Lecture Module - Introduction and MATLAB Review

ME3001 - Mechanical Engineering Analysis

Mechanical Engineering

Tennessee Technological University

Module 1 - Introduction and MATLAB Review

Module 1 - Introduction and MATLAB Review

- Topic 1 - Solving Non-Linear Equations
- Topic 2 - The Newton-Raphson Method, Secant Method
- Topic 3 - The Bisection Method

Topic 1 - Solving Non-Linear Equations

- What is a Non-Linear Equation ?
- Solving Non-linear Equations
- Analytical vs. Numerical Methods
- Example

What is a Non-Linear Equation ?

Different Types of Non-Linear Equations

- **Polynomials (excluding first order)**
- **Transcendentals**

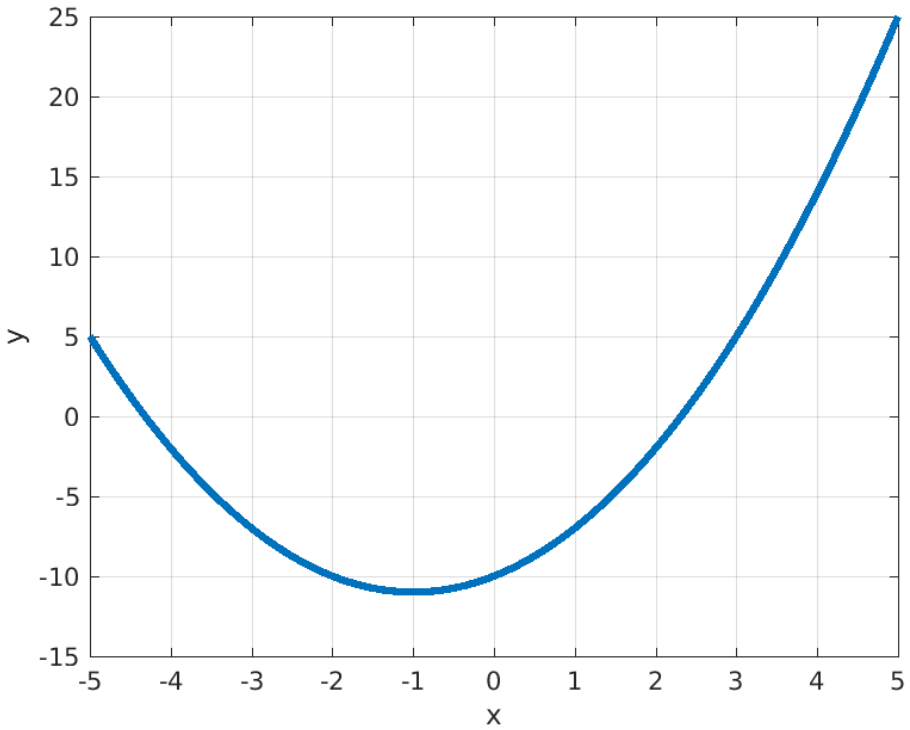
  " a transcendental function "transcends" algebra in that it cannot be expressed in terms of a finite sequence of the algebraic operations of addition, multiplication, and root extraction. Examples of transcendental functions include the exponential function, the logarithm, and the trigonometric functions. "
  - Exponentials
  - Logarithms
  - Trigonometrics

What is a Non-Linear Equation ?

Solving Non-linear Equations

Example: Solve the following equation.

$$y = x^2 + 2x - 10$$



Solving Non-linear Equations

Defintion of **Solution**

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- -
- -

Analytical vs. Numerical Methods

Analytical

- solution to a problem that can be written in **closed form**
- solution in terms of known functions, constants, etc.
- gives an **exact answer**

Numerical

- an **approximation** to the solution of a mathematical equation
- iterative procedure or algorithm
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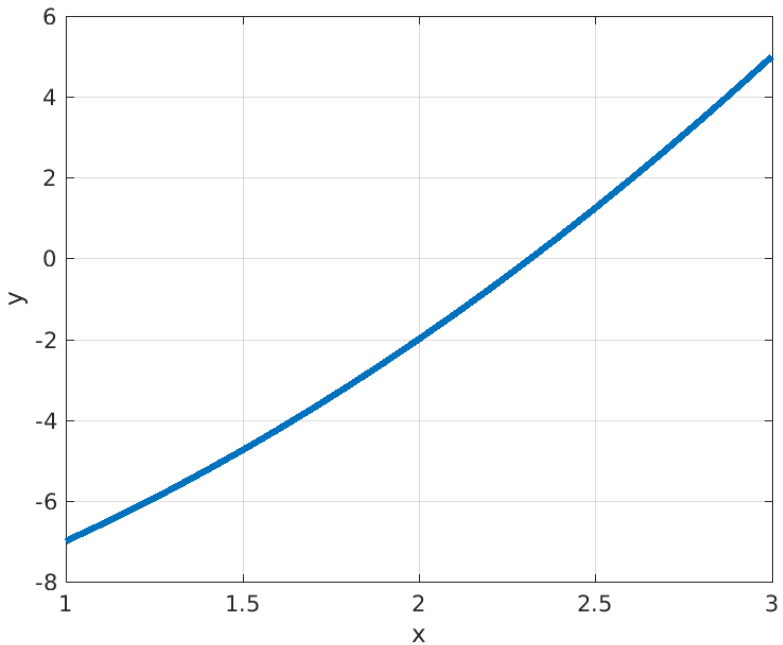
Example

We are looking for where the line crosses the x-axis, so how can we tell where this happens?

$$y = x^2 + 2x - 10$$



Topic 2 - The Newton-Raphson Method, Secant Method

- Classification of Methods
- Taylor Series Derivation
- The Newton Raphson Method
- The Finite Difference
- Modified Newton-Raphson, Secant Method
- Algorithm Comparison

Classification of Methods

Taylor Series Derivation

The Newton Raphson Method

The Newton Raphson Method

The Newton Raphson Method

The Newton Raphson Method

The Finite Difference

Topic 3 - The Bisection Method

- Analytical vs. Numerical
- A Bracketing Method: Graphical Explanation
- Algorithm Description

Analytical vs. Numerical

Analytical vs. Numerical

A Bracketing Method: Graphical Explanation

Algorithm Description

Algorithm Description

Algorithm Description

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Algorithm Description

Topic 3 - Mechanical Design Problem

- Problem Statement
- Mathematical Model
- Solution Approach
- Design

Problem Statement

Problem Statement