Course Syllabi: UMA007 : Numerical Analysis (L : T : P :: 3 : 1 : 2)

1. **Course number and name**: UMA007 : Numerical Analysis

2. **Credits and contact hours**: 4.5 and 6

3. **Text book, title, author, and year**

   Text Books / Reference Books
   - *Curtis F. Gerald and Patrick O. Wheatley, Applied Numerical Analysis, Pearson, (2003) 7th Edition,*
   - *M. K. Jain, S .R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publishers (2012), 6th edition.*
   - *Steven C. Chappra, Numerical Methods for Engineers, McGraw-Hill Higher Education; 7^{th} edition (1 March 2014)*
   - *J. H. Mathew, Numerical Methods for Mathematics, Science and Engineering, Prentice Hall, (1992) 2nd edition,*
   - *Richard L. Burden and J. Douglas Faires, Numerical Analysis, Brooks Cole (2004), 8th edition.*
   - *K. Atkinson and W. Han, Elementary Numerical Analysis, John Willey & Sons (2004), 3rd Edition.*

   a. Other supplemental materials
      - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   Floating-Point Numbers: Floating-point representation, rounding, chopping, error analysis, conditioning and stability.
   Non-Linear Equations: Bisection, secant, fixed-point iteration, Newton method for simple and multiple roots, their convergence analysis and order of convergence.
   Linear Systems and Eigen-Values: Gauss elimination method using pivoting strategies, LU decomposition, Gauss-Seidel and successive-over-relaxation (SOR) iteration methods and their convergence, ill and well conditioned systems, Rayleigh's power method for eigen-values and eigen-vectors.
   Interpolation and Approximations: Finite differences, Newton's forward and backward interpolation, Lagrange and Newton's divided difference interpolation formulas with error analysis, least square approximations.
   Numerical Integration: Newton-Cotes quadrature formulae (Trapezoidal and Simpson's rules) and their error analysis, Gauss-Legendre quadrature formulae.
   Differential Equations: Solution of initial value problems using Picard, Taylor series, Euler's and Runge-Kutta methods (up to fourth-order), system of first-order differential equations.
   Laboratory Work: Lab experiments will be set in consonance with materials covered in the theory. Implementation of numerical techniques using MATLAB.

5. **Specific goals for the course**

   After the completion of the course, the students will be able to:
   - Understand the errors, source of error and its effect on any numerical computations and also analysis the efficiency of any numerical algorithms.

- Learn how to obtain numerical solution of nonlinear equations using bisection, secant, newton, and fixed-point iteration methods.
- Solve system of linear equations numerically using direct and iterative methods.
- Understand how to approximate the functions using interpolating polynomials.
- Learn how to solve definite integrals and initial value problems numerically.

6. Brief list of topics to be covered

- Floating-Point Numbers
- Non-Linear Equations
- Linear Systems and Eigen-Values
- Interpolation and Approximations
- Numerical Integration
- Differential Equations