

MECH 306: Equation Solving Techniques

Catalog description: 4.0 units

Numerical analysis, analytical methods, and equation solving techniques for mechanical engineering design. Structured problem formulation, parametric studies, introduction to programming concepts, and optimization for design. 3.0 hours discussion, 2.0 hours activity.

Prerequisites: MATH 260

Recommended: PHYS 204A

Course objectives: For students to learn how to

1. Apply a range of numerical methods for solving algebraic and differential equations that occur in engineering analysis and design
2. Apply computer programming concepts to implement a number of numerical methods for solving algebraic and differential equations
3. Use equation-solving software to solve algebraic and differential equations methods

Course outcomes: Using current mechanical engineering tools (Matlab[®]/Excel[®]) students shall be able to

1. Numerically solve for roots of non-linear algebraic equations
2. Numerically solve a system of linear algebraic equations
3. Obtain coefficients of an interpolating polynomial
4. Perform numerical integration and differentiation on discrete data
5. Numerically or symbolically solve first-order ordinary differential equations
6. Numerically or symbolically solve higher-order Initial-Value or Boundary-Value ordinary differential equations

Topics covered

1. Fixed-point iteration, Bi-section, False-position, Newton-Raphson, and Secant Methods
2. Cramer's rule, Gauss elimination, Jacobi, and Gauss-Seidel
3. Lagrange and Newton's divided-difference interpolating polynomials
4. Linear and polynomial regression
5. Numerical differentiation formulas
6. Rectangular, trapezoidal, and Simpson's rules; Romberg integration, Gauss quadrature
7. Euler and Runge-Kutta methods

Class/Laboratory schedule

One hundred fifty minutes of lecture and one hundred minutes of activity per week

Contribution of course to meet the professional component

This course contributes to the student's ability to apply advanced mathematics.

Relationship of course to Mechanical Engineering Program Outcomes

This course contributes principally to Program Outcomes A and D. Students must achieve a grade of C or better in the portion of the course devoted to Matlab[®] to pass the course and satisfy Program Outcome D.