



**MANGALORE UNIVERSITY**  
DEPARTMENT OF MATHEMATICS  
MSC MATHEMATICS

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| <b>MTS 505</b> | <b>Advanced Numerical Analysis</b> | <b>4 Credits (48 hours)</b> |
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**Prerequisite:** Knowledge of syllabus prescribed for the course MTS 404 (Numerical Analysis).

**Course Outcome:** Students will have the knowledge and skills of Numerical Integration, Numerical solutions of Ordinary Differential Equations, Solving systems of Linear Differential Equations.

**Course Specific Outcome:** At the end of the course Students will have the knowledge and skills to understand, explain in depth and apply in various situations the concepts -

- To use different quadrature rules for computing the approximate value of definite integrals
- To use different numerical techniques to solve ordinary differential equations with initial and boundary conditions.
- To use different methods to find numerical solution of second order partial differential equations.

### Unit I - Numerical Integration:

Recapitulation of the methods based on interpolation, Methods based on undetermined coefficients. Romberg integration, Gauss-Legendre integration methods, Gauss-Chebyshev integration methods, Gauss-Laguerre integration methods, Gauss-Hermite integration methods. Double integration, Trapezoidal rule, Simpson's rule.

**(15 Hours)**

### Unit II - Ordinary Differential Equations:

Introduction, Numerical methods, Euler method, Backward Euler method, Mid-point method, Single step methods, Taylor series method, Runge-Kutta methods, Multistep methods, Determination of  $a_j$  and  $b_j$ , Predictor-corrector methods, Boundary value problems, Finite difference methods, Trapezoidal, Dahlquist and Numerov methods.

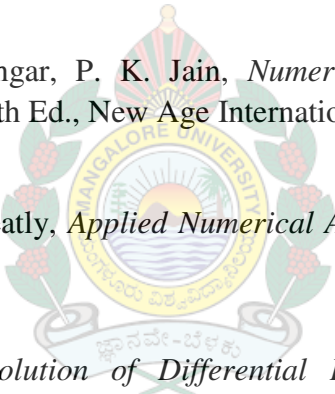
**(15 Hours)**

### Unit III - Systems of Linear Differential Equations:

Introduction, Difference methods, Parabolic equations in one space dimension, Schmidt formula, Du Fort-Frankel scheme, Crank-Nicolson and Crandall schemes, Solution of hyperbolic equation in one dimension by explicit schemes, The CFL condition, Elliptic equations, Dirichlet problem, Neumann problem, Mixed problem.

(18 Hours)

### References

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- [1] M. K. Jain, S. R. K. Iyengar, P. K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 6th Ed., New Age International, 2012.
- [2] C. F. Gerald and P. O. Wheatly, *Applied Numerical Analysis*, Pearson Education, Inc., 1999.
- [3] M. K. Jain, *Numerical Solution of Differential Equations*, 2nd Ed., New Age International (P) Ltd., New Delhi, 1984.

A. R. Mitchell, *Computational Methods in Partial Differential Equations*, John Wiley and Sons, Inc., 1969.