1. Determine the overall transfer function for the system shown below. (20%)

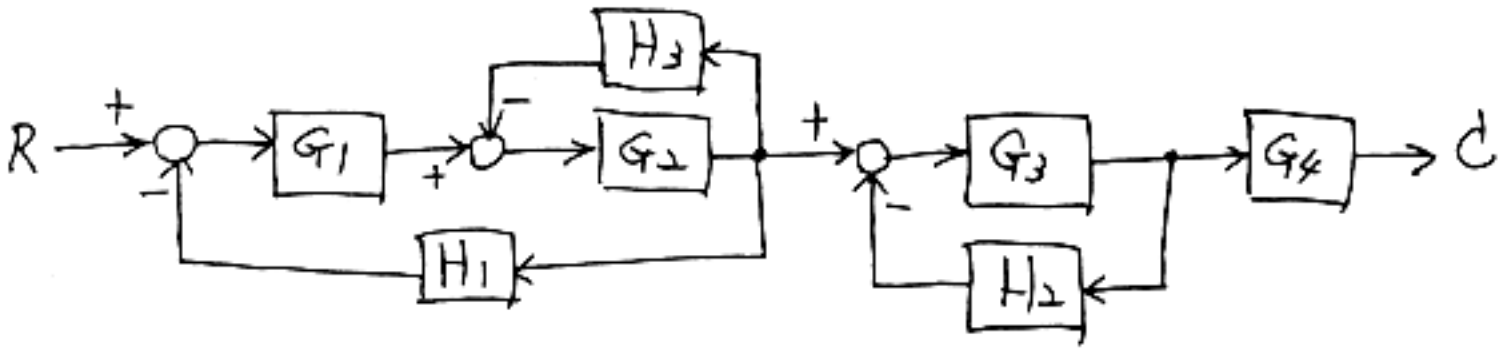

Figure 1.

2. Given the transfer function

$$G(s) = \frac{C(s)}{R(s)} = \frac{2}{s^3+6s^2+11s+6} = \frac{2}{(s+1)(s+2)(s+3)}$$

Obtain two differential state representations (state models). (20%)

3. The steady-state error to a unit-ramp input of the system shown in Fig. 3(A) is

$$e_{ss} = \frac{2\zeta}{\omega_n}.$$

Show that the steady-state error for following a ramp input may be eliminated, if we introduce the input through a (1+ks) element and choose the proper value for k (See Fig. 3(B).). (20%)

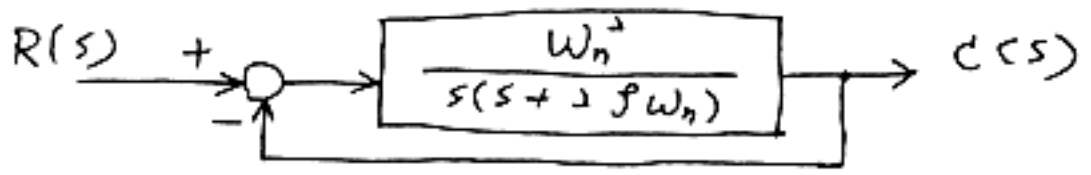

Figure 3(A)

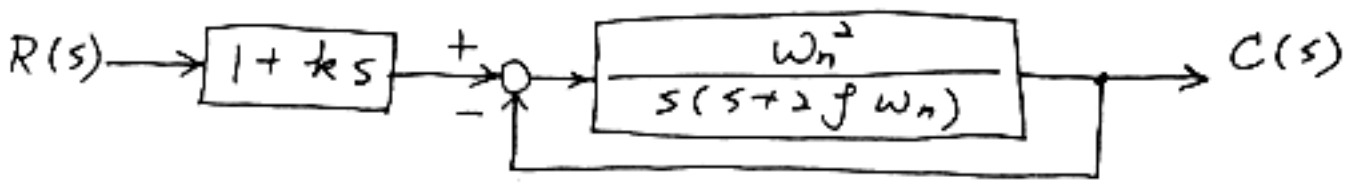

Figure 3(B)

(背面仍有題目,請繼續作答)

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4. Figure 4 shows the system with an unstable feedforward (open-loop) transfer function.
   1) Sketch the root-locus plot and locate the closed-loop poles (13%)
   2) Show that the unit-step response curve will exhibit overshoot. (7%)

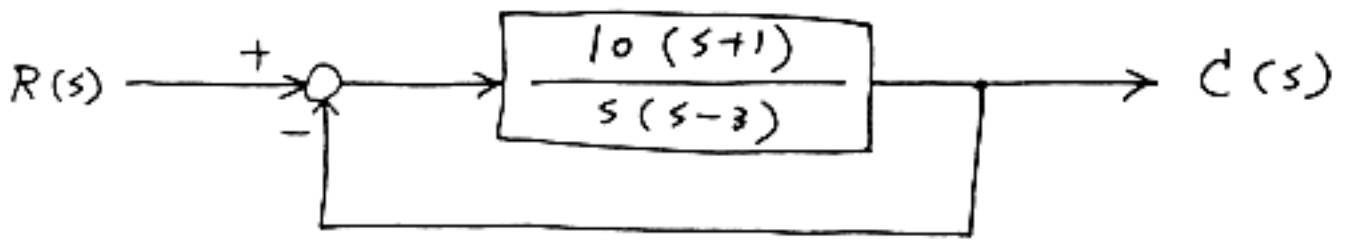

Figure 4

5. Obtain the time response of the system given by

$$\dot{x}(t) = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$

where u(t) is the unit step function occurring at t=0, and the initial conditions are $x_1(0)$ and $x_2(0)$. (20%)