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國立臺北科技大學 106 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 system with loop transfer function $GH(s)=\dfrac{10}{s(s+3)^2}$

(a) (5%) Find gain crossover frequency and phase margin.

(b) (5%) Find phase crossover frequency and gain margin.

(c) (5%) If a transportation lag e^{-Ts} is added to the loop (now the loop transfer function becomes $GH(s)e^{-Ts}$), find the delay time T such that the system becomes marginally stable.

(d) (5%) If a gain K is added to the loop (now the loop transfer function becomes $KGH(s)$), find K such that the system becomes marginally stable.

2. A unity-feedback control system with plant transfer function $G_p(s)=\dfrac{1}{s(s+0.2)}$ is compensated by a Proportional-and-Derivative controller (PD controller with parameters K_p、K_D), Please design the PD controller so that the closed-loop system have the following performances：(1) steady state error $e_{ss}=0.008$ when ramp input (r(t)= t) is applied, (2) damping ratio ξ=0.8 for the closed-loop poles.

3. A characteristic equation F(s)= $s^3+s^2+(K+2)s+3K=0$, 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%) all the departure angles

(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.

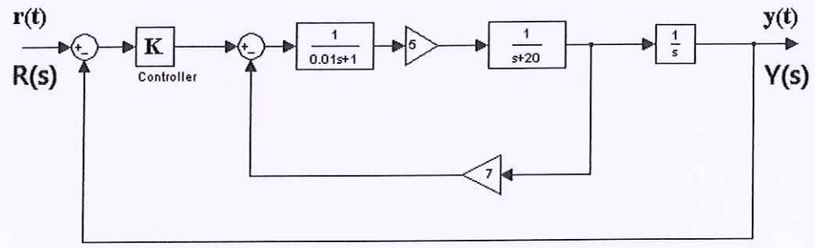
4. A dc motor is compensated by a proportional controller with gain K, as shown below.

(a) (5%) Find the closed-loop transfer function $\dfrac{Y(s)}{R(s)}$.

(b) (5%) Find the range of K so that the closed-loop system is stable.

(c) (5%) Find the critical value of K so that the system is marginally stable. In such a case, the system will show oscillation when subject to a unit-step input, what is the oscillation frequency?

(d) (5%) If K=100, what is the steady state response of output y(t) when the reference input r(t) is a unit-step input function.



5. A system with transfer function $\dfrac{Y(s)}{U(s)}=\dfrac{10}{(s+1)(s+2)(s+3)}$, 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 = - **KX,** find the state feedback gain matrix **K** so that the closed-loop system has poles at s= -1+2j, s= -1-2j, s= -10.