

Course Outline

ENME 602 – Numerical Analysis

Lecturer:

Dr. Hesham Hamed Ibrahim

Associate Professor- Mechatronics Department

Teaching Assistants:

Instructor Office Hours:

Course Schedule:

Tutorials: as scheduled

Course Type:

Lectures & Tutorials

Prerequisites:

MATH-103, MATH-203, and MATH-301

I. Course Description

This course is the 6th semester course of mathematics. The course aims to introduce numerical methods based on the knowledge of the basic courses MATH-103, MATH-203, and MATH-301. The material discussed is related to numerical procedures like interpolation, root-finding methods, numerical integration, numerical solution of linear systems of equations, numerical solutions of differential equations. The course will explain the different numerical methods and review the related mathematical terms. The collection of methods to deal with practical problems is a major goal of the course. The discussed numerical methods will allow students to solve practical problems in engineering.

II. Learning Outcomes of the Theoretical Part of the Course

By the end of the theoretical part, the student will be able to:

Knowledge & Understanding

1. Recognize numerical solution methods for different types of problems.
2. Identify numerical solution strategies.
3. Recognize methods of approximation.
4. Identify solution methods for linear systems of equations.

Intellectual skills

5. Differentiate between numerical methods.
6. Formulate and analyze simulation- and modeling problems.
7. Categorize numbers and errors occurring on computers.
8. Approximate functions and interpolate function values.
9. Integrate functions numerically using different effective methods.
10. Find roots of equations and systems of equations by different methods.
11. Solve linear systems of equations.
12. Solve ordinary differential equations by different methods.
13. Solve boundary value problems.

Professional & Practical skills

14. Numerical calculations in any kind of application and awareness of problems in any numerical work.
15. Student should know how they can effectively use a computer for numerical calculations.

III. Course Contents

Wk	Topic
1	<ul style="list-style-type: none">- Introduction- Round of Errors and Computer Arithmetic
2	<ul style="list-style-type: none">- Algorithms and Convergence- Roots of Non-linear Equations:<ul style="list-style-type: none">• Bisection Method
3	<ul style="list-style-type: none">- Roots of Non-linear Equations:<ul style="list-style-type: none">• Newton's Method and Its Extensions• Fixed-Point Iteration Method
4	<ul style="list-style-type: none">- Interpolation and Polynomial Approximation<ul style="list-style-type: none">• Lagrange Interpolation• Newton Divided Differences
5	<ul style="list-style-type: none">- Interpolation and Polynomial Approximation<ul style="list-style-type: none">• Newton Divided Differences• Hermite Interpolation
6	<ul style="list-style-type: none">- Linear Systems: Iterative Methods<ul style="list-style-type: none">• Jacobi Technique• Gauss-Seidel Technique
7	<ul style="list-style-type: none">- Linear Systems: Iterative Methods<ul style="list-style-type: none">• Gauss-Seidel Technique• Error Bounds
8	<ul style="list-style-type: none">- Numerical Integration
9	<ul style="list-style-type: none">- Numerical Integration
10	<ul style="list-style-type: none">- Numerical Solution of Differential Equations<ul style="list-style-type: none">• Euler Method• Runge Kutta Method
11	<ul style="list-style-type: none">- Boundary value problems<ul style="list-style-type: none">• Finite Difference Method for linear Problems
12	<ul style="list-style-type: none">- Minimization Problems<ul style="list-style-type: none">• Least Squares Approximation

IV. Course Material

Recommended Textbooks:

- Richard L. Burden and J. Douglas Faires, *Numerical Analysis*, Brooks/Cole CENGAGE Learning, 9th Edition. ISBN: 978-0-538-73564-3.
- G. Baumann (2010). *Mathematics for Engineers IV: Numerics*. Munich: Oldenbourg. ISBN: 978-3-486-59042-5.
- S.C. Chapra and R.P. Canale (2003). *Numerical Methods for Engineers*. Boston: McGraw Hill. ISBN: 0073101567.

V. Methods of Instruction

One lecture per week, and weekly tutorials which will have in-class exercises and assignments.

VI. Assessment and Attendance Policy

Course Assessment:

Home and Class work	10 %
3 Quizzes (best 2)	20 %
Mid Term Exam	30 %
Final Examination	40 %

Please note the following rules:

- Assignments and project reports will be handed-in before deadline; no late reports will be accepted.
- Assignments will be submitted to the TA through the e-mail
- There will be NO makeup examinations for students not attending the Quizzes.

Attendance policy:

- The attendance policy for the lectures, tutorials and exams follow the university rules and policies.