ME 3001 Lecture - Introduction to Analysis

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- ## What is analysis? What is this class about?

  "detailed examination of the elements or structure of something, typically as a basis for discussion or interpretation."

- ## How does it apply to mechanical engineering?

  "mathematical modeling of engineering systems and the theoretical and numerical solutions to non-linear equations, systems of linear equations, and ordinary and partial differential equations"

  "mathematical methods for solving mechanical engineering problems with modern computing tools"

- ## What areas of engineering will we cover?

  - Statics and Mechanics
  - Rigid Body Dynamics
  - Fluid Dynamics
  - Thermodynamics and Heat Transfer
  - Vibrations

- **We will be doing some mathematics in this class!**
  - Algebra and Arithmetic
  - Matrix/Linear Algebra
  - Calculus
  - Ordinary and Partial Differential Equations
  - The Fourier Series
- **This class is different than a traditional mathematics class.**
  - By nature engineering problems are hard to solve on paper.
  - So, will be using calculators but we will also be using...
  -
- **Modern Computing Tools**
  -
  -
  -

- **Main Topics to be Covered**

Mathematical Modeling of Engineering Problems Involving:

1. Solutions to Non-Linear Equations

   - Rigid Body Dynamics
   - Optimization and Design

2. Solving Systems Linear Equations

   - Statics and Structural
   - Equilibrium Equations
   - The Eigenvalue Problem
   - Mechanisms and Machines

3. Ordinary Differential Equations

   - Rigid Body Dynamics
   - Thermodynamics and Heat Transfer
   - Electronics and Circuits

4. Partial Differential Equations

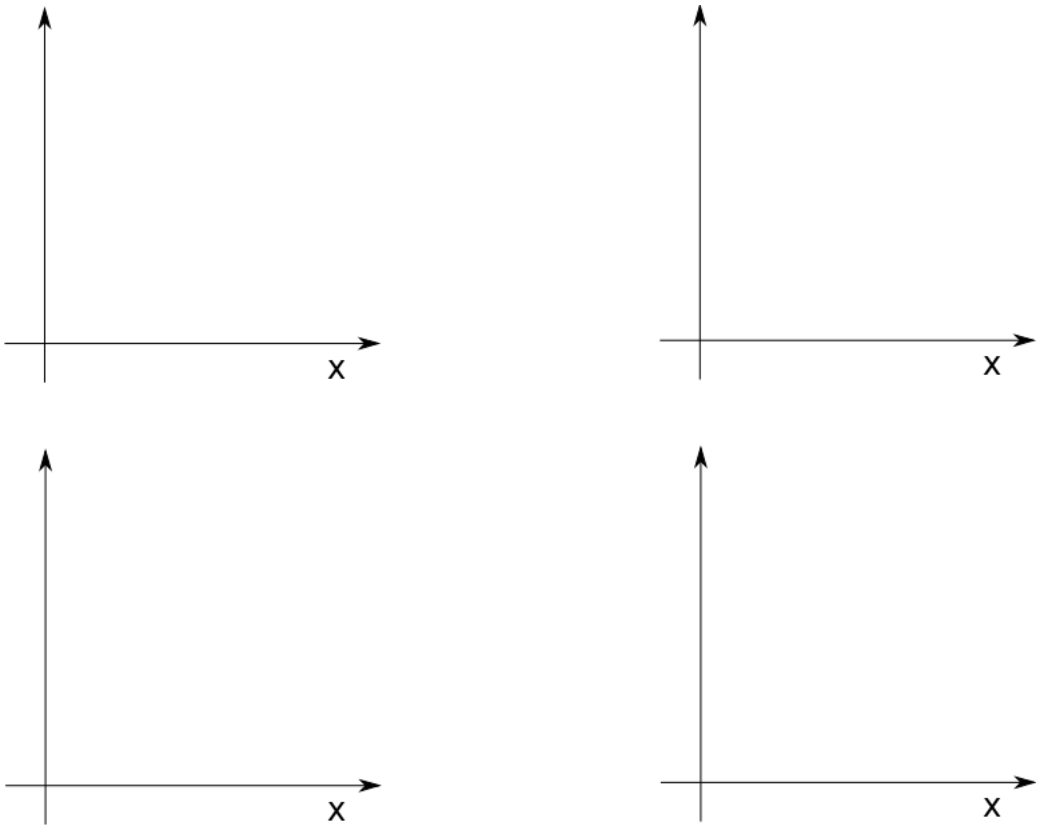
   - Fluid Dynamics
   - Thermodynamics and Heat Transfer

1. Solutions to Non-Linear Equations

- What is a non-linear equation?

- What does it mean to solve a non-linear equation?

- Standard form of this problem:



2. **Solving Systems Linear Equations**

- What is a system of linear equations?

- What does it mean to solve a system of linear equations?

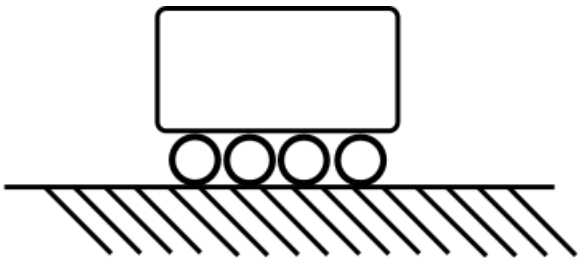
- A very simple example:

3. **Ordinary Differential Equations**

- What is a Differential Equations? What about a system of them?

- What does it mean to solve a differential equation?

- A very simple example:



ODE:

Solution:

4. **Partial Differential Equations**

- What is different about a Partial Differential Equation?

- What is different about the solution to a PDE?

- What does this allow us to do?