Course Title: Numerical Methods with Computer Programming

Course Code: MATH-406

Course Type: Major Math

Prerequisites: Numerical Analysis & Computational Tools

Credit Hours: 3 (3 + 0)

Course Objectives: After the completion of the course, students will be able to:

- Extend knowledge of numerical methods to differential equations, difference equations and advanced integration techniques.
- Explore numerical differentiation and integration.
- Understand ordinary differential equations using numerical methods.
- Study the formulation and solution of difference equations.
- Apply numerical methods to solve ordinary differential equations.

Course Contents:

Numerical Differentiation: Derivatives using Lagrange's interpolation formula, Newton's divided difference formula, Gregory Newton's forward/backward interpolation formula, Gauss's forward/backward interpolation formula, Stirling's formula, Laplace Everett's formula, Bessel's formula.
Lab Work: In MATLAB / Mathematica / Python.

Numerical Integration: Newton-Cotes formulae,Trapezoidal rule, Simpson rule, Weddle's rule, Boole's rule, Errors in quadrature formulae, Gaussian quadrature formulae.
Lab Work: In MATLAB / Mathematica / Python.

Formulation of Difference Equations: Analogy of difference equations, Linear homogeneous difference equations with constant coefficients, Linear non-homogeneous difference equations with constant coefficients.

Numerical Methods for Ordinary Differential Equations: Solutions of first order differential equations, Simultaneous first order differential equations, Higher order differential equations using Taylor's series method, Euler's method, Improved Euler's method, Modified Euler's method and Runge-Kutta methods, Predictor-corrector methods for solving initial value problems.
Lab Work: In MATLAB / Mathematica/ Python.

Recommended Books:

1. Burden, R. L. and Faires, J. D., *Numerical Analysis*, Cengage Learning, 10th edition, 2015.
2. Chapra, S. C. and Canale, R. P., *Numerical Methods for Engineers*, McGraw Hill, 7th edition, 2014.
3. Gerald, C. F. and Wheatley, P. O., *Applied Numerical Analysis*, Pearson College Div., 7th edition, 2003.

4. Mathews, J. H., *Numerical Methods for Mathematics*, Pearson College Div., 1992.

5. Vedamurthy, V. N. and Iyenger, N. Ch. S. N., *Numerical Methods*, Vikas Publishing House Pvt. Ltd, 2002.

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