MODELS & REPRESENTATIONS

Systems in the real world are physical entities or processes that can be described using mathematical models.

WHY MODELS?

To predict and analyze system behavior under various conditions

TIME DOMAIN RESPONSE

INITIAL CONDITIONS

The system's behavior starting from a non-zero state.

STEP

The system's reaction to a sudden change, typically from zero to one.

GENERAL INPUT

How the system reacts to any variable input over time

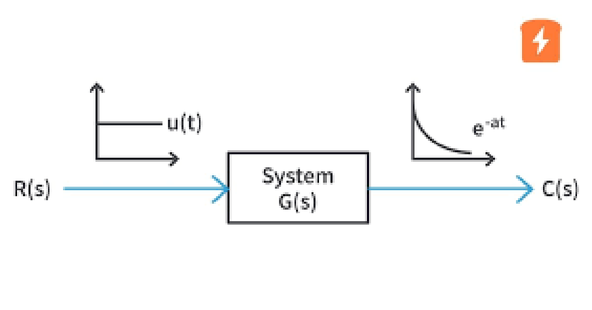
REPRESENTING THE SYSTEM

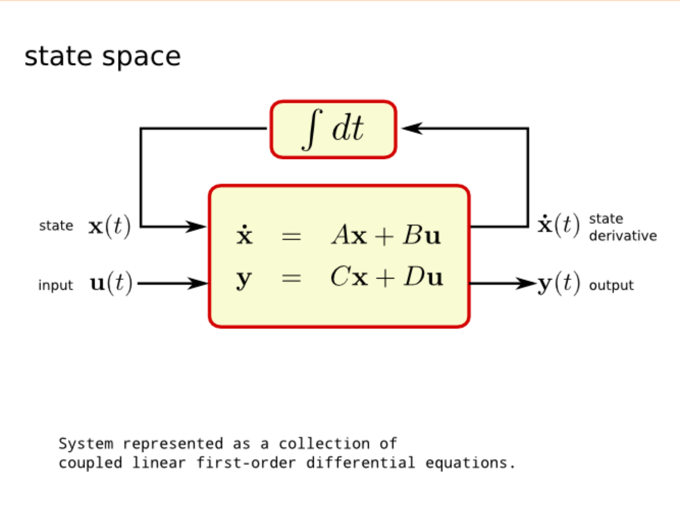
Solve the differential equation

$$\frac{d^2x}{dt^2} + 4\frac{dx}{dt} + 13x = 0$$

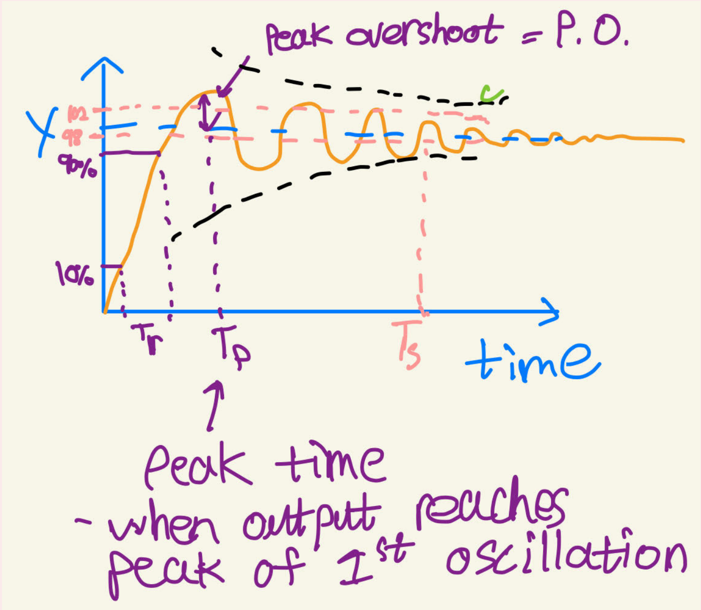
with initial conditions

$$x(0) = 1$$
$$x'(0) = 0$$





SYSTEM CHARACTERISTICS



Stability is the ability of a system to return to its steady state after a disturbance.

Settling Time is the time taken for the response to reach and stay within a certain range of the final value.

Rise Time is the time taken for the response to go from 10% to 90% of its final value.

POLES AND ZEROS

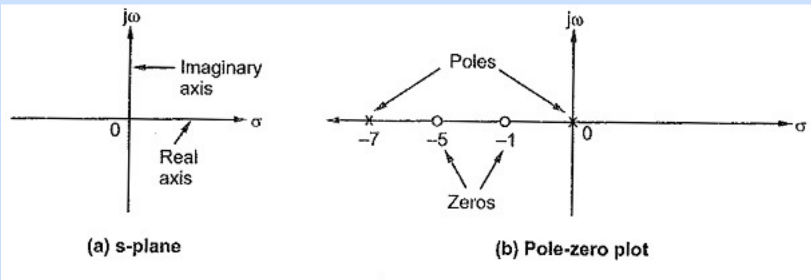


Fig. 3.14

Poles are values of s that cause the system's transfer function to become infinite.

Zeros are values of s that cause the system's transfer function to be zero.

S-Plane is a graphical representation of complex poles and zeros in a system's transfer function.