Department of Mathematics
Faculty of Mathematics & Computer Science
M.Sc. (Applied Mathematics), 2nd Semester

Course Code	AM 202
Course Name	Numerics of Ordinary Differential Equations
Course Credits	04

Course objectives:

To give exposure of the fundamental concepts, theoretical basis and application of numerical techniques to solve ordinary differential equations. To provide students with the technical tools enabling them to solve ordinary differential equation, which arises in the modeling of real life phenomena.

Minimum pre-requisites:

AM 102 (Numerical Analysis and Methods)
AM 103 (Ordinary Differential Equations and Applications)

Course structure:

An Overview: Picard & Taylor series methods; Euler's method, midpoint method.

Runge-Kutta methods: Convergence analysis of the general explicit one-step method, derivation of classical Runge-Kutta methods, Runge-Kutta methods of order greater than four, error bounds and estimates for Runge-Kutta methods, weak stability theory for Runge-Kutta methods, implicit Runge-Kutta methods.

Linear mulitistep methods: Construction of linear multistep methods, Convergence, Order and error constant, Local and global truncation error, Consistency and zero-stability, maximum order of zero-stable methods, specification of linear multistep methods. Problems in applying linear multistep methods, starting values, a bound for the local and global truncation error, weak stability theory, the Schur criterion, the Routh-Hurwitz criterion, comparison of explicit and implicit linear multistep methods, predictor-corrector methods, absolute stability and accuracy of predictor-corrector methods.

Stiff Problems: Stability numerical methods for stiff systems, backward differentiation methods for stiff systems, Gear’s method.

Boundary Value Problems: Introduction to Shooting, Finite difference, Collocation and finite element methods for the boundary value problems for second order ordinary differential equations.

Reading suggestions:

- J.D. Lambert, Computational Methods in Ordinary Differential Equations. Wiley, Chichester, 1991.
- H.B. Keller, Numerical Methods for Two-point Boundary Value Problems. SIAM, Philadelphia, 1976.
- E. Hairer, S.P. Norsett, and G. Wanner, Solving Ordinary Differential Equations I: Nonstiff Problems. Springer-Verlag, Berlin, 1987.
- P. Henrici, Discrete Variable Methods in Ordinary Differential Equations. Wiley, New York, 1962.
- K.W. Morton, Numerical Solution of Ordinary Differential Equations. Oxford University Computing Laboratory, 1987.
- J.C. Butcher, The Numerical Analysis of Ordinary Differential Equations, Wiley, New York 1987.
- L.F. Shampine, Numerical Solution of Ordinary Differential, Equations, Chapman and Hall, London 1994.
- C.W. Gear, Numerical Initial Value Problems in Ordinary Differential Equations, , Prentice-Hall, Englewood Cliffs, NJ 1973.

Evaluation and weightage:

- 30% for Computer practicals
- 10% for Quiz
- 20% for Mid-Term examination
- 40% for End-Term examination