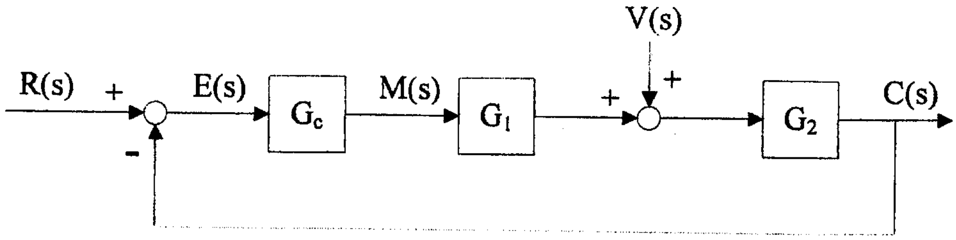
本試題是否可以使用計算機：☑可使用 ，□不可使用 （請命題老師勾選）

(24%)1. A feedback control system is sketched below.



$G_c = k$ (proportional control)

$$G_1 = \frac{1}{s^2+2s+4}, \quad G_2 = \frac{1}{5s+1}$$

a) Obtain $C(s)/R(s)$, and $C(s)/V(s)$. (8%)

b) Find the value of k at the stability limit. (4%)

c) Suppose that the disturbance is a unit step. Find the equilibrium values of $c(t)$, $m(t)$ and $e(t)$. Also find the initial slope of the output $c(t)$. (8%)

d) We would like to make the offset zero for a unit step reference input, r. In this case what type of feedback controller must be used? (4%)

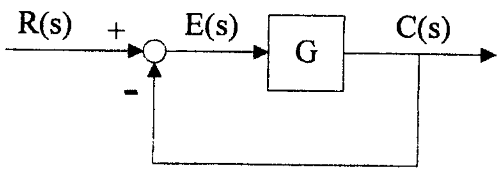
(10%)2. Given a dynamic system that you can subject to testing by specifying the input and observing the output, state two tests you could do to find out if the system is linear or nonlinear.

(16%)3. A feedback control system sketched below is to be designed to satisfy the following specifications for a step input:

i) Maximum overshoot: $5.1\% \le M_p \le 8.1\%$. (Hint: $M_p = e^{-\pi\left(\zeta/\sqrt{1-\zeta^2}\right)}$)

ii) Settling time (2% criterion): $1 \text{ second} \le t_s \le 2 \text{ seconds}$.

iii) Peak time t_p: as small as possible.

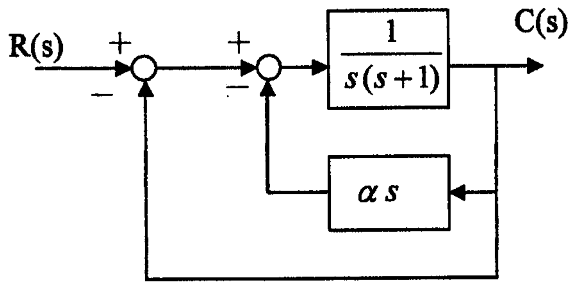


$$G = \frac{k}{s(s+p)}$$

Determine the gain, k, and the parameter, p.

（背面仍有題目,請繼續作答）

(15%) 4. (a) Draw the root locus of the following system with α as varying parameter. (b) Determine the steady-state error to the unit-ramp input, damping ratio and settling time for the system without derivative feedback, i.e., $\alpha = 0$. (c) Discuss the effect of derivative feedback on transient and steady-state response of the system assuming $\alpha = 0.2$.



(10%) 5. Sketch the Bode plots for the following transfer function and determine the system gain K for the gain cross-over frequency ω_c to be 5 rad/sec.

$$G(s) = \frac{K s^2}{(1+0.2s)(1+0.02s)}$$

(25%) **6.** (a) Given following feedback system, sketch the Nyquist plot for this system when $G_c(s) = 1$ and determine the maximum value of K for stability. (b) If $G_c(s)$ is modified to $(1+1/s)$, what then is the maximum value of K for stability? (c) Compare the results in (a) and (b).