國立臺南大學 104 學年度 **電機工程學系碩士班** 招生考試 控制系統 試題卷

1. Find the following transfer functions for the SFG shown in Fig. 1. (15%)

   (a) $\left.\frac{Y_7}{Y_1}\right|_{Y_8=0}$

   (b) $\left.\frac{Y_7}{Y_8}\right|_{Y_1=0}$

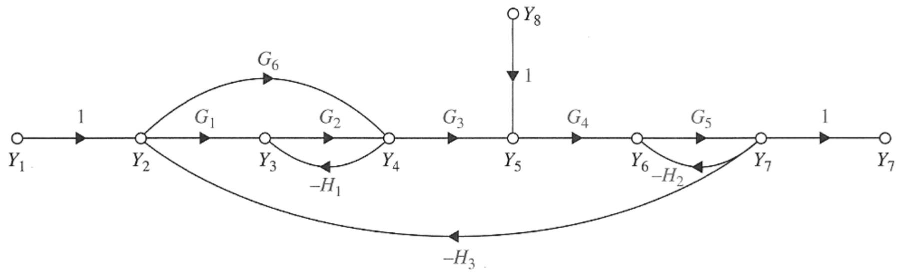

Fig. 1

2. Determine the range of K such that the system shown in Fig. 2 is stable. (15%)

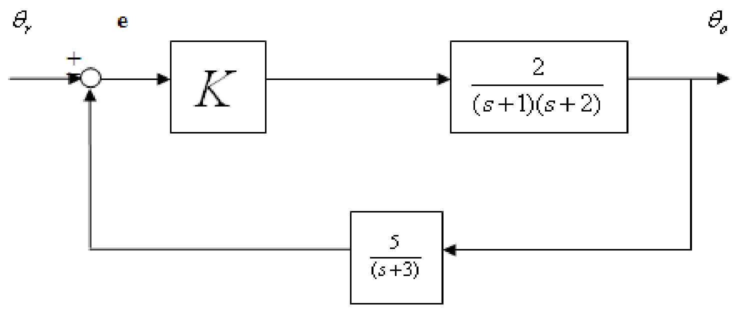

Fig. 2

3. Consider that a multivariable system is described by the differential equations. (20%)

$$\frac{d^2y_1(t)}{dt^2} + 4\frac{dy_1(t)}{dt} - 3y_2(t) = u_1(t)$$

$$\frac{dy_1(t)}{dt} + \frac{dy_2(t)}{dt} + y_1(t) + 2y_2(t) = u_2(t)$$

Write (a) the state equation and output equation in vector-matrix form (b) the transfer-function . The state variables of the system are assigned as:

$$x_1(t) = y_1(t),\ x_2(t) = \frac{dy_1(t)}{dt},\ x_3(t) = y_2(t).$$

4. Find the inverse Laplace transform of the following function, (10%)

$$G(s)=\frac{100(s+2)}{s(s^2+4)(s+1)}e^{-s}$$

5. Fig. 3 shows the block diagram of a control circuit, where k_c is the constant gain of an error amplifier. k_{pwm}, k_{ct} and L are the constants. "s" is the Laplace operator.

(a) The transfer function of the circuit described in Fig. 3 can be formulated as $i_L(s)=H(s)i_r(s)-Y(s)v_L(s)$.
Find the functions $H(s)$ and $Y(s)$. (10%)

(b) If the error amplifier in Fig. 3 is replaced by a phase-lead controller with the transfer function $G_c(s)$, written as

$$G_c(s)=\frac{E_{co}(s)}{E_{ci}(s)}=\frac{1}{a}\left(\frac{1+aTs}{1+Ts}\right).$$

The phase-lead controller is then implemented with an OP-amp circuit shown in Fig. 4. Find a and T in terms of the circuit parameters R_1, R_2, and C. (15%)

(c) Similar to 5(b), if a PI-controller of the transfer function

$$G_{PI}(s)=k_P+\frac{k_I}{s}$$

is applied to replace the error amplifier in Fig. 3. Draw an OP-amp circuit to realize such a PI-controller. (15%)

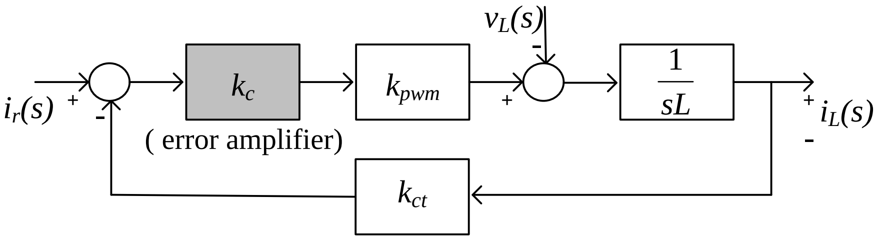

Fig. 3

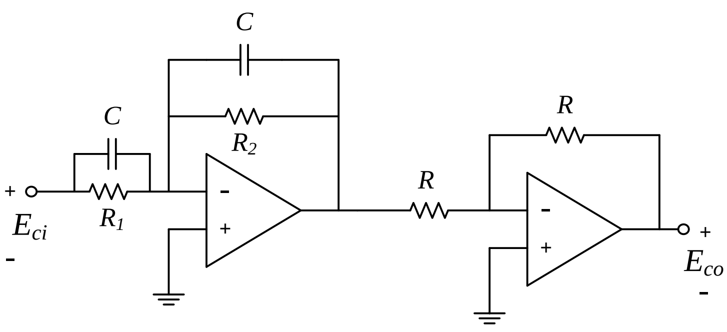

Fig. 4