SNS COLLEGE OF TECHNOLOGY

Coimbatore-11
An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECT212 – CONTROL SYSTEMS

II YEAR/ IV SEMESTER

UNIT II – TIME RESPONSE ANALYSIS

TOPIC 7- PD COMPENSATION

OUTLINE

- REVIEW ABOUT PREVIOUS CLASS
- PD-CONTROLLER
- ADVANTAGES AND DISADVANTAGES
- DIAGRAM OF PD CONTROLLER
- ACTIVITY
- EXAMPLE
- SUMMARY

PD-CONTROLLER

PD-CONTROLLER

The additive combination of Prop. & Derivative control actions is known as PD-control

$$m = Kc*e + (Kc*Td)*(de/dt) + M \quad \text{or}$$

$$\mathbf{m - M = Kc\ (1 + Td*s)\ e}$$

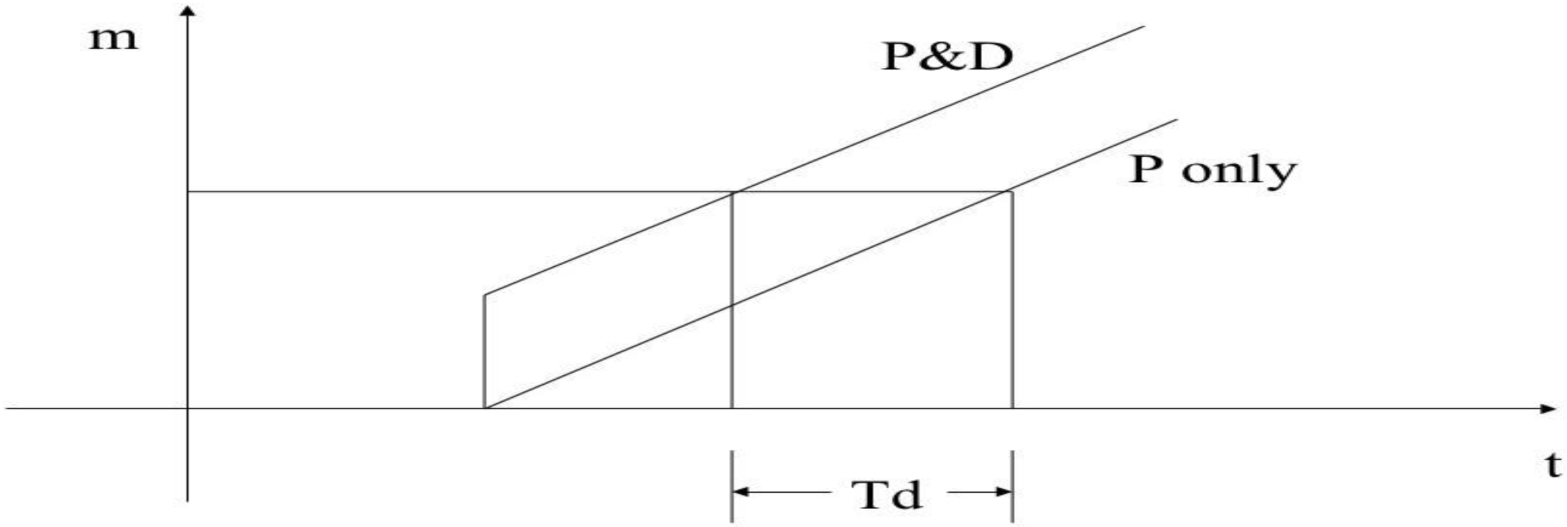
For a linear change of deviation : $e = Et$

$$\mathbf{m - M = Kc\ (1 + Td*s)\ Et}$$

$$\mathbf{m - M = KcE\ (t + Td)}$$

PD-CONTROLLER

Deviation , e is defined at time t while the manipulated variable is defined at time (t+Td).
So net effect is to shift the manipulated variable m , ahead by a Time Td , the derivative time.



PD-CONTROLLER

Proportional and Derivative Controller

it is a combination of proportional and a derivative controller the output (also called the actuating signal) is equals to the summation of proportional and derivative of the error signal.

Mathematical Analysis

output is directly proportional to the summation of proportional of error and differentiation of the error signal, writing this mathematically we have,

$$A(t) \propto \frac{de(t)}{dt} + A(t) \propto e(t)$$

Removing the sign of proportionality we have,

$$A(t) = K_d \frac{de(t)}{dt} + K_p e(t)$$

Where, K_d and K_p proportional constant and derivative constant respectively.

ADVANTAGES AND DISADVANTAGES OF PROPORTIONAL AND DERIVATIVE CONTROLLERS.

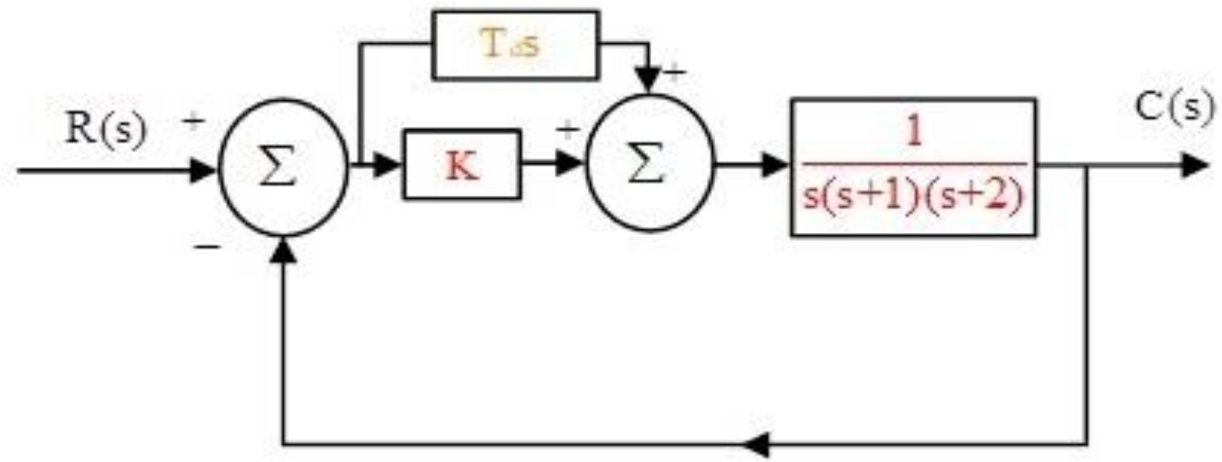
Advantages and disadvantages are combinations of advantages and disadvantages of proportional and derivative controllers.

Readers should note that adding ‘zero’ at the proper location in the open-loop transfer function improves stability, while the addition of pole in the open-loop transfer function may reduce the stability.

The words “at proper location” in the above sentence are very important & it is called designing of the control system (i.e. both zero & pole should be added at proper points in the complex plane to get the desired result).

DIAGRAM OF PD CONTROLLER

Inserting the PD controller is like the addition of zero in open-loop transfer function [G(s)H(s)].



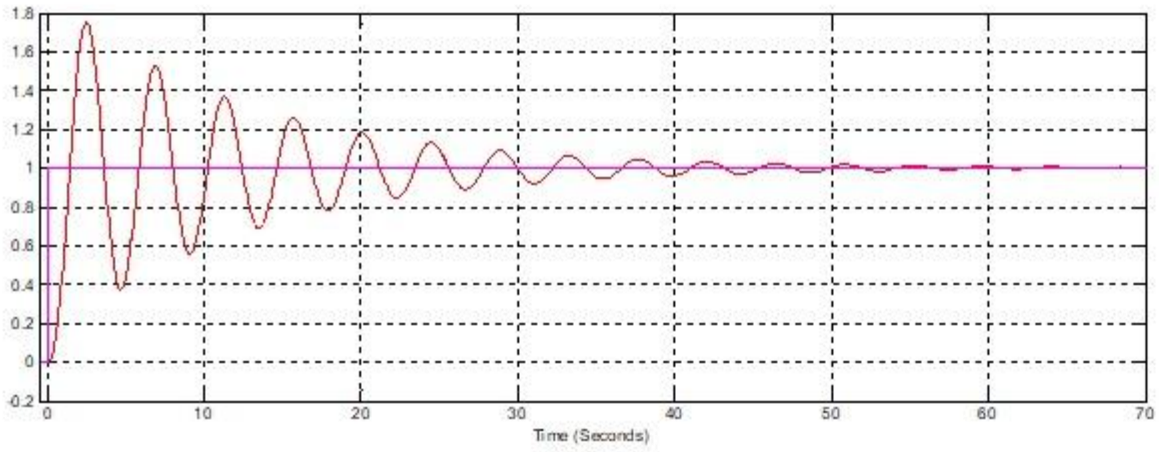
ACTIVITY -BRAINTEASERS

1.What comes once in a minute, twice in a moment, but never in a thousand years?

2.I have keys, but no locks. I have space, but no room. You can enter, but you can't go outside. What am I?

EXAMPLE

In the present case, we have taken the values of K=5.8, Td=0.5. Its time response, against step input, is shown in Fig. You can compare Fig, with Fig-1 and can understand the effect of inserting the derivative part in the P-controller. EXAMPLE



EXAMPLE

The transfer function of the PD controller is K+Tds or Td(s+K/Td);

so we have added one zero at -K/Td.

By controlling the value of ‘K’ or ‘Td’, the position of the ‘zero’ can be decided. If ‘zero’ is very far away from the imaginary axis, its influence will decrease, if ‘zero’ is on the imaginary axis (or very close to the imaginary axis)

it will also be not accepted (root locus generally starts from ‘poles’ & terminates at ‘zero’,

Designer’s aim is generally such that root locus should not go towards the imaginary axis, due to this reason ‘zero’ very near to imaginary axis is also not acceptable, hence a moderate position of ‘zero’ should be kept)

Generally, it is said, PD controller improves transient performance and the PI controller improves the steady-state performance of a control system.

SUMMARY