逢甲大學101學年度碩士班招生考試試題 編號：016 科目代碼：311

科目	自動控制	適用系所	航太與系統工程學系控制組	時間	100 分鐘

※請務必在答案卷作答區內作答。 共 2 頁第 1 頁

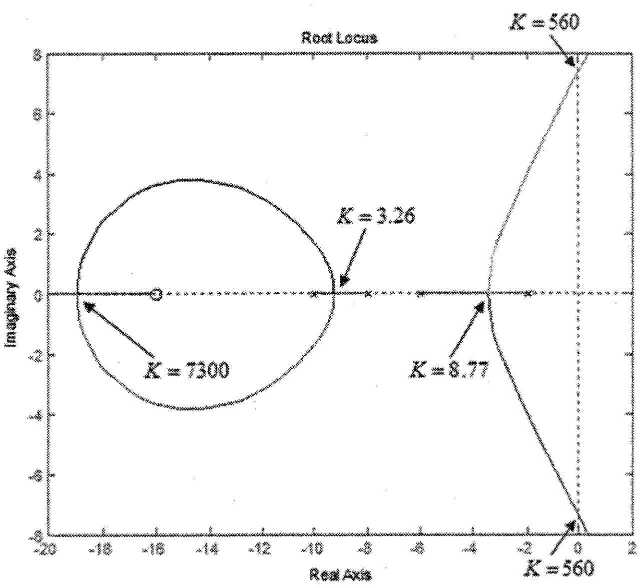
1. **(20 %)** Answer the following questions from the root locus diagram shown on the right

   (a) What is the approximate Characteristic Eq. for this plot(Hint: C.E.: $D(s)+K\,N(s)=0$)?

   (b) What is the range of K that gives the stable system response?

   (c) What is the range of K that gives the stable and under-damped system response?

   (d) What is the value of K that gives the fastest system response?



2. **(20 %)** The Routh-Hurwitz Criteria method.

   (a) Find the range of K values for which the following system will be stable.

$$S^3+(2K-26)S^2+(100-14K)S+4=0$$

   (b) Find the range of K values for which the following system will be stable.

$$S^3+9S^2+26S+K=0$$

3. **(10 %)** Determine the condition on b_1, b_2, c_1 and c_2 so that the following system is completely controllable & observable.

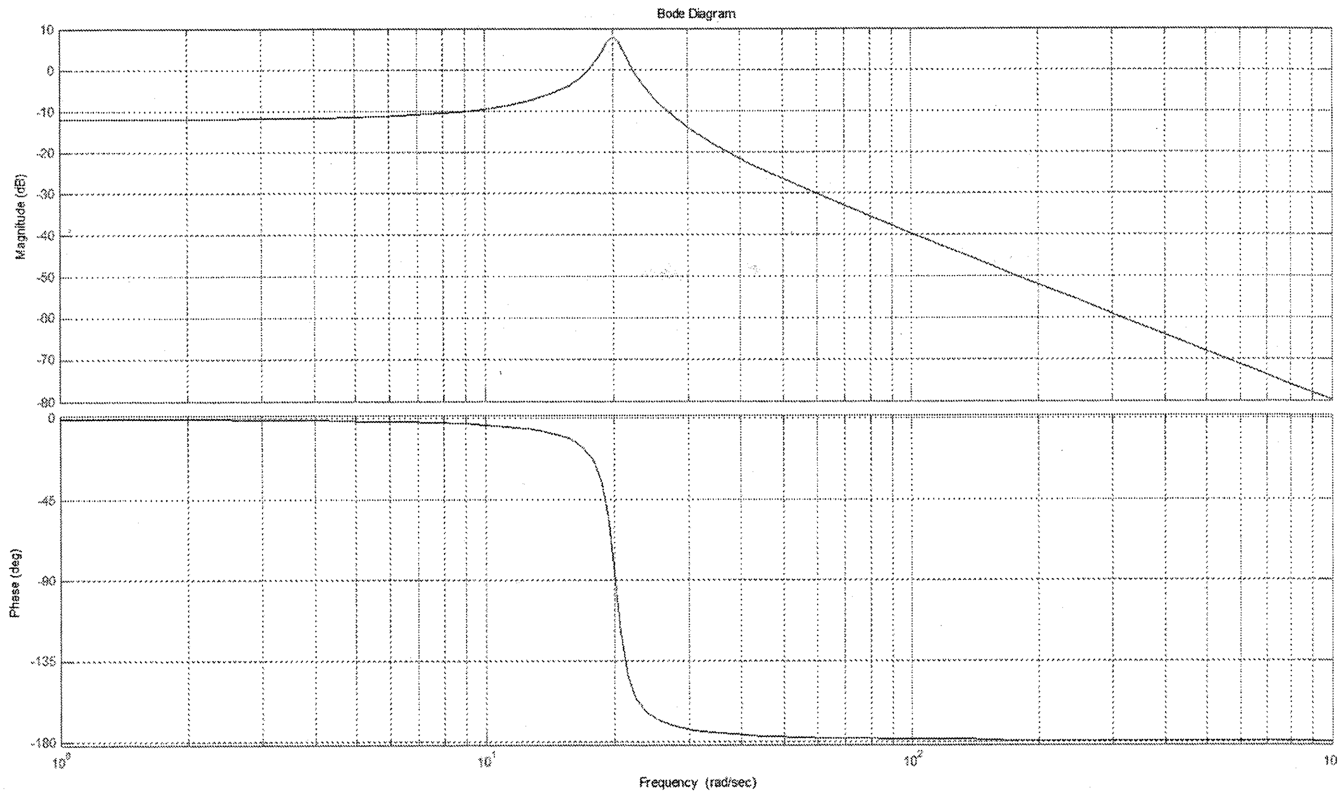
$$\frac{dx(t)}{dt}=Ax(t)+Bu(t)\;;\;\; y(t)=Cx(t)$$

$$A=\begin{bmatrix}1 & 1\\ 0 & 1\end{bmatrix}\quad B=\begin{bmatrix}b_1\\ b_2\end{bmatrix}\quad C=\begin{bmatrix}c_1 & c_2\end{bmatrix}$$

4. **(10 %)** Reduce the closed-loop transfer function of the system given below to 2nd order, and verify you result by using the Final Value Theorem with unit step input.

$$\frac{Y(s)}{R(s)}=\frac{600}{(s^2+22s+120)(s^2+6s+25)}$$

5. **(20 %)** Answer the following questions based on the Bode plot shown below:



(a) What is the approximate Transfer Function of above system:

(A) $TF = \dfrac{S+a}{S^2 + 2\varsigma\omega_n S + \omega_n^{\ 2}}$ (B) $TF = \dfrac{a}{S^2 + 2\varsigma\omega_n S + \omega_n^{\ 2}}$

(C) $TF = \dfrac{1}{(S+a)(S^2 + 2\varsigma\omega_n S + \omega_n^{\ 2})}$ (D) $TF = \dfrac{aS}{S^2 + 2\varsigma\omega_n S + \omega_n^{\ 2}}$

(b) What is the approximate value of constant a : (A) 1 (B) 10 (C) 100 (D) 1000.

(c) What is the approximate value of natural frequency ω_n : (A) 2 (B) 10 (C) 11 (D) 20.

(d) What is the approximate value of damping ratio ς : (A) 0.5 (B) 0.05 (C) 0.2 (D) 0.707.

6. **(20 %)** Assume that a mass-spring-damper system is modeled by: $\ddot{x} + 2\dot{x} + K_m x = f(t)$, where $x(t)$ is the position of the mass. If $f(t) = 0$, and the mass is held motionless [$i.e., \dot{x}(0) = 0$] at $x(0) = 5$ before being released at $t = 0$.

(a) Determine the Characteristic Equation of this system.

(b) Find the value of K_m for the system to have the critical damped response.

(c) Find the range of K_m for the system to have the under damped response.

(d) Choose the value of K_m from the answer of (c) to have the time constant $\tau = 2$.