ME04

# 國立臺北科技大學108學年度碩士班招生考試

## 系所組別：1112 機械工程系機電整合碩士班甲組

## 第二節　自動控制　試題（選考）

第一頁　共一頁

**注意事項：**

1. 本試題共5題，每題20分，共100分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. A negative feedback closed loop system with loop transfer function $GH(s)=\dfrac{K(s-1)}{s^4+2s^3+2s^2}$, please plot the root locus for $0 \leqq K < \infty$, and answer the following questions

(a)(4%) the starting locations and ending locations of the root loci.

(b)(4%) angles and centroid of the Asymptotes.

(c)(4%) the intersection of the root loci with the imaginary axis; At the intersection, what is the corresponding value of K?

(d) (4%) the departure angle of the complex conjugate roots (if any).

(e)(4%) the range of K such that the system is stable.

2. A unity-feedback system with open-loop transfer function $G(s)=\dfrac{K}{s(Js+2)}$, the steady state error is 1 when subject to a unit ramp input; and the maximum overshoot is 0.2 when subject to unit step input, find $K$ and $J$ values.

3. A system with ordinary differential equation $\dddot{y}(t)+6\ddot{y}(t)+11\dot{y}(t)+6y(t)=2u(t)$ where $y$(t) is output and $u$(t) is input variable,

(a)(4%) find the transfer function of the system $G(s)=\dfrac{Y(s)}{U(s)}$.

(b)(4%) find the poles and zeros of the system $G(s)$.

(c)(4%) define state variables as $x_1=y, x_2=\dot{y}, x_3=\ddot{y}$, find the state-space equation for the system.

(d) (8%) By use of the state feedback control law $u = -\mathbf{KX}$, find the state feedback gain matrix **K** so that the closed-loop system has a pair of dominant complex conjugate poles with undamped natural frequency $2\sqrt{2}$ and damping ratio $1/\sqrt{2}$ and an insignificant pole at $s$= -12.

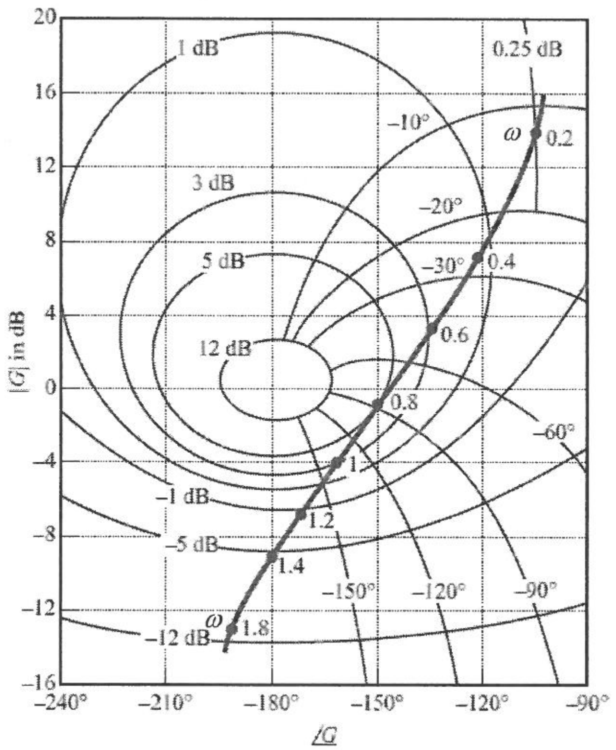
4. A unity-feedback system with open-loop transfer function $G(j\omega)$ locus shown in Nichols chart below,

(a)(5%) please estimate (as best as you can) the gain margin, phase margin, gain crossover frequency, and phase crossover frequency.

(b)(5%) Estimate the resonant peak, resonant frequency, and bandwidth.

(c)(5%) If loop transfer function $G$(s) is multiplied by $K$, find the critical value of $K$ such that the system becomes marginally stable.

(d)(5%) If loop transfer function $G$(s) is multiplied by a transport lag $e^{-Ts}$, find the critical value of $T$ such that the system becomes marginally stable.




5. A negative feedback closed loop system with loop transfer function $GH(s)=\dfrac{2(T_2s+1)}{s^2(T_1s+1)}$, Figures 1 and 2 are two Nyquist plots of $GH$(s).

(a)(10%) For Figure 1, is it the case $T_1>T_2$ or $T_1<T_2$ ? and determine the closed loop stability using the Nyquist stability criterion.

(b)(10%) For Figure 2, is it the case $T_1>T_2$ or $T_1<T_2$? and determine the closed loop stability using the Nyquist stability criterion.

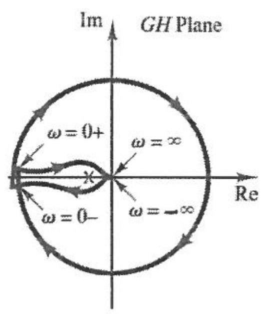



Figure 1

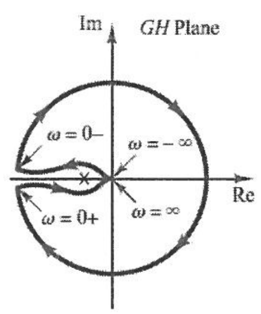



Figure 2