

※ 考生請注意：本試題不可使用計算機

1. (20%) Consider the system shown in Figure 1. Plot the root loci for the system. Determine the value of K such that the dominant closed-loop pole is located at -0.5 .

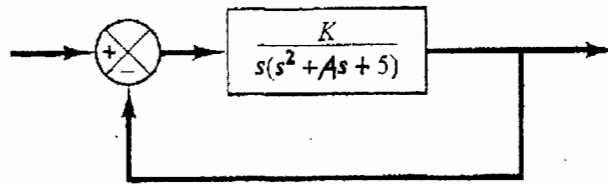


Figure 1

2. (30%) Consider the mechanical system shown in Figure 2. Obtain the transfer function of the system. The displacement x_i is the input and displacement x_o is the output. Is this system a mechanical lead network or lag network?

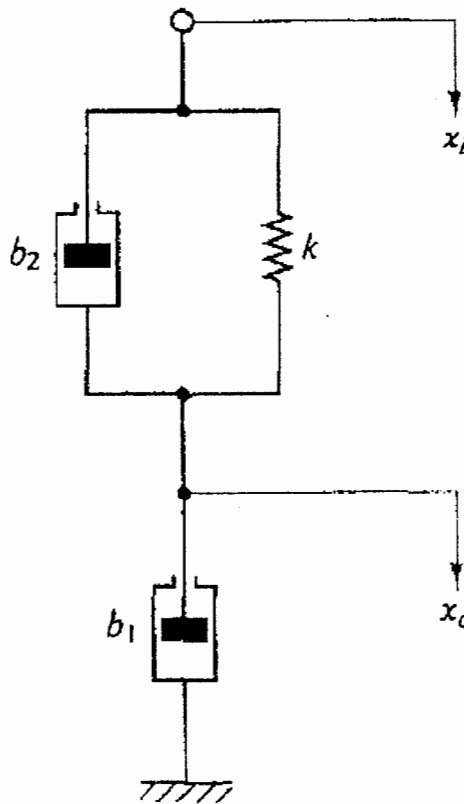


Figure 2

(背面仍有題目,請繼續作答)

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3. (20%) Consider the second-order plant shown in Figure 3.

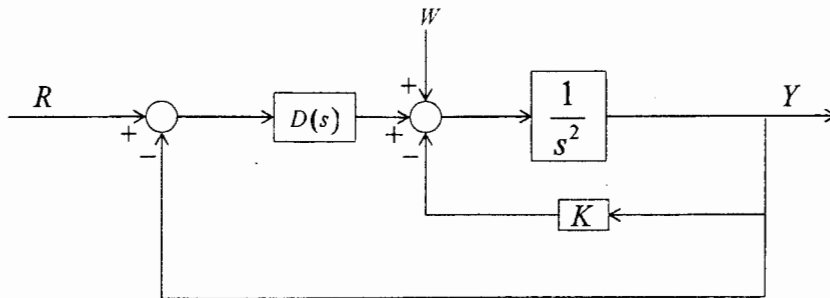


Figure 3

- What condition must $D(s)$ satisfy so that the system can track a ramp reference input with constant steady-state error?
- For a transfer function $D(s)$ that stabilizes the system and satisfies the condition in part (a), find the classes of disturbances $w(t)$ that the system can reject with zero steady-state error.
- For a transfer function $D(s)$ that stabilizes the system and satisfies the condition in part (a), Can $D(s)$ be a P , PD , PI or PID controller? Also, find the necessary condition (or conditions) that the controllers must satisfy.

4. (30%) A mass-spring-damper system is shown in Figure 4.

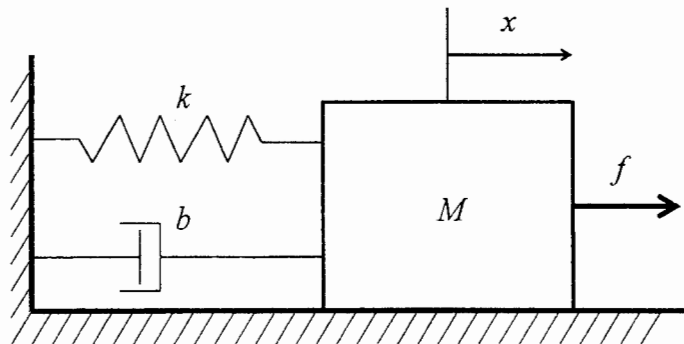


Figure 4

- Plot the control system block diagram of this system to describe the relationship between the position of the mass and the external force.
- Find the transfer function of this system with zero initial conditions and $b = 0.8$, $k = 2$, $M = 1$.
- What kind of system modes will you expect? Please sketch the expected responses and explain them.
- Determine the DC gain of the system.