系所組別: 航空太空工程學系丙組

考試科目: 自動控制　　　　　　　　　　　　　　　　　　　考試日期：0307，節次：1

※ 考生請注意：本試題 ☑可 □不可 使用計算機

1. A control system has two forward paths as shown in Figure 1.
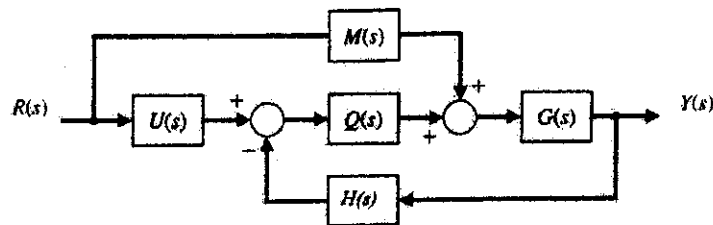

Figure 1

10%(A). Determine the overall transfer function $T(s) = Y(s) / R(s)$.

5%(B). Suppose that $Q(s) = \dfrac{k}{s}$, $G(s) = \dfrac{1}{s+3}$, $M(s) = 2$, $U(s) = 4$, $H(s) = 1$

Is the system stable for any $k > 0$? Explain why.

10%(C). Suppose that $k = 2$, what is the response $y(t)$ for the impulse input

$r(t) = \delta(t)$ in (B)?

2. Consider the control system in Figure 2 with $G_c(s) = k > 0$ and $G_P(s) = \dfrac{1}{s^3 + 2s^2 + 2s}$
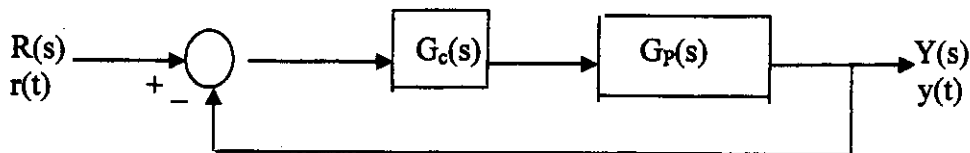

Figure 2

5% (A). Find the range of gain k so that the system is stable.

5% (B). Draw the root locus for the system.

　　　　　(只要用觀念畫出根軌跡走勢即可，不要求太詳細.)

5%(C). What is the steady-state error e_{step} of the system for a unit step input?

5%(D). What is the minimum steady-state error e_{ramp} of the system for

　　　　a unit ramp input?

5%(E). If we set $k = 1$, what is the approximated settling time t_s of the step

　　　　response ?

（背面仍有題目，請繼續作答）

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3. Consider the open-loop transfer function of a negative unity feedback system

$$G(s) = \frac{K(s+1)}{s(s-2)(s^2+4s+30)}.$$

a) Draw the Nyquist plot for the system. (15%)
b) Determine from the plot in a) what is the stability range of K for the system to be stable. (10%)

4. The characteristic equation of a closed-loop system is

$$s^3 + 8s^2 + (k-20)s + 2k = 0 \quad \text{and} \quad k = 40.$$

a) Draw the Bode plot for the system. (10%)
b) Compute the phase margin. (10%)
c) Is the system stable? (5%)