

淡江大學九十學年度碩士班招生考試試題

系別：機械工程學系

科目：自動控制

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本試題雙面印製

1. (20%) A step response of a second order system is described by the following function:

$$y(t) = 100 - 112.5e^{-10t} + 12.5e^{-50t}$$

- a) Find the damping ratio of the system ?
- b) Is there any zero in the system ? Why ?

2. (20%) A step response of a system is shown in Fig. 2 a). Select a frequency response plot (magnitude) from Fig. 2b) that matches this step response. Give your reasoning for the selection.

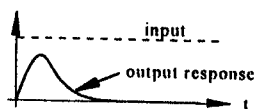


Fig. 2 a)

Bode diagram: (magnitude plot)

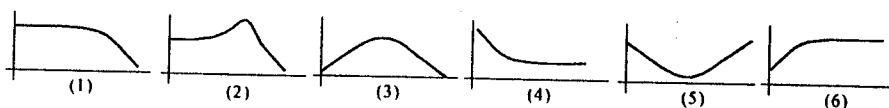


Fig. 2 b)

3. (20%) Consider the magnitude plot of a straight-line approximated Bode diagram for a minimum-phase system $G(s)$ shown in Fig. 3,

- a) What is $G(s)$?
- b) Suppose that $G(s)$ is not minimum-phase, find any two $G(s)$ that have the magnitude characteristics shown in Fig. 3 ?

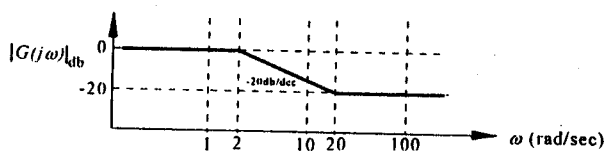


Fig. 3

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4. (20%) The open loop transfer function of a system is: $G(s) = \frac{K}{s(s+2)(s+5)}$

- a) Find the range of K where the system is stable ?
- b) If $K = 20$, find the gain margin of the system ?

5. (20%) A DC motor is used for torque control as shown in Fig. 5, where e is the motor voltage, T_d is the external disturbance torque, and T_m is the motor torque to be controlled. The motor shaft has infinitive stiffness, and its viscous friction is negligible. If it is required that the steady state error = 0 for step torque command regardless of motor speed, design a torque controller for the motor that can meet the requirement. You may use either or both ω and i as the feedback for the controller.

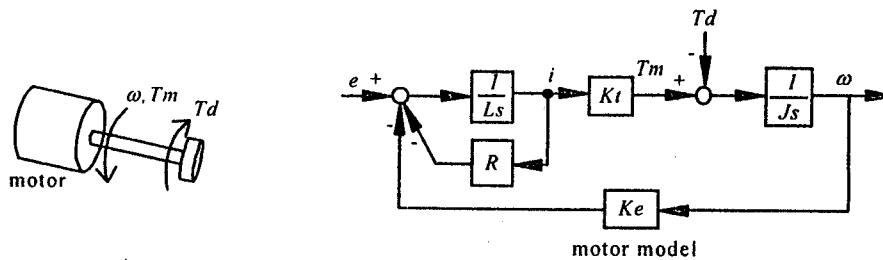


Fig. 5