CHE 407 PROCESS CONTROL DERS NOTLAR[1-5]

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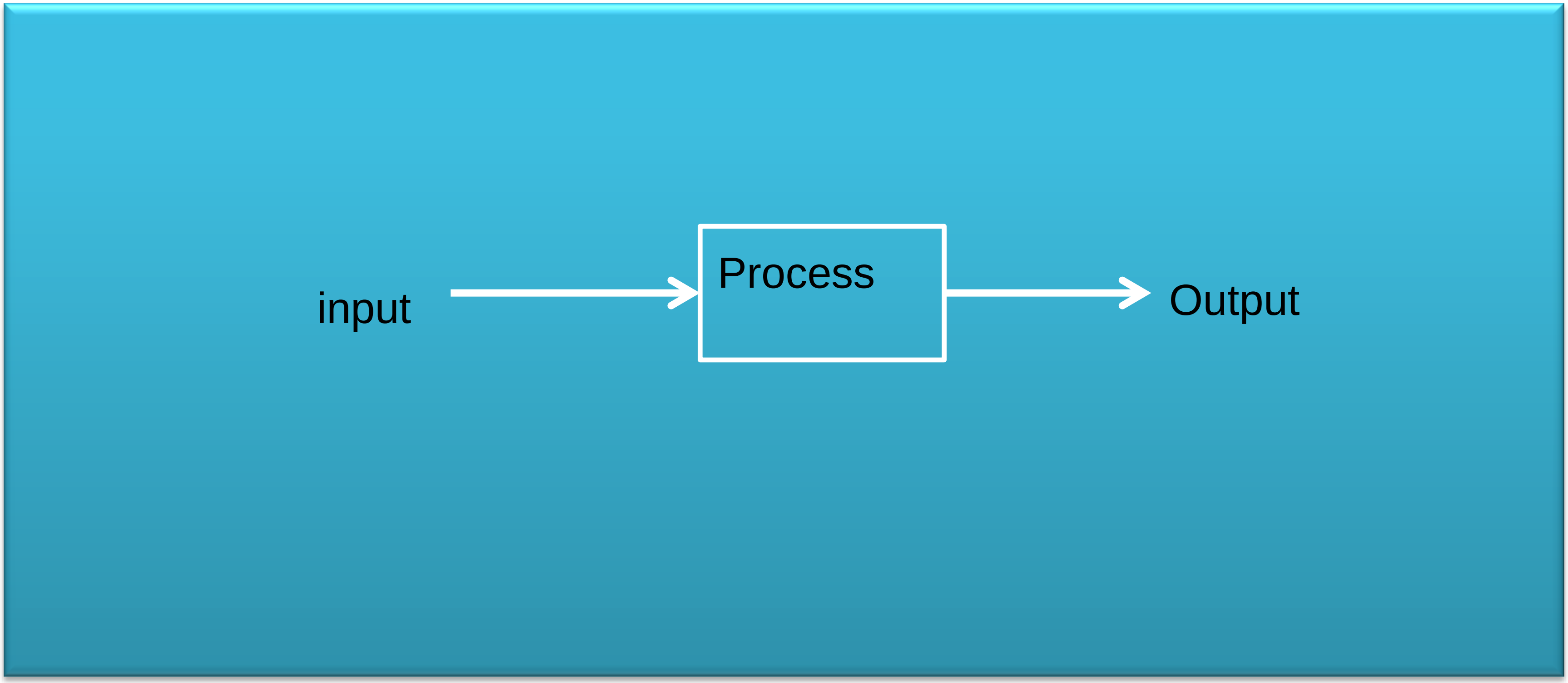
INTRODUCTION AND GENERAL CONCEPTS

Process Definition

A system with its known input and output variable is defined as a" **PROCESS**".

Block diagram



Block diagram of a system.

Mathematical models of systems:

The relation between the input and output variables of a system.

Two different equations are written

→ Steady state equations

→ Unsteady state equations

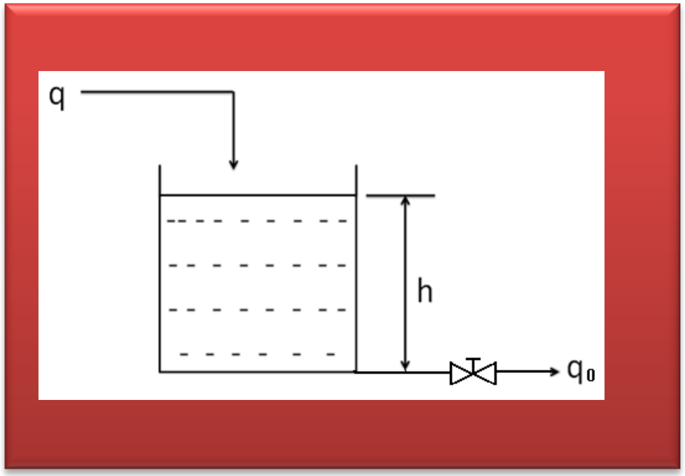
Steady state condition:

The input and output variables are constant (not changing with time)

Unsteady state condition:

The variables of system change over time

A liquid level system



Şekil. a liquid level system

The valve characteristics are

$$q_0 = Ch^3$$

where q0 = outlet flow rate (m3/min) and h = level above the valve (m). Consider the case where the steady state height is 1.5 m when the inlet flow rate is 0.55 m3/min.

Steady state $q_s - q_{0_S} = 0 \quad \rightarrow \quad q_s - Ch_s^3 = 0$

- Unsteady state $q - q_0 = A\frac{dh}{dt} \;\rightarrow\; q - Ch^3 = A\frac{dh}{dt}$
- Linearizing the nonlinear term, h^3, by means of a Taylor series expansion;
- $f(x) = f(x_s) + \left.\frac{df}{dx}\right|_{x_s}(x - x_s) + (higher\ order\ terms)$
- $h^3 = h_s^3 + 3h_s^2(h - h_s)$
- Substituting the linearized term into unsteady state equation;
- Unsteady state $q - C(h_s^3 + 3h_s^2(h - h_s)) = A\frac{dh}{dt}$
- Unsteady state - Steady state $(q - q_s) - C(h_s^3 + 3h_s^2(h - h_s) - h_s^3) = A\frac{d(h-h_s)}{dt}$
- $(q - q_s) - 3Ch_s^2(h - h_s) = A\frac{d(h-h_s)}{dt}$

- Introducing deviation variables;
- $q - q_s = Q \;\; ; \quad h - h_s = H$
- $Q - 3Ch_s^2 H = A\frac{dH}{dt}$
- $A\frac{dH}{dt} + 3Ch_s^2 H = Q$
- $\frac{A}{3Ch_s^2}\frac{dH}{dt} + H = \frac{1}{3Ch_s^2}Q$
- $\tau\frac{dH}{dt} + H = RQ$