Department of Mathematics
Course syllabus
March, 2019

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Website:	`https://elearning.amu.edu.et/course/view.php?id=279`
Learner:	Second year Civil& Metal G2A
Course:	Numerical method
Course code:	Math 2073
Pre-requisite:	Computer Programming(Comp2064)
Credit Hours:	5 ECTS
Academic year:	$2019/2^{nd}$ semester

Course Objective

At the end of the course students will be able to:

- Identify and estimate computational errors;
- Solve systems of linear and non-linear equations;
- Compute data fitting
- Perform numerical differentiation and integration;
- Examine numerical solution differential equations.

Course Learning Outcomes

1. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
2. Apply numerical methods to obtain approximate solutions to mathematical problems.
3. Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
4. Analyse and evaluate the accuracy of common numerical methods.
5. Implement numerical methods in Matlab.
6. Write efficient, well-documented Matlab code and present numerical results in an informative way.

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1. **Basic Concepts in Error Estimation**
    - 1.1 Mathematical Modeling
    - 1.2 Errors and Approximations in Computation
    - 1.3 Types of Errors
    - 1.4 Introduction to MatLab
2. **Numerical Solutions of Non-linear Equation**
    - 2.1 Bisection Method
    - 2.2 Fixed point Iteration Method
    - 2.3 Newton Raphson Method
    - 2.4 Secant Method
3. **Solving System of Equations**
    - 3.1 Direct method review
    - 3.2 LU decomposition method
        - 3.2.1 Crout's and Doolittle's decomposition method
        - 3.2.2 Chelosky decomposition method
    - 3.3 Indirect (Iterative) method
        - 3.3.1 Jacobi's method
        - 3.3.2 Gauss-Seidel method
    - 3.4 Eigen value Problem
        - 3.4.1 Power method
        - 3.4.2 Inverse Power Method
    - 3.5 System of non-linear equations
        - 3.5.1 Newton Raphson method
        - 3.5.2 General fixed point Iteration method
4. **Interpolation**
    - 4.1 Newton's forward interpolation formula
    - 4.2 Newton's backward interpolation formula
    - 4.3 Lagrange's interpolation formula
    - 4.4 Newton's divided difference interpolation formula
    - 4.5 Spline interpolation
5. **Least Square Method**
    - 5.1 Linear least square method
    - 5.2 Non-linear least square method(exponential and polynomial)
    - 5.3 Continuous least square method
6. **Numerical Differentiation and Integration**
    - 6.1 Numerical Differentiation
    - 6.2 Numerical Integration
        - 6.2.1 Newton cotes quadrature formula
            - 6.2.1.1 Trapezoidal rule
            - 6.2.1.2 Simpson's rules

6.2.4 Gauss quadrature

6.2.5 Romberg's Integration

7. **Numerical solutions of differential equation**

   7.1 Euler's method

   7.2 Modified Euler's method

   7.3 Runge-Kutta method

Assessment Method

1. Continuous assessment 60% (i.e, test+quiz+project+assignment)
2. Final exam 40%
3. Attendance requirement: minimum 80%

References

1. Richard L. Burden, Numerical Analysis, 2016, 10th Ed.
2. Erwin Kreyszig (2010), Advanced Engineering mathematics, 9th edition.
3. Chapra C.S. and Canale P.R. (2015), Numerical Methods for Engineers with Programming and Software Application, 7th edition, McGraw-Hill Education.
4. Jaan Kiusalaas(2005). Numerical Methods in Engineering with MATLAB, Cambridge University Press.