SNS COLLEGE OF ENGINEERING

(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

SENSORS AND INSTRUMENTATION

Guess Today's Topic????

FIRST order performance

- In the context of measurement systems, the terms "first order" and "second order" refer to the order of the system's response to changes in input. Specifically, a first-order system responds to changes in input at a rate proportional to the input, while a second-order system responds to changes in input at a rate proportional to the input and its first derivative.

FIRST order performance

First Order Systems ultimately reach the same result as zero order systems except that they take some time to get there when a step input is applied.

The relationship between the output and the input is given by the following equation:

$$a\frac{d\theta_o}{dt} + b\theta_o = c\theta_i$$

where a, b and c are constants.

$$\tau\frac{d\theta_o}{dt} + \theta_o = K\theta_i$$

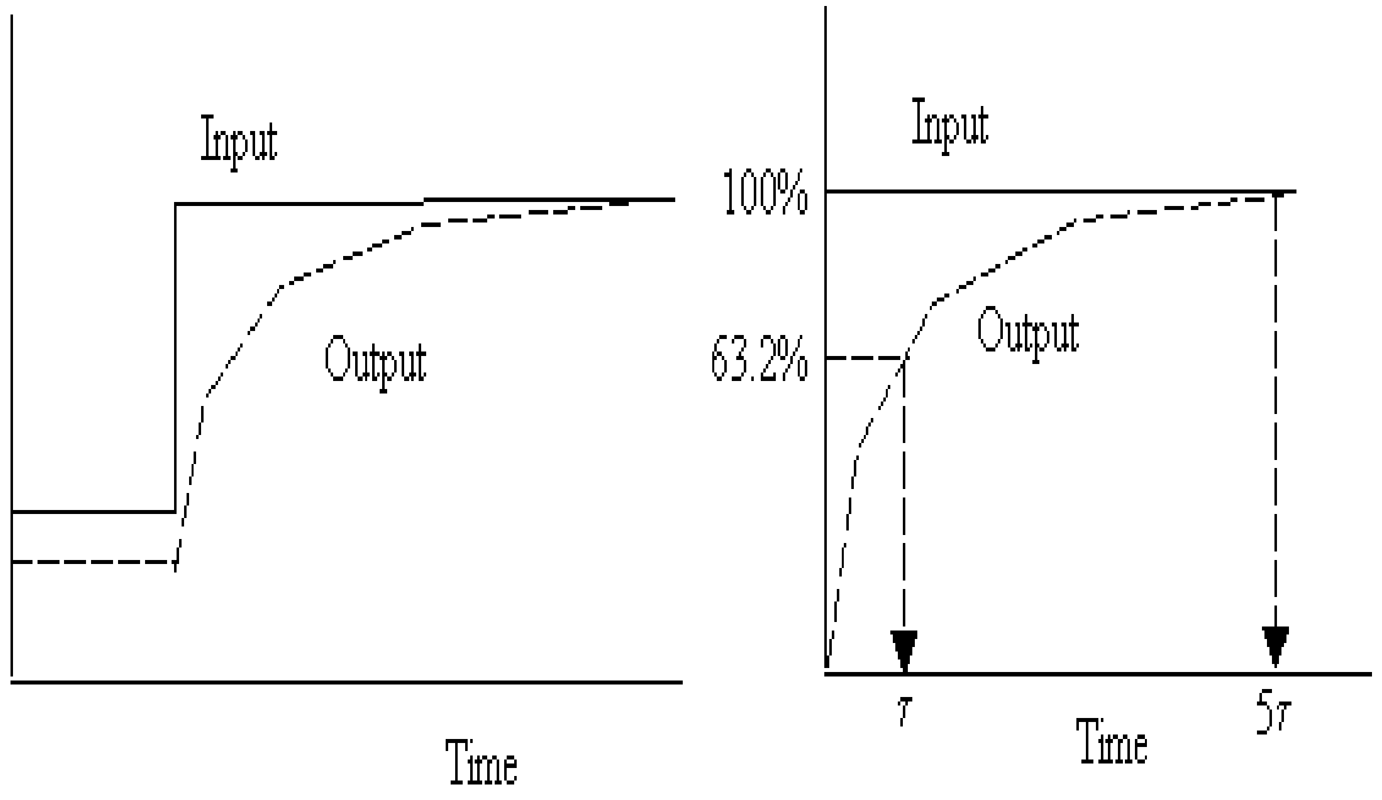
This equation is normally written as follows:

where τ=a/b and is the time constant in seconds

K=c/b and is the static sensitivity (units depending on application)

FIRST order performance

The form of the step response is shown as follows:



FIRST order performance

The above curve is an exponential rise to a final value. The equation that relates the output to time is as follows:

$$\theta_o = \theta_{initial} + (\theta_{final} - \theta_{initial})(1 - e^{-t/\tau})$$

where $\theta_{initial}$ is the steady state value before the step input is applied and θ_{final} is the steady state value after the step input is applied, i.e. after the exponential rise.

The time constant, τ, is the length of time for the output to reach 63.2% of its final value. It takes almost five time constants for the output to reach its final value.


Thank you