Course Title	**:**	**Numerical Methods and Computation**
Course Code	**:**	**MAB251**
Number of Credits	**:**	**(3-0-2) 4 Credits**
Prerequisites (Course code, if available)	**:**	
Course Type	**:**	

Course Objectives

To explore complex systems, physicists, engineers, financiers and mathematicians require computational methods since mathematical models are only rarely solvable algebraically. Numerical methods, based upon sound computational mathematics, are the basic algorithms underpinning computer predictions in modern systems science. The course will cover the classical fundamental topics in numerical methods such as, approximation, numerical integration, numerical linear algebra, solution of nonlinear algebraic systems and solution of ordinary differential equations.

Course Contents

Principles of floating point computations and rounding errors. Solutions of nonlinear equations: Bisection method, Newton's method and its variants, fixed point iterations, convergence analysis; Newton's method for non-linear systems. Solution of linear systems: Gauss elimination, Gauss Jordan, LU decomposition, Cholesky method, Iterative methods and their convergence analysis. Interpolation: Polynomial interpolation, Hermite interpolation, spline interpolation, error estimates. Numerical differentiation: Based on interpolation, the method of undetermined coefficients, Richardson extrapolation, Error estimates. Numerical integration: Based on interpolation, quadrature methods, Gaussian quadrature, Error estimates. Initial value problems: Taylor series method, Euler and modified Euler methods, Runge-Kutta methods, multistep methods, stability and convergence analysis. Eigen-value approximation - Powers method, Jacobi’s method.

Laboratory component: Implementation of algorithms developed in this course in MATLAB/C/C++.

Texts/References

1. D. Kincaid and W Cheney, *Numerical Analysis: Mathematics of Scientific computing*, 3rd edition AMS, 2002.
2. K. E. Atkinson, *An Introduction to Numerical Analysis*, John Wiley and Sons, 1989.
3. R.L. Burden, J.D. Faires, *Numerical Analysis*, 6th Edition, Cole Publishing company, 1987.
4. J. Stoer and R. Bulirsch, *Introduction to Numerical Analysis*, 2nd ed., Texts in Applied Mathematics, Vol. 12, Springer Verlag, New York, 1993.

Course outcomes

At the end of the course student would demonstrate competence with understanding the theoretical and practical aspects of the use of numerical methods. They would be able to establish the limitations, advantages, and disadvantages of different numerical methods. Further, they would be able to implement numerical methods for solving various engineering problems.