21.11.23

CSEA61

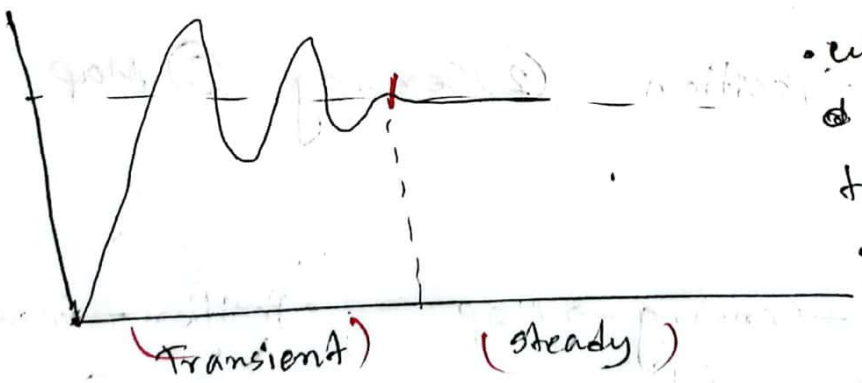
"Lecture – 10"

Introduction to Control System Theory

→ **Cybernetics:**

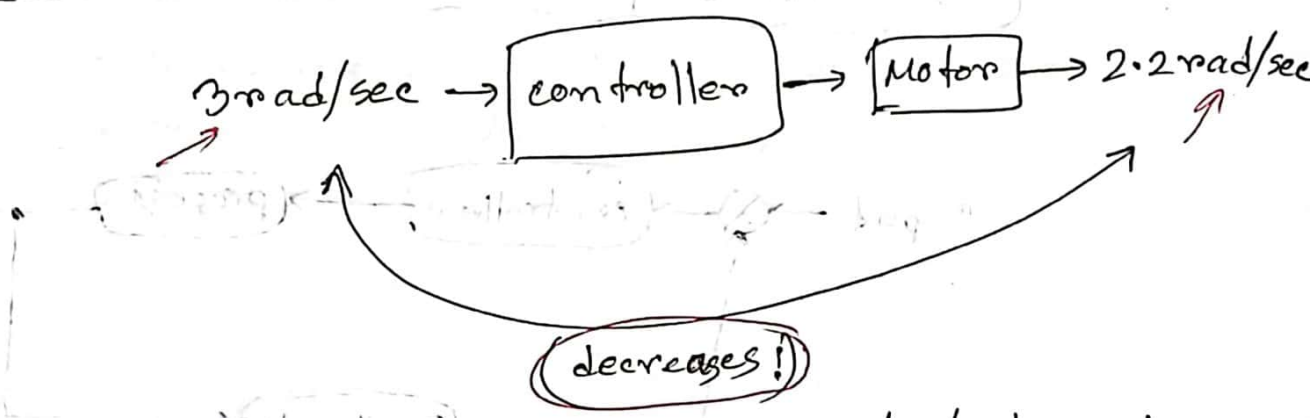
- comes from greek word 'kybernetes'.
- It means we will work on the basis of the Feedback.
- Feedback মানে সুমাবে যে আমি যতটুকু signal দিচ্ছি ততটুকু যাচ্ছে কিনা।
- According to the feedback we will increase or decrease our input

→



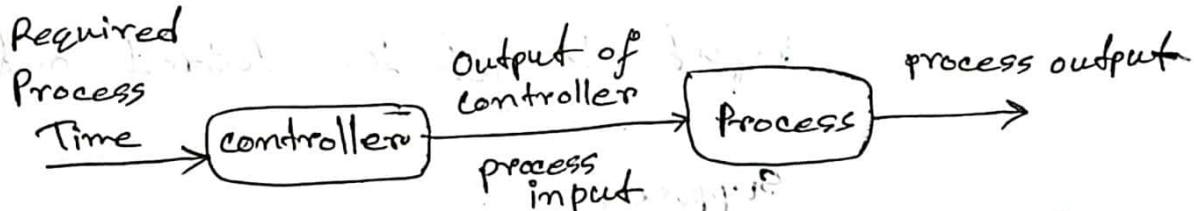
- we have to mitigate the transient state. To do that we have to control the voltage.

→ Control System:



if we somehow know the output by using feedback, then we can increase out input and if the ~~out~~ output decreases ~~then~~ we can reduce the input

~~Open~~ (1) Open Loop Control:

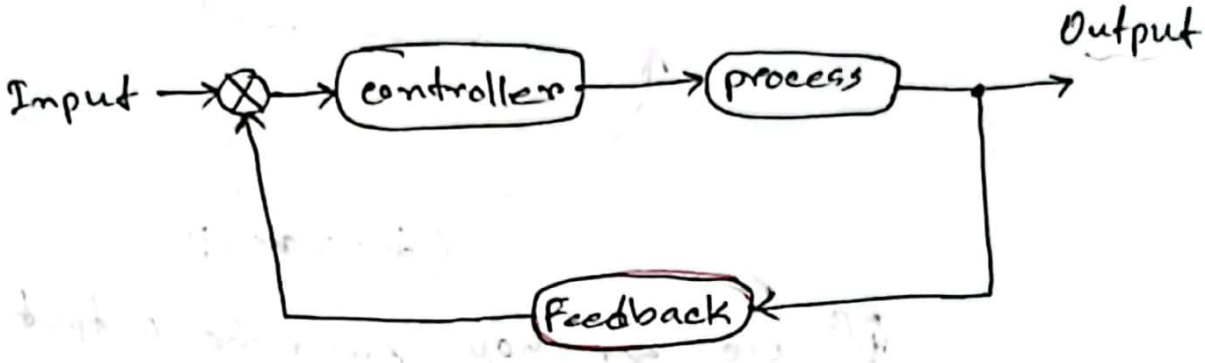


Required
V = 3 rad/s

Output
V = 2.2 rad/s

problem: My desired value যেটা, সেটা আদৌও আমি reach করতেছি কিনা সেটা আমি monitor করতে পারতেছি না।

(2) Closed Loop Control:



⇒ from the feedback we can increase/decrease ~~out~~ our input. If we didn't get the desired value in the output, we can monitor that using the feedback. And we can tell the controller to change the input to get the desired output.

Suppose,

(i) Input → 5 ; output → 2 ;

- say to increase the input to the controller.

(ii) Input → 5 ; Output → 8

- say to decrease the input to the controller.

→ Feedback Diagram:

- Boxes are the controller/individual parts.
- arrows are the input/output signals.
- some '⊗' will be there which are called summation or ~~differentiate~~ element deference

→ Block Diagram:

(1) $X \longrightarrow \boxed{G} \longrightarrow Y$

input — output

gain = G (parameter of the block)

$\therefore$ output = (input * gain)

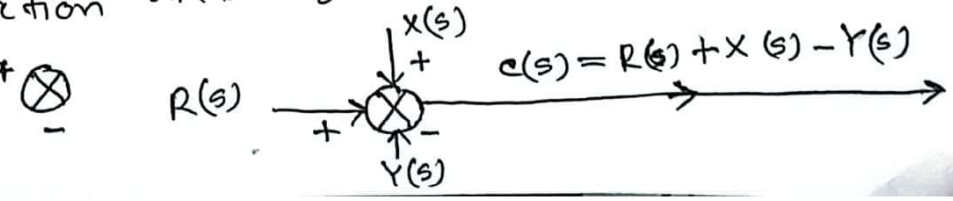
$\therefore$ gain = (output / input)

⊙ our target is to relate input and output by solving the block diagram.

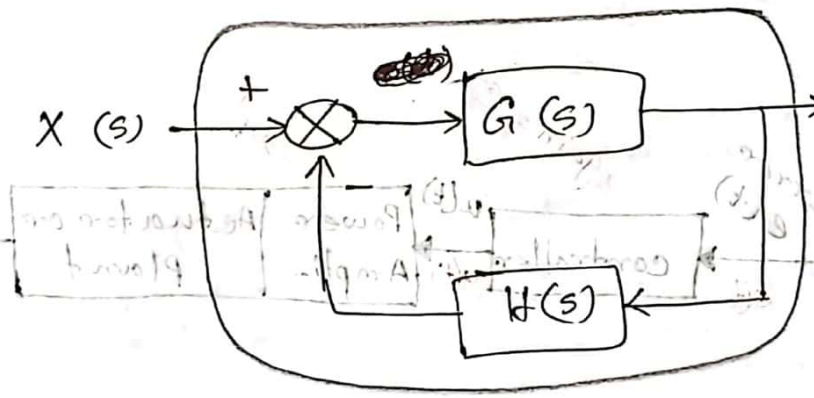
Rules:

- cascaded elems, $\boxed{a(t)} \longrightarrow \boxed{b(t)} = a(t) * b(t)$ (gain)

- Summation and deference elems,



another simple example:



Here,

~~$Y(s) = G(s) * e(t)$~~

$$Y(s) = G(s) * [X(s) - H(s) * Y(s)]$$

$$\Rightarrow Y(s) = [G(s) * X(s)] - [G(s) * H(s) * Y(s)]$$

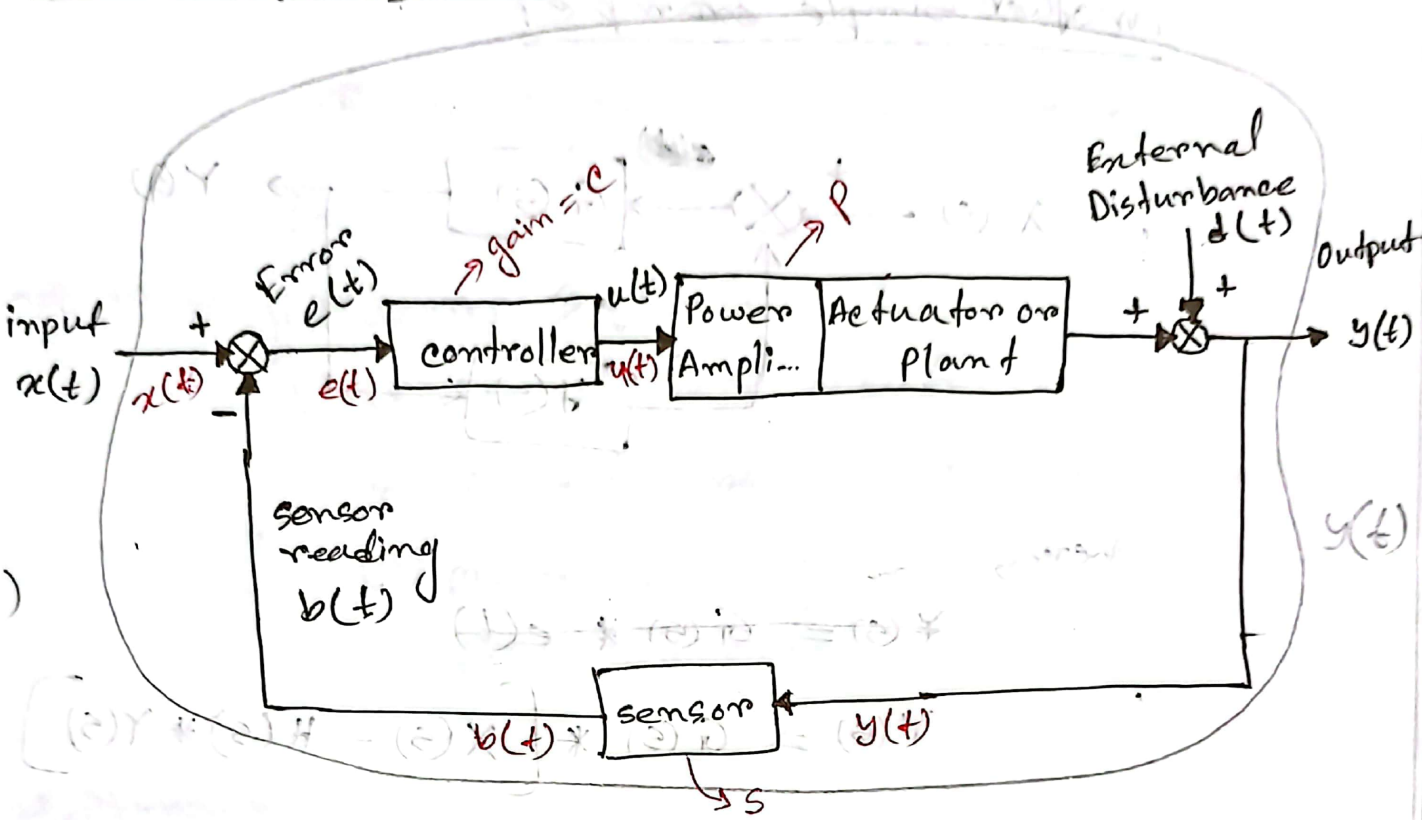
$$\Rightarrow Y(s) + [G(s) * H(s) * Y(s)] = [G(s) * X(s)]$$

$$\Rightarrow \boxed{Y(s) = \frac{G(s) * X(s)}{1 \pm G(s) * H(s)}}$$

(why ±?)

only for ঋণাত্মক feedback ও ধনাত্মক ক্ষেত্রে formula (+) হবে and vice-versa.

Block Diagram Solve:



Here,

$$u(t) = c * e(t)$$

~~$\Rightarrow u(t) = c * [x(t) - b(t)]$~~

~~$\Rightarrow u(t) = c * [x(t) - \{s * y(t)\}]$~~

$$\therefore y(t) = u(t) * p$$

$$\Rightarrow y(t) = c * e(t) * p + d(t)$$

$$\Rightarrow y(t) = c * [x(t) - b(t)] * p + d(t)$$

$$\Rightarrow y(t) = c * [x(t) - s * y(t)] * p + d(t)$$

$$\Rightarrow y(t) = x(t) * c * p - c * s * y(t) * p + d(t)$$

$$\Rightarrow \frac{y(t)}{x(t)} = \frac{c * p + d(t)}{1 + c * p * s}$$