107ME04

國立臺北科技大學 107 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）

注意事項：

1. 本試題共 5 題，每題 20 分，共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
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. For a negative feedback closed loop system with loop transfer function $GH(s)=\frac{K(s+2)}{s^2}$, where K is positive

(a) (10%) Find K so that the system has a phase margin of $60°$

(b) (5%) At such value for K, what is the gain margin?

(c) (5%) Is the closed loop system stable or unstable ?

2. A negative feedback closed loop system with loop transfer function $GH(s)=\frac{10(s+K)}{s(s+1)(s+8)}$, 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 breakaway points

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

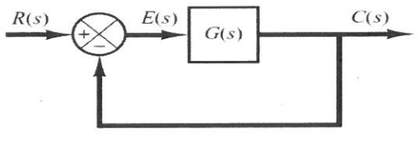
(e) (4%) the range of K such that the system is stable.

3. A typical second-order system as shown with $G(s)=\frac{4}{s^2+2s}$

(a) (5%) Find the undamped natural frequency and the damping ratio.

(b) (10%) Find the maximum overshoot, rise time, steady state error when subject to a unit step input

(c) (5%) Find the steady state error for a unity ramp input.



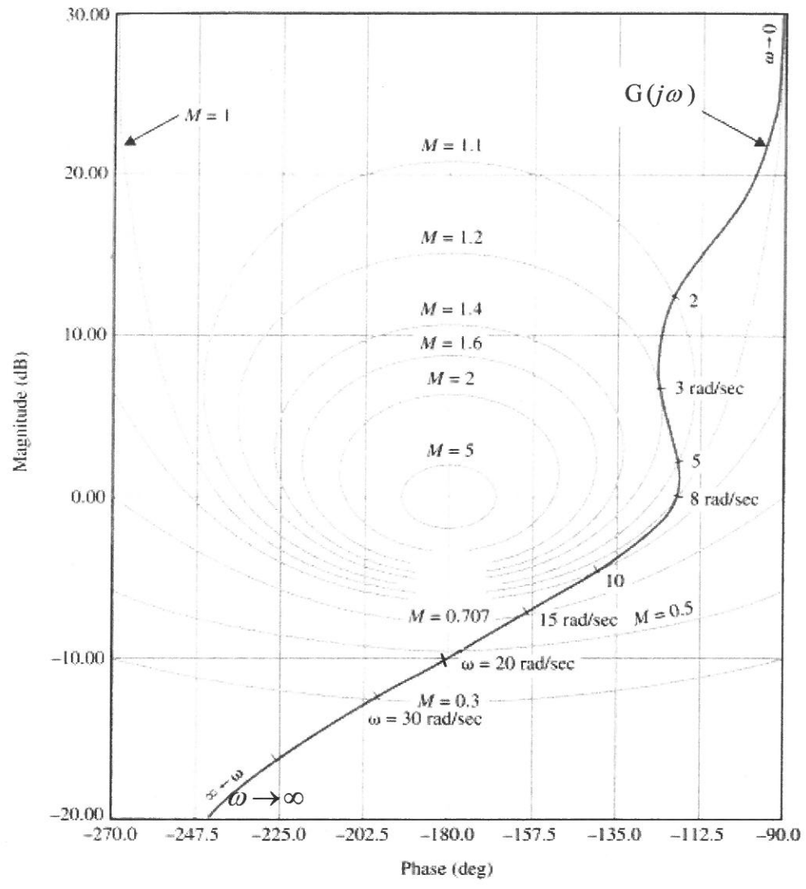
4. A unity feedback system with loop transfer function G(s) whose Nichols chart is as shown in the plot with M-circles given.

(a) (5%) Estimate the gain margin and phase margin, the gain crossover frequency and phase crossover frequency.

(b) (5%) Estimate the resonant peak and 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 system with transfer function $\frac{Y(s)}{U(s)}=\frac{5}{(s+1)^2(s+2)}$, define state variables as $x_1 = y, x_2 = \dot{y}, x_3 = \ddot{y}$

(a) (8%) Find the state-space equation for the system.

(b) (12%) 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 and damping ratio 0.6 and an insignificant pole at s= -10 .