Details of Course

Course Title	Course Structure			Pre-Requisite
MC 204 : Scientific Computing	L	T	P	Nil
	3	0	2	

Course Objective: The course will develop numerical methods aided by technology to solve algebraic, transcendental, and differential equations, and to calculate derivatives and integrals. The course will also develop an understanding of the elements of error analysis for numerical methods and certain proofs. The course will further develop problem solving skills.

Course Outcome (CO):

CO1	Apply numerical methods to obtain the errors and the approximate solutions to the linear and non-linear transcendental and polynomial equations.
CO2	Describe the Eigen value problems for the system of linear algebraic equations and analyze the applications.
CO3	Identify numerical methods for various mathematical operations and tasks, such as interpolation formulae like forward, backward, and divided difference formulae.
CO4	Apply the appropriate techniques for numerical differentiation and integration problems
CO5	Design the numerical solution of initial value problems of the ordinary differential equations with implicit and explicit methods as appropriate

S. No.	Contents	Contact hours
1.	Solution of Transcendental and polynomial equations: Types of error in numerical methods, significant digits, Bisection method, Fixed point iteration method, Secant method, Regula Falsi method, Newton - Raphson method and their convergence, Solution of system of nonlinear equations using Newton -Raphson method.	8
2.	System of Linear Algebraic equations and Eigen value problems: Ill conditioned equations, Methods for solving system of equations: Direct and Iterative methods, convergence of iterative methods, power method.	8
3.	Interpolation: Finite Difference operators and their properties, Interpolation of equal spacing intervals: Newton and Gauss forward and backward formula, Bessel's and Sterling Interpolation formulae, Interpolation of Unequal intervals: Newton's Divided difference Central difference formulae: Lagrange's method, Hermite interpolation, Piecewise and quadratic Spline Interpolation.	9

4.	Numerical Differentiation and Integration: Optimum choice of step length, Differentiation: formulae, derivatives with unequal intervals, Integration: Newton's Cotes formula, Gauss Quadrature formula, Trapezoidal formula, Simpson's $(1/3)^{rd}$ rule and error estimates, Method of undetermined coefficients, Romberg integration, Richardson Extrapolation.	8
5.	Numerical solution of ODE: Initial Value Problems: Picard's method, Taylor series method, Convergence of Numerical methods and Routh- Hurwitz criteria for stability, Euler's and Modified Euler's method, Classical Runge- Kutta method, Predictor- Corrector method, Milne's method, Adams- Moulton method.	8
	Total	42

Suggested Books:

S. No.	Name of Books/Authors/Publishers	Year of Publication
1	Numerical Methods for Scientific and Engineering Computation by M. K. Jain and S.R.K. Iyengar, New Age International Publishers.	2007
2	Applied Numerical Analysis, Gerald &Wheatley, Addison – Wesley.	2003
3	Elementary Numerical Analysis, S.D. Conte, & C. Deboor, Tata Mc- Graw hill.	2005
4	A First Course in Numerical Methods, By Uri Ascher, SIAM	2011
5	R. S. Gupta, Elements of Numerical Analysis, 2nd Edition	2015