



Answer all the following questions:

**Problem 1: (25 Marks) [ILOS: b7], [ILOS: a1.2, b5.1,]**

(a) A filter is represented by the signal flow graph shown in the figure. Its input is  $x(t)$  and output is  $y(t)$ . Explain the transfer function of the filter is: [ 10 Marks]

- (A)  $\frac{-(1+ks)}{s+k}$                       (B)  $\frac{(1+ks)}{s+k}$                       (C)  $\frac{-(1-ks)}{s+k}$                       (D)  $\frac{(1-ks)}{s+k}$

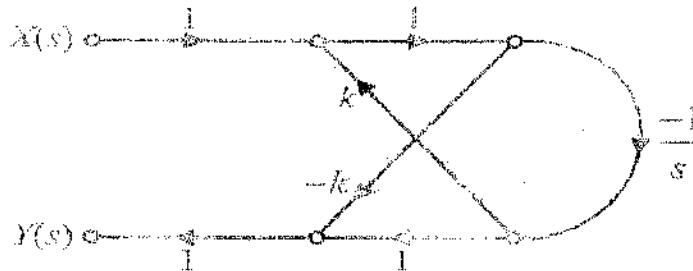


Fig. 1

(b) The characteristic equation of a control system is given by: [ILOS: a1.2, b5.1,]

$$s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$$

Explain: The number of the roots of the equation which lie on the imaginary axis of  $s$ -plane is: [ 15 Marks]

- (A) 0                      (B) 2                      (C) 4                      (D) 6

**Problem 2: ( 20 Marks)**

(a) What are the advantages and disadvantages of open-loop and closed-loop control systems? [ 10 Marks]

(b) Simplify the block diagram then obtain the close-loop transfer function  $Y(S)/R(S)$ . [10 Marks] [ILOS: b7.1]

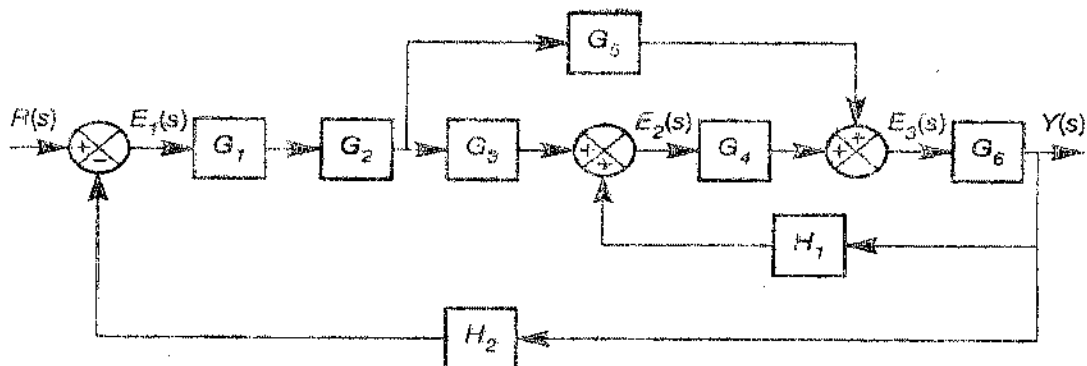


Fig. 2

**Problem 3: ( 20 Marks)**

- (a) Explain what are the components of PID controllers? And shows the controller effects on the steady state error? (8 Marks).
- (b) Obtain analytically the rise time, peak time, maximum overshoot, and settling time in the unit-step response of a closed-loop system given by:  $\frac{C(s)}{R(s)} = \frac{36}{s^2 + 2s + 36}$ , and show locations of poles and zeros on the pole-zero plot. [12 Marks]. [ILOS: b2.1]

**Problem 4: ( 25 Marks)**

- (a) Find the position, velocity, and acceleration error constant for the system shown below. Then, find the steady state error for a unit step, unit-ramp, and unit-parabolic inputs. [10 Marks] [ILOS: b2.1]

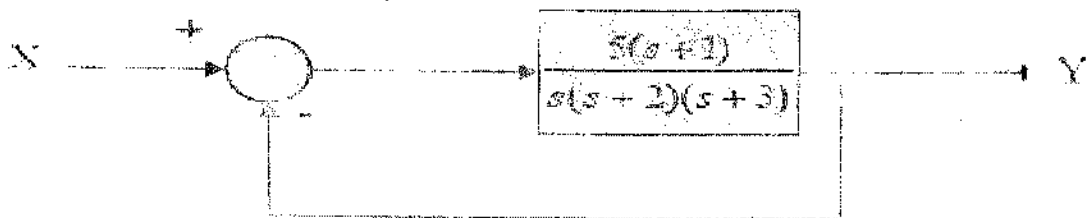


Fig. 3

- (b) A feedback control system is proposed. The corresponding block diagram is: [ILOS: a4.1, b5.1]

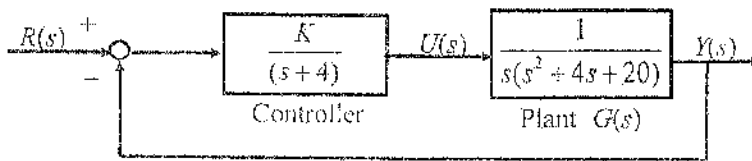


Fig. 4

The controller gain  $K$  varies from 0 to  $\infty$ . **Explain** with drawing what is the number of breakaway points in the root locus diagram? (15 Marks)

- (A) One      (B) Two      (C) Three      (D) Zero

مع تمنياتي لكم بالتوفيق والنجاح،،،