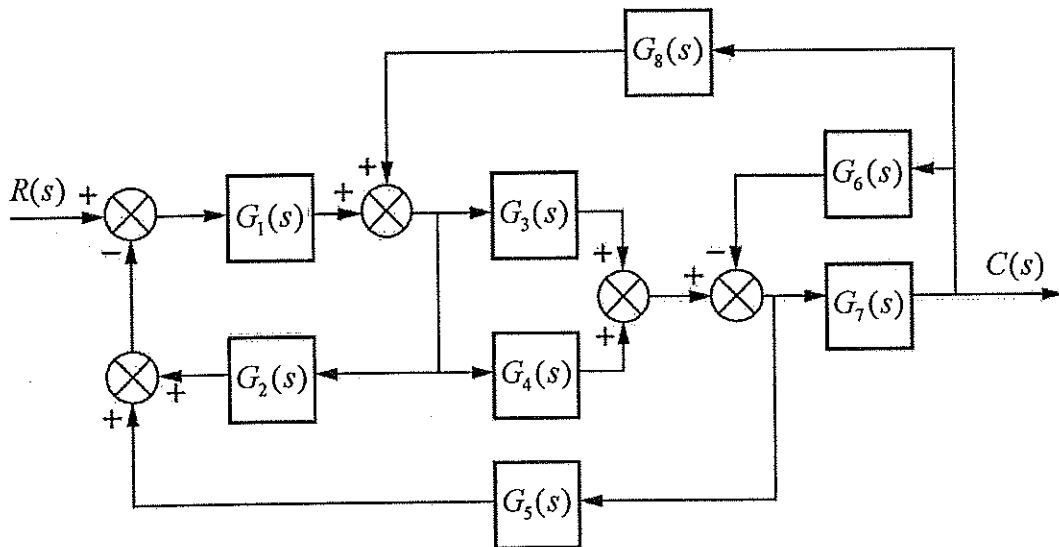# 國立臺北科技大學 105 學年度碩士班招生考試

系所組別：2132 電機工程系碩士班丙組

第二節 控制系統 試題 （選考）

注意事項：

1. 本試題共 4 題，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。
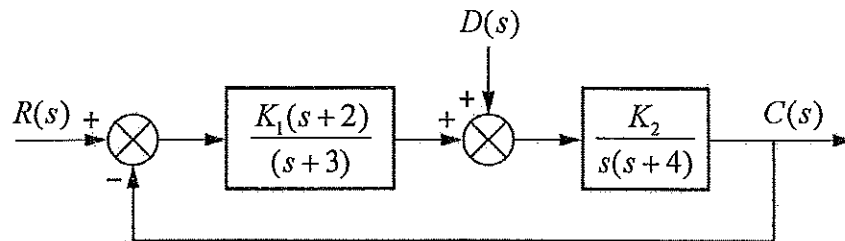
1. Considering the following system.

10% (a) Find the equivalent transfer function $C(s)/R(s)$.

10% (b) Let $G_1(s) = \dfrac{1}{s}$, $G_2(s) = 1$, $G_3(s) = 1$, $G_4(s) = 1$,

$$G_5(s) = \frac{5}{s+7},\ G_6(s) = 1,\ G_7(s) = \frac{3}{s+2},\ G_8(s) = \frac{1}{s+6}.$$

Determine whether the closed-loop system is stable. Justify your answer.

2. Considering the following system.

10% (a) When $K_1 = 1$ and $K_2 = 1$, find the total steady-state error due to step inputs for both the input $R(s)$ and the disturbance $D(s)$.

10% (b) Find the sensitivity of the steady-state error for changes in $K_1 = 1$ and $K_2 = 1$. Assume step inputs for both the input $R(s)$ and the disturbance $D(s)$.

10% (c) Design the values of K_1 and K_2 to meet the specifications:
steady-state error component due to a unit ramp input $R(s)$ is 0.03, and
steady-state error component due to a unit step disturbance $D(s)$ is -0.012.

3. Considering the following system, where $G(s) = \dfrac{(s+10)(s+20)}{(s^2 - 20s + 225)(s+30)}$.
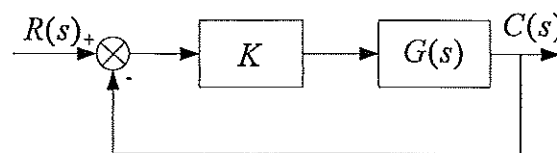
10% (a) Sketch the root locus.

10% (b) Find the range of gain K that makes the system stable.

10% (c) Find the value of gain K that yields closed-loop dominant poles with critically damped response.

4. Given the unity feedback system with the plant $G(s) = \dfrac{K(s+1)}{s(0.1s - 1)}$.

10% (a) When $K = 1$, determine the stability of the system by using the Nyquist criterion (stable, marginally stable, or unstable).

10% (b) Use the Nyquist criterion to find the range of gain K for stability.