

## Module 1 - Introduction

ME3050 - Dynamic Modeling and Controls

Mechanical Engineering

Tennessee Technological University

### Topic 1 - What is System Dynamics?

## Topic 1 - What is System Dynamics?

- Welcome Back!
- Definition of Dynamics
- Modeling and Analysis
- Model Based Design

## Welcome to New Video topics

*Welcome Back!*

- Things are going to be different but we will still learn!
- These new outlines should help keep me/us on track.
- The material will be organized in  $\sim 10$  min videos, and you can watch them at anytime.

# Definition of Dynamics

Dynamics is ...

the study of how moving objects behave,

or

an area of mechanics that studies movement and its causes,

or

*system dynamics* is the study of **modeling** and **analysis** of dynamical systems as a function of time.

# Dynamics vs System Dynamics

Dynamics: find state of object at a specific instant in time

System Dynamics: find state of system as a function of time

→ Leads to use of differential equations.  $m\ddot{x} + c\dot{x} + kx = f(t)$

# What is Mathematical Modeling?

A mathematical model is a description of a system using mathematical concepts and language. The process of developing a mathematical model is termed mathematical **modeling** ...

... used in the natural sciences and engineering disciplines ... [Wikipedia](#)

- Model Simplification
- Force and Loading Analysis with FBDs
- Fundamental Laws Lead to Equations of Motion
- Newton's Second Law and Conservation of Energy

# What is Analysis?

**Analysis** is the process of breaking a complex topic or substance into smaller parts in order to gain a better understanding of it...

Wikipedia

- Study Model to find System Response
- Time-Domain analysis: examine system response in time to various inputs and initial conditions
- Frequency-Domain analysis: examine system response when subject to sinusoidal inputs

# Model Based Design

Model-Based Design (MBD) is a mathematical and visual method of addressing problems associated with designing complex control, signal processing and communication systems. It is used in many motion control, industrial equipment, aerospace, and automotive applications... [Wikipedia](#)



Image: Wikipedia



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