

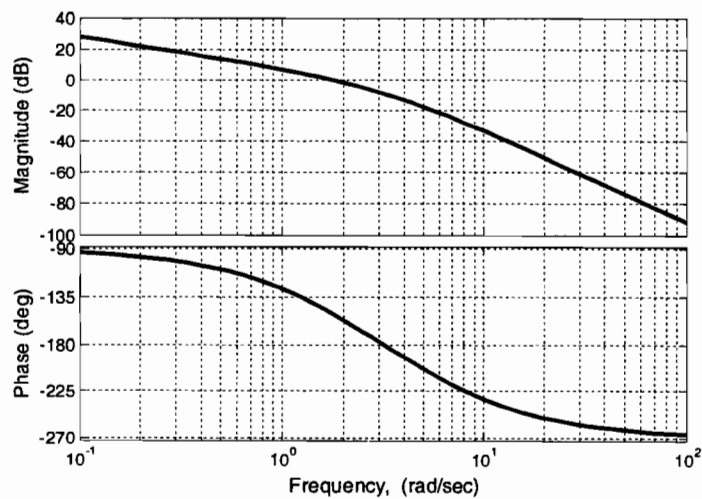
國立台灣科技大學九十六學年度碩士班招生試題

系所組別：機械工程系碩士班丁組

科目：系統控制

題目共四題，總分 100 分

- The Bode plot of an open loop system $G(s)$ is given below:
 - Approximately estimate the transfer function from the frequency response. [10%]
 - Find the gain margin, phase margin, crossover frequency, and the DC gain. [10%]
 - Sketch the Nyquist plot and mark the gain and phase margin on the Nyquist plot. [5%]
 - To achieve a phase margin of 40° and a velocity constant $K_v=8$, would you propose to use a PI, PD, or PID controller? What is the advantage/disadvantage of this choice compared to lead/lag filter design? [10%]

Figure 1: Bode plot for the uncompensated $G(s)$

- Consider the block diagram shown in Fig.2.
 - Find the state space model (including the output equation) using the marked x_1 and x_2 as state variables. [10%]
 - Design the state feedback controller such that the closed-loop eigenvalues are at -3 and -4. [5%]
 - Suppose now the constant gain "5" becomes variable, denoted as α . Determine whether the open-loop system may become uncontrollable or unobservable as α is varied. [10%]

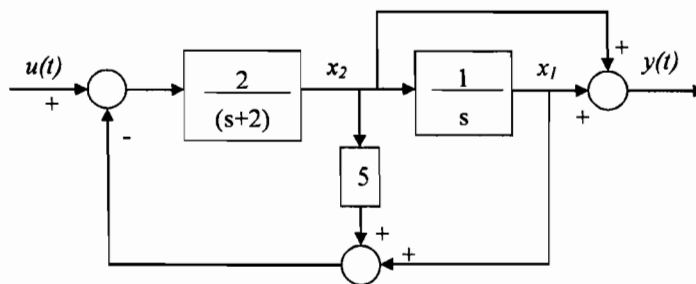


Figure 2

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3. Consider the operational amplifier circuit shown in Fig. 3.

- (a) Derive the transfer function from V_i to V_o in terms of C and R_f . [10%]
 (b) Suppose C is chosen to be $0.1\mu\text{F}$, find the value of R_f such that the compensated system has damping ratio of 0.7. [10%]
 (c) It is observed that the output response (V_o) is always stable no matter what values of C and R_f are used (both positive), provided that the devices are not damaged. Justify this observation using root locus or frequency response. [5%]

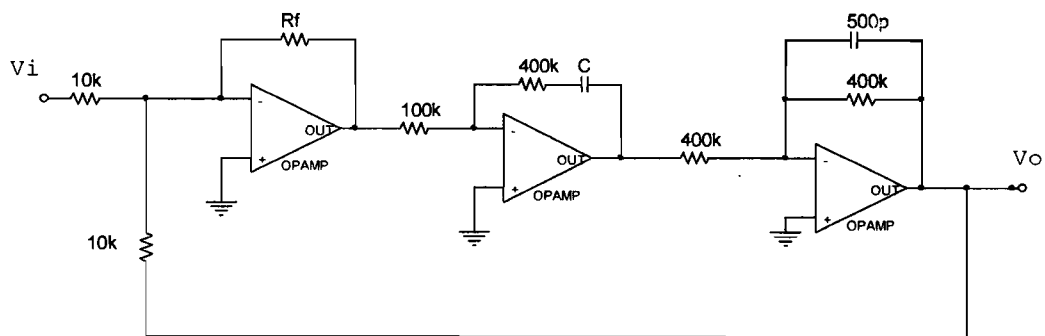


Figure 3

4. Answer the following:

- (a) (True or False) Generally speaking, a system with higher bandwidth exhibits
 i. smaller rise time [2%]
 ii. smaller settling time [2%]
 iii. larger resonant peak [2%]
 iv. better stability [2%]
 v. larger percent overshoot [2%]
 (b) Is it true that systems with open-loop right half plane zeros always exhibit undershoot in step responses, and why? [5%]