Lecture Module - Introduction

ME3050 - Dynamics Modeling and Controls

Mechanical Engineering

Tennessee Technological University

Module 1 - Introduction

Module 1 - Introduction

- Topic 1 - System Dynamics
- Topic 2 - Units and Conversions
- Topic 3 - Models and Assumptions

Topic 1 - System Dynamics

- Definition of Dynamics
- Modeling and Analysis
- Model Based Design
- Course Topics

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

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

Modeling and Analysis

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

Modeling and 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

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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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Image: Wikipedia

Model Based Design

Model Based Design

Course Topics

Course Topics

Topic 2 - Units and Conversions

- Standard Units
- Unit Conversions
- Frequency and Circular Frequency
- Example - Units Matter

Standard Units

Standard Units

Unit Conversions

Frequency and Circular Frequency

Frequency and Circular Frequency

Frequency and Circular Frequency

Example - Units Matter

Example - Units Matter

Topic 3 - Models and Assumptions

- Mathematical Modeling
- Solid Mechanics and Dynamics
- Thermal and Fluid Systems
- Electrical and Power Systems

Mathematical Modeling

Mathematical Modeling

Solid Mechanics and Dynamics

Thermal and Fluid Systems

Thermal and Fluid Systems

Electrical and Power Systems

Electrical and Power Systems