EIPC (NEE-403)
Unit-4
Process Control

Electronic Control System

- Function of ECS is to keep the variables of a system electronically at the desirable value.

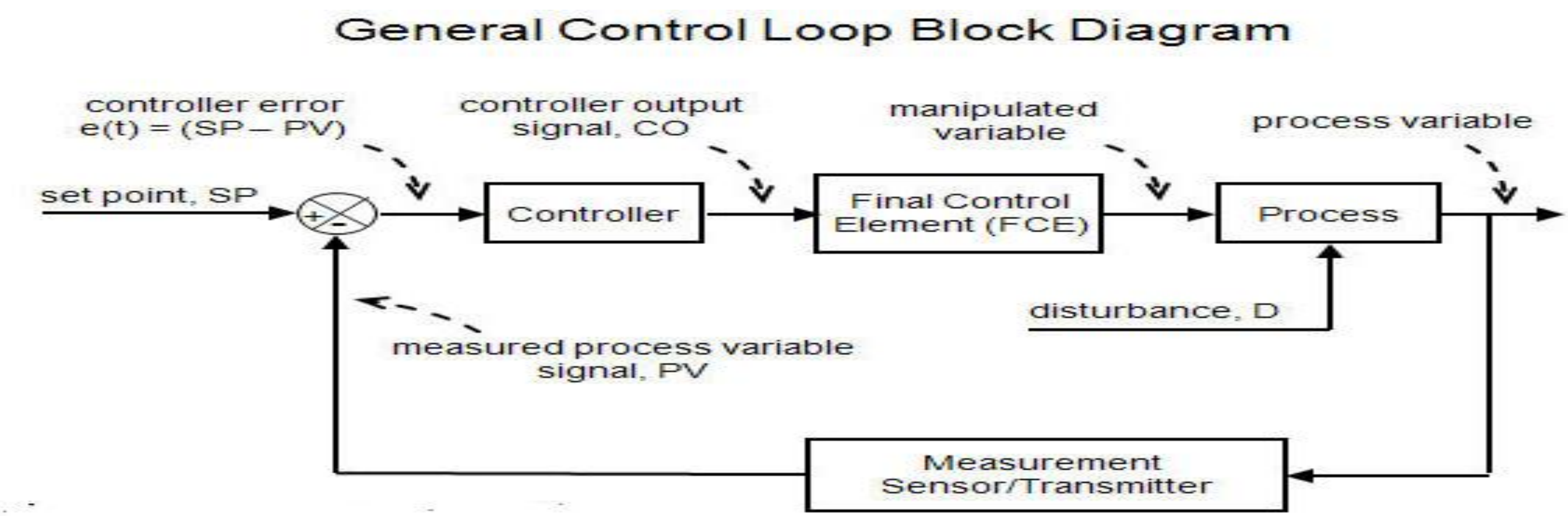
- Implemented In two ways

- Analog (PID Controllers)

- Digital (ON/OFF / Digital Processors)

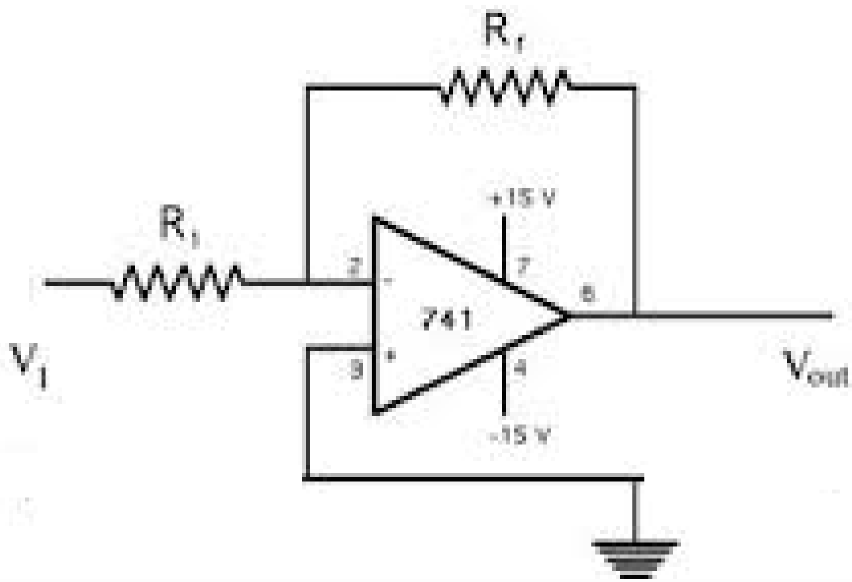
Analog Control

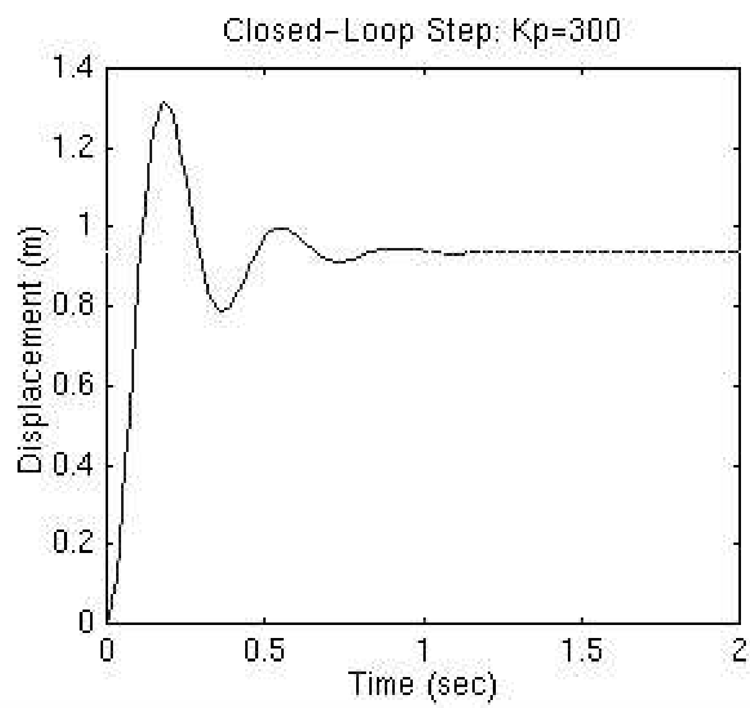
- The system to be controlled is the Plant /Process .A sensor measures the quantity to be controlled. An actuator affects the plant. A controller or control processor processes the sensor signal to drive the actuator. Disturbance is a signal from external of the plant that occurs unpredictably and disturbs the plant from reaching the pre specified level



Proportional (P) controller

- Proportional control is the most basic control that is always used in the controllers. This is easy to develop, but cannot remove steady-state error.
- The equation of the P controller in time domain: ***u(t) = K p e(t) where K p -proportional gain.***

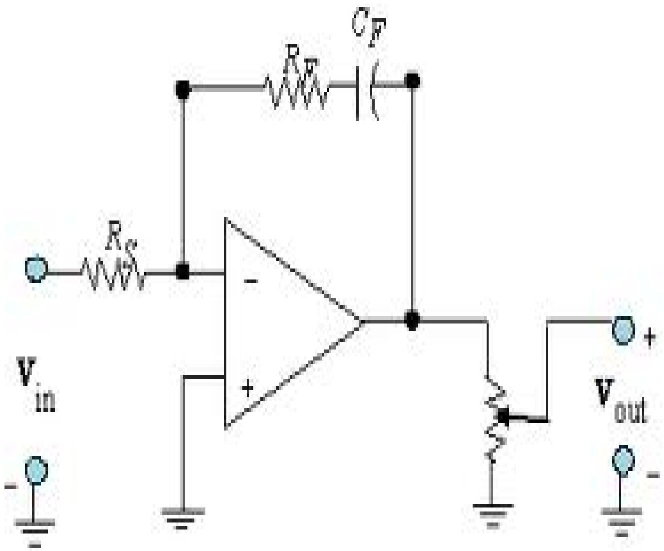


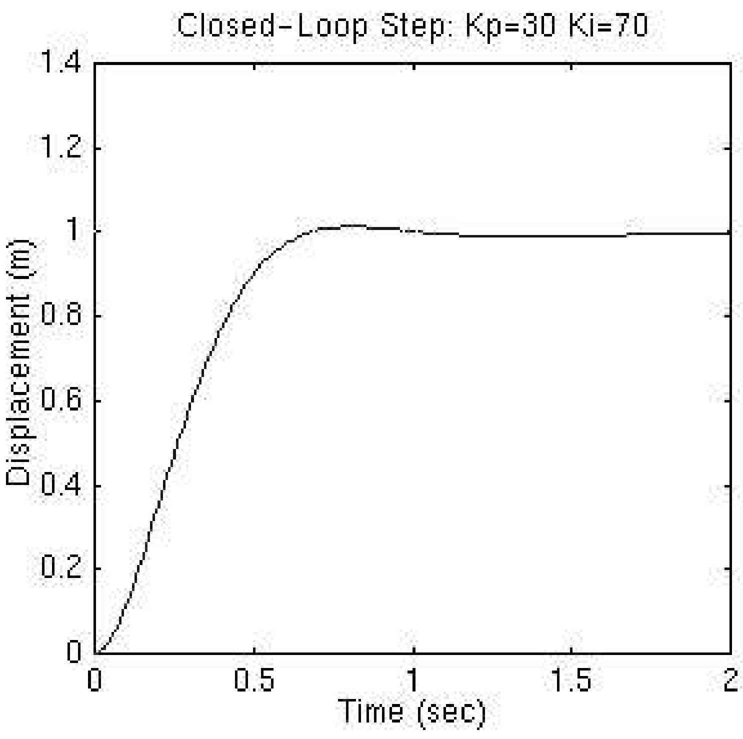


Proportional-Integral (PI) controller

- Proportional-Integral controller is used to eliminate steady-state error, but if integral gain is mistuned, the system can become unstable and the response time can be slower.
- The equation of the PI controller in time domain:

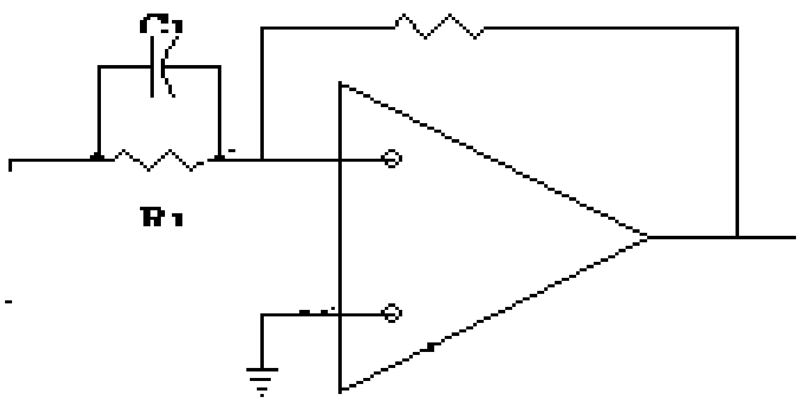
$$u(t) = K_p e(t) + K_i \int_0^t e(\tau) d\tau$$ *where K i : integral gain*

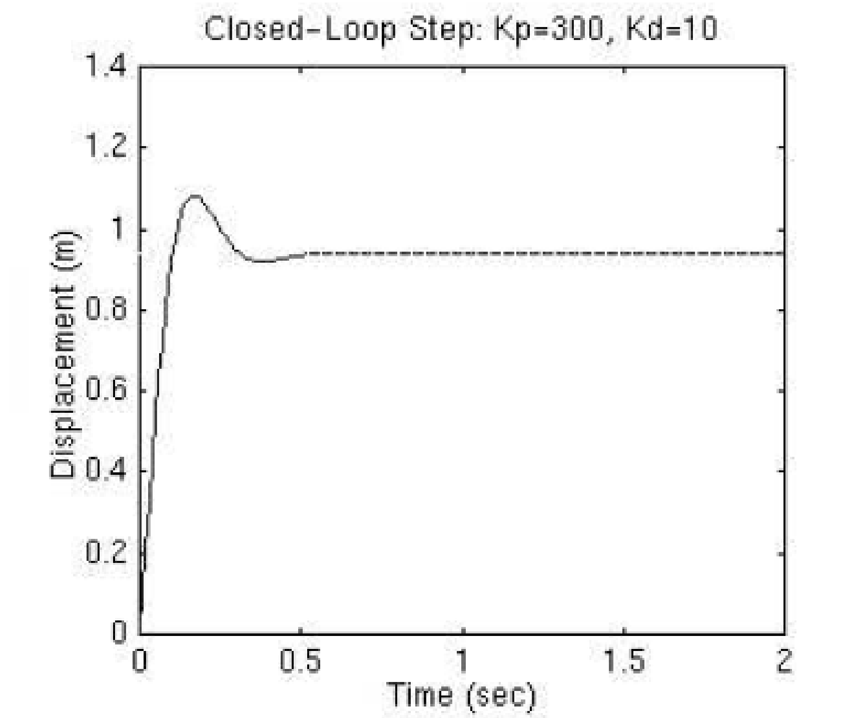




Proportional-Derivative (PD) controller

- PD control increases the stability of the system and makes the response time faster, but with the presence of noise in the system.
- The equation $u(t) = K_p e(t) + K_d \frac{d}{dt} e(t)$ er in time domain:



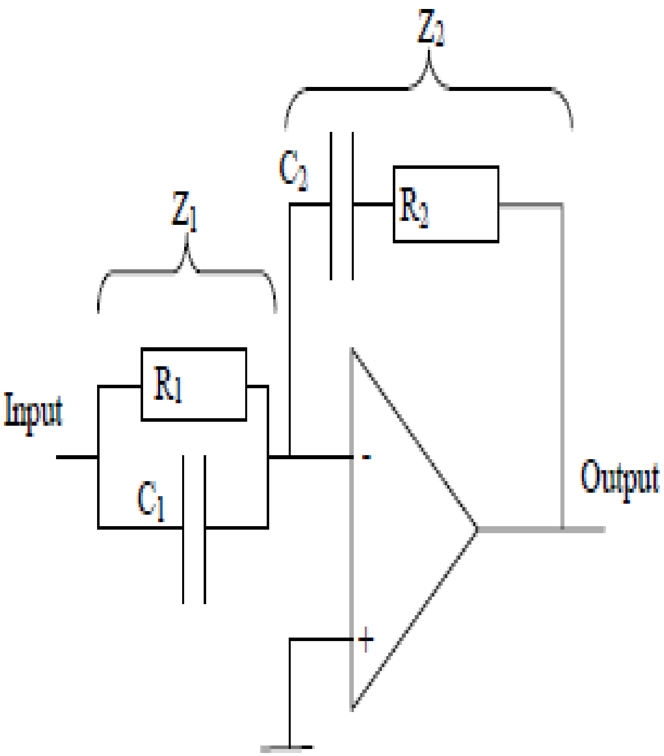


PID (Proportional-Integral-Derivative)

- More than 80% of the feedback controllers are PID controllers in the actual fields, because its performance is good and it is easy to tune.

- The equation of the PID controller in time domain:

$$u(t) = K_p e(t) + K_d \frac{d}{dt} e(t) + K_i \int_0^t e(\tau) d\tau$$

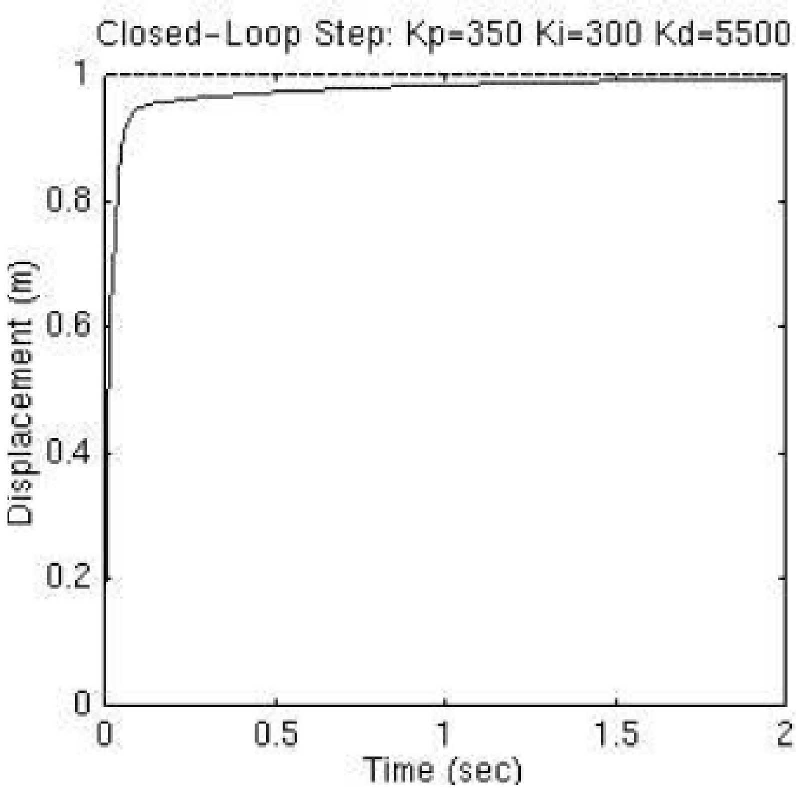


Where:

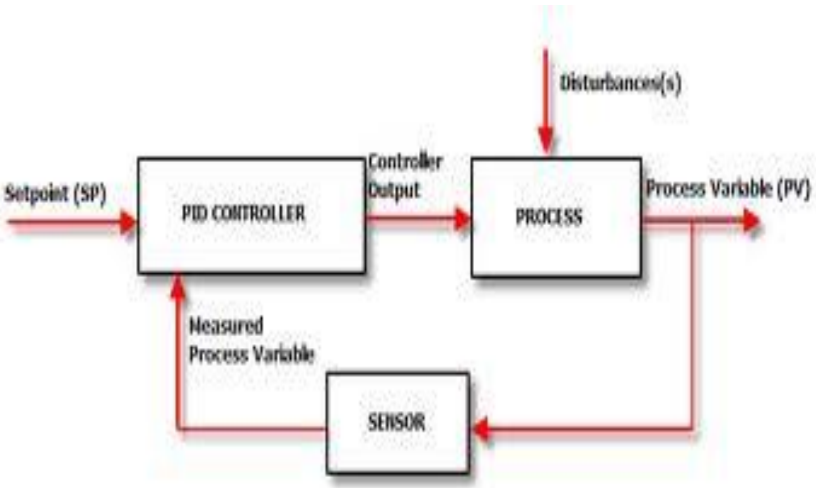
$$K_p = \frac{R_2}{R_1} + \frac{C_1}{C_2}$$

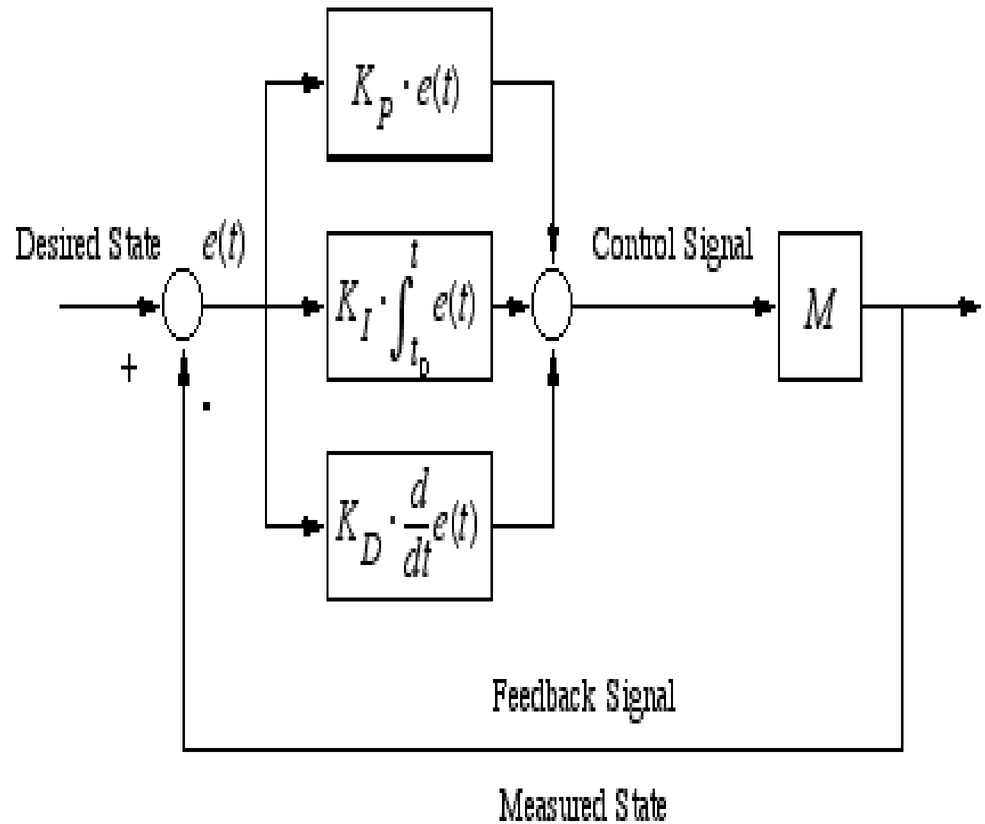
$$K_i = R_2 \cdot C_1$$

$$K_d = \frac{1}{R_1 \cdot C_2}$$



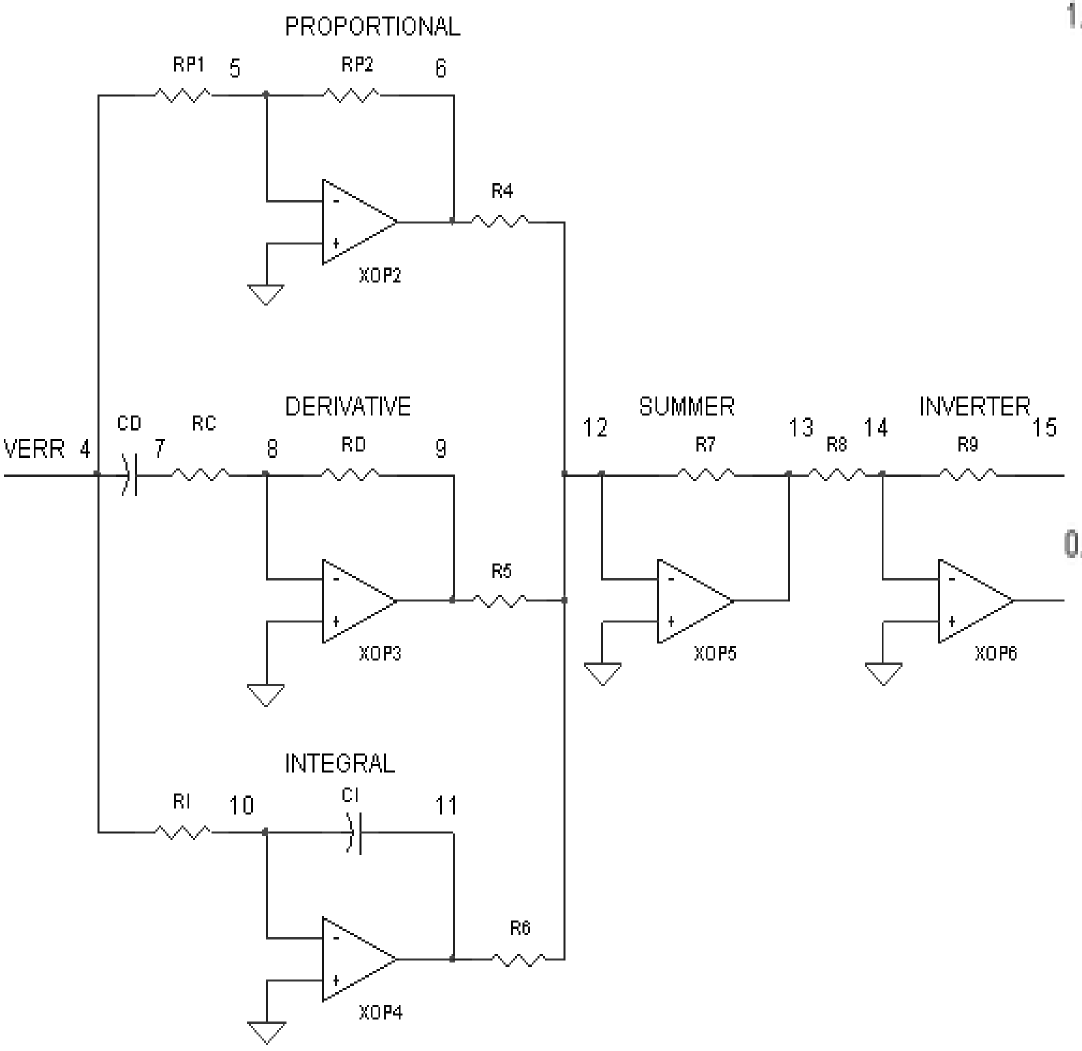
PID (Proportional-Integral-Derivative)

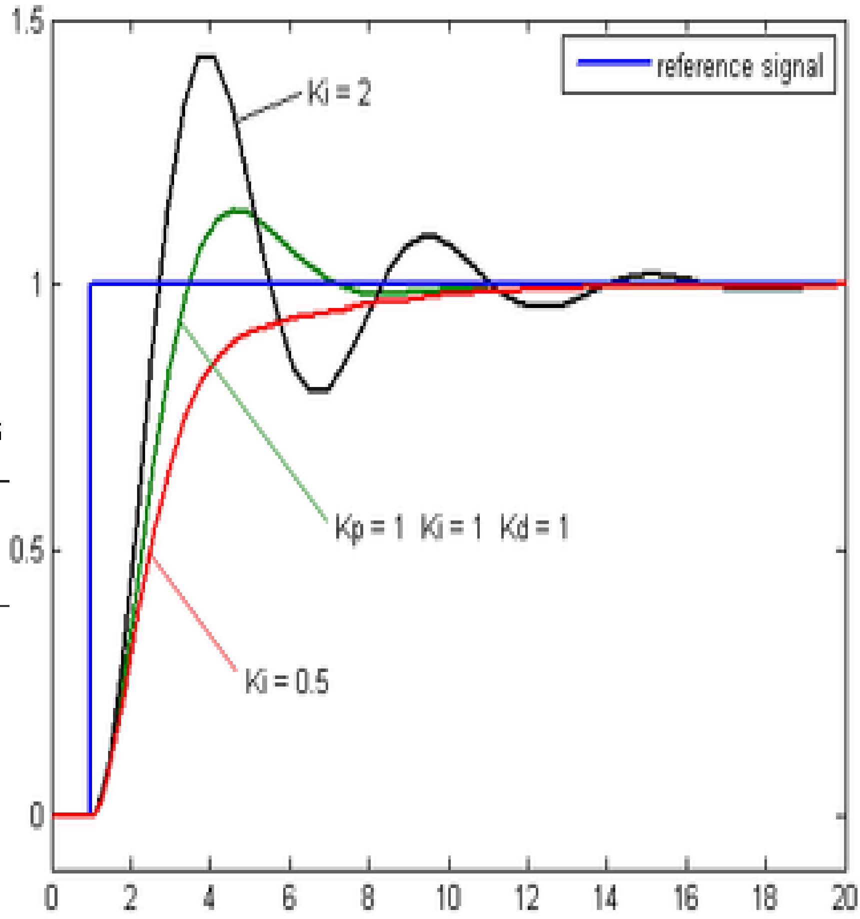




$$u(s) = \left(K_P + K_I \frac{1}{s} + K_D s\right) e(s)$$

PID (Proportional-Integral-Derivative)





Thank You