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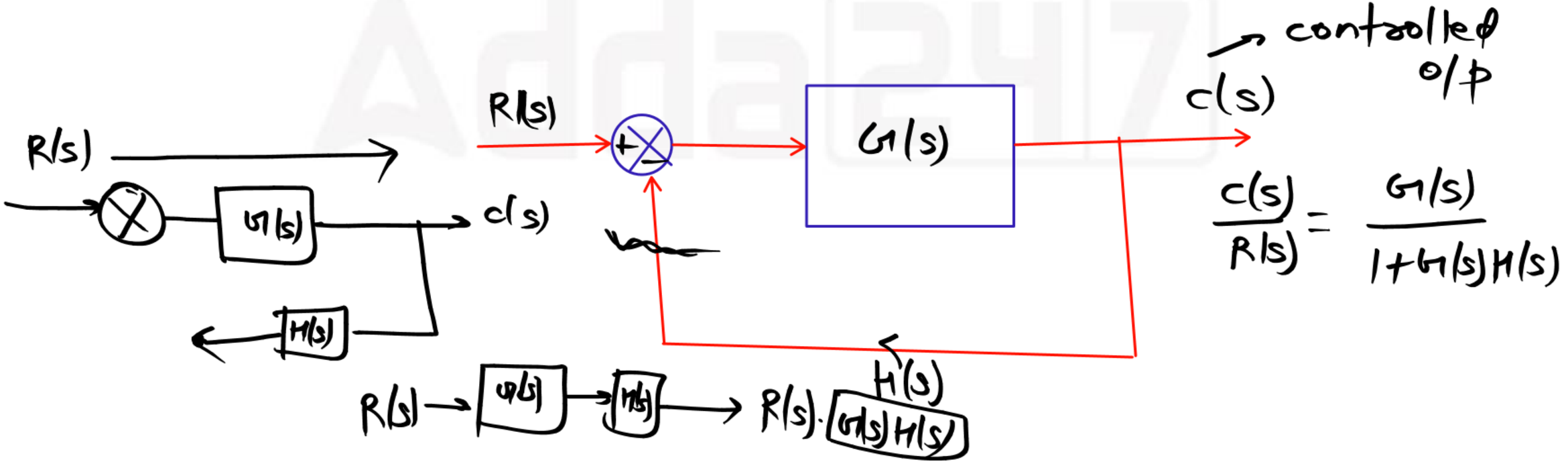
# type & order of control system

## closed loop control system :→

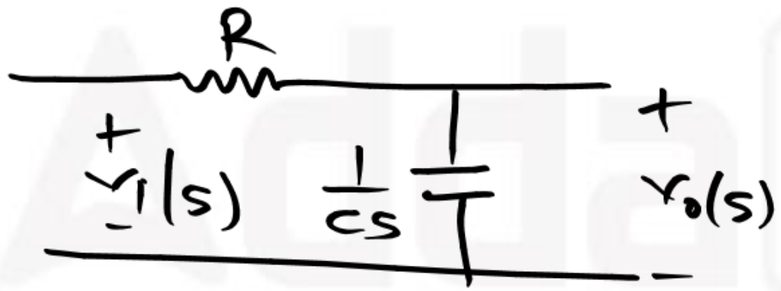



$$\frac{C(s)}{R(s)} = \frac{G(s)}{1+G(s)H(s)}$$

$G(s)H(s)$ → open loop transfer funct.

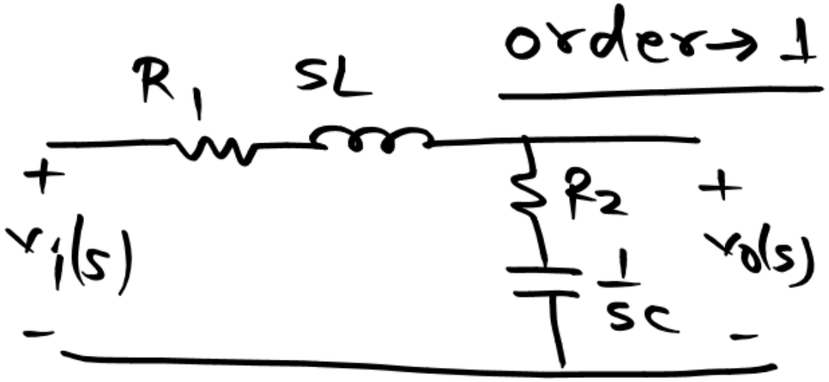
$G(s)$ → feed forward transfer fn.

## order of the control system




$$\frac{V_o(s)}{V_i(s)} = \frac{1}{SRC+1}$$

order → 1

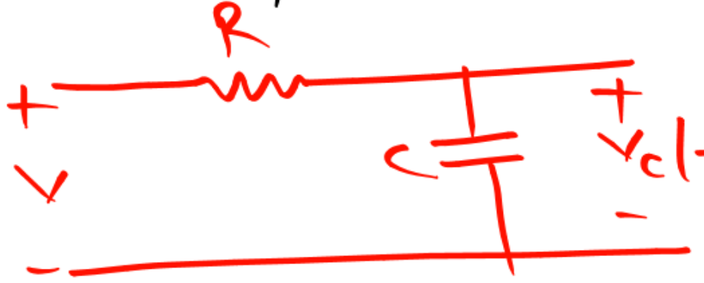



$$\frac{V_o(s)}{V_i(s)} = \frac{R_2+\frac{1}{SC}}{R_1+SL+R_2+\frac{1}{CS}} = \frac{R_2CS+1}{LCS^2+(R_1+R_2)CS+1}$$

## order →

* order of the system is defined by open loop tr. f$^n$ - $(G(s)H(s))$

* transient response depends upon order of the system.




$$V_c(t) = V\left(1 - e^{-t/RC}\right) = V - Ve^{-t/RC}$$

$V$ → steady state.

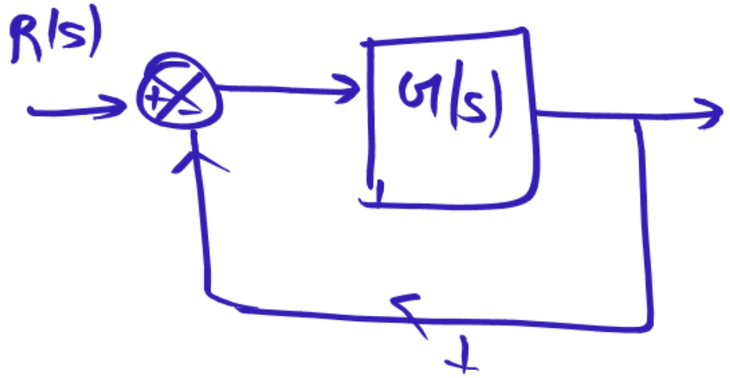
$Ve^{-t/RC}$ → transient

Q. $H(s) = 1$

$$G(s) = \frac{K(s+2)}{s(s+3)}$$

Order → $G(s)H(s) = \frac{K(s+2)}{s(s+3)}$ ← (2)

Q. $H(s) = 1$




$$\frac{C(s)}{R(s)} = \frac{s+2}{s^4+3s^3+2s^2+2s+4}$$

$$\frac{C(s)}{R(s)} = \frac{s+2}{s^4+3s^3+2s^2+2s+4} = \frac{G(s)}{1+G(s)}$$

$$G(s) \quad \frac{G(s)}{1+G(s)} \qquad \frac{G(s)}{1+G(s)-G(s)} = \frac{Num}{den-Num} = G(s)$$

$$[H(s)=1]$$

$$G(s) = \frac{s+2}{s^4+3s^3+2s^2+2s+4-s-2} = \frac{s+2}{s^4+3s^3+2s^2+s+2}$$

(4)

$\int \rightarrow \frac{1}{s}$

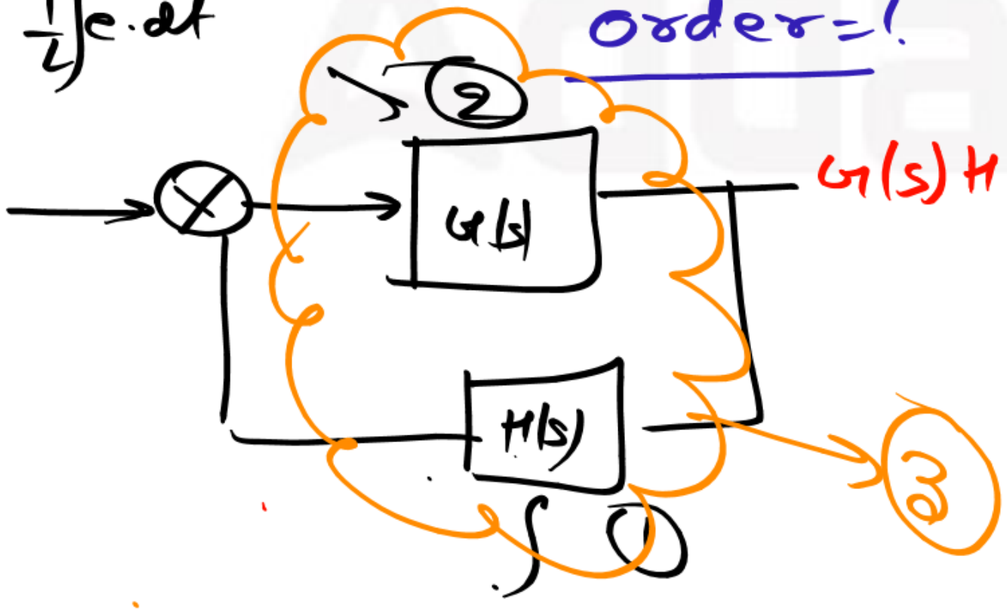


$e = L\frac{di}{dt}$

$\int di = \frac{1}{L}\int e \cdot dt$

eg. $G(s) = \frac{K(s+2)}{s(s+1)}$ $H(s) = \frac{1}{s}$

order = ?




$G(s)H(s) = \frac{K(s+2)}{s(s+1)} \cdot \frac{1}{s} = \frac{K(s+2)}{s^2(s+1)}$

order → 3

$\frac{(s+1)}{s(s+1)}$

$\frac{1}{s}$

# types of the control system

* Response :→ transient response + steady state response.
  - transient response → order
  - steady state response → type
* type of the system is determined by (order)

type :→

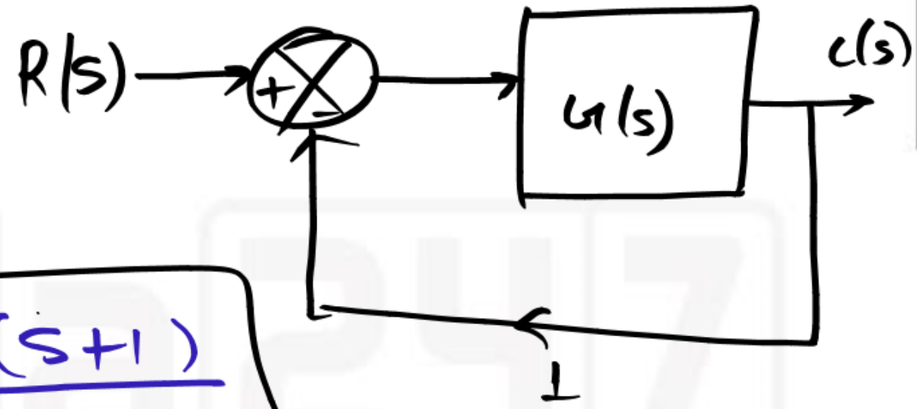
No. of poles at origin of

$\boxed{G(s)H(s)}$.

✓ $G(s)H(s) = \frac{K}{s}$ type → 1

✓ $G(s)H(s) = \frac{K}{s^2(s+2)}$ type → 2

Q. $H(s) = 1$




$$\frac{C(s)}{R(s)} = \frac{(s+1)}{s^2+s+1}$$

Type = ?

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

$$G(s) = \frac{\text{Num}}{\text{den-Num}} = \frac{s+1}{s^2+s+1-s-1}$$

(2)

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

THANKS FOR

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