted in Fig. 4.

(a) (15%) Roughly estimate the parameters k, a and b of the motor's transfer function $P(s) = k/[(s+a)(s+b)]$, according to the Bode plot in Fig. 4.

(b) (15%) Determine R so that the control system is stable with the phase margin of about 50 degree.

(c) (15%) Determine the steady-state value of θ, given $R = 1\Omega$.

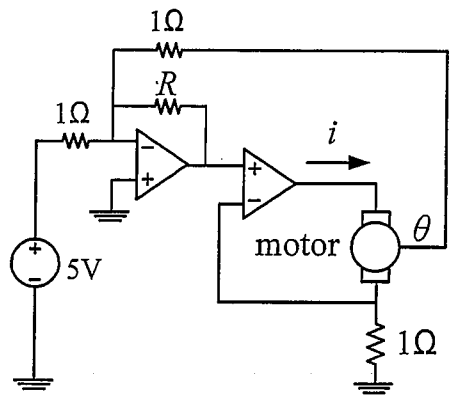

Fig. 3.

國立中山大學100學年度碩士班招生考試試題

科目：控制系統【電機系碩士班乙組】

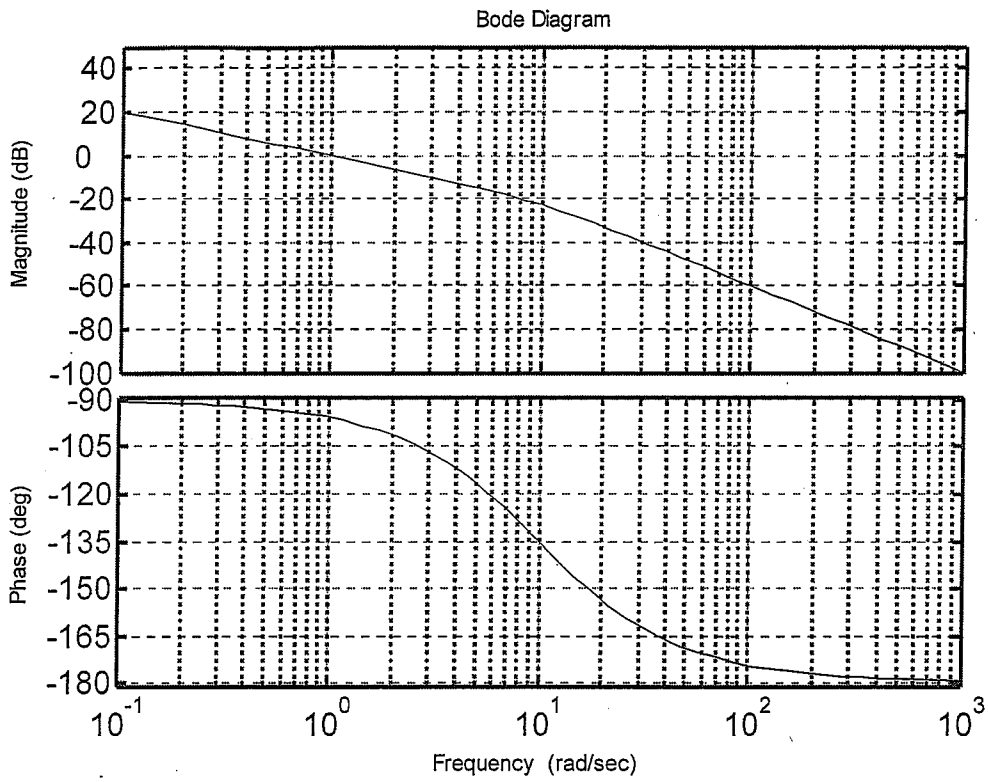

Fig. 4.

Problem 3 (25%) Find if the following controllers would stabilize the plant P in Fig. 5. Note: All answers need justifications or no scores will be given.

(a) (5%) $C(s)=\dfrac{-s+2}{s+2}$, (b) (5%) $C(s)=\dfrac{s+2}{s}$, (c) (5%) $C(s)=\dfrac{4s+2}{s-2}$,

(d) (5%) $C(s)=\dfrac{-0.5s+2}{s}$, (e) (5%) $C(s)=5$.

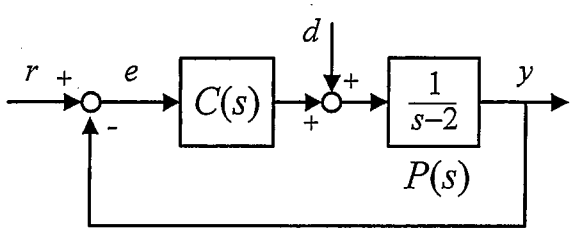

Fig. 5

Problem 4 (10%) A function y is expressed in terms of the following linear convolution. Is it bounded for $t>0$? Justify your answer.

$$y(t)=\int_0^t \sin(\tau)\cos(t-\tau)d\tau\,.$$