Module Code	MA4053	Module Title	Numerical Analysis for Scientific Computing			
Credits	3	Hours/Week	Lectures	3	Pre – requisites	MA1032
			Lab/Assignments	0		

Learning Outcomes

After completing this module, the students should be able to

- understand a spectrum of advanced concepts in numerical analysis
- apply them to solve engineering and scientific problems

Outline Syllabus

Modeling, Computers, and Error Analysis

- Mathematical Modeling and Engineering Problem Solving
- Programming and Software
- Approximations and Round-Off Errors
- Truncation Errors and the Taylor Series

Solution of Linear Algebraic Equations

- Gauss- Jordan Elimination and Backsubstitution
- LU- Decomposition and its Applications
- Tri- Diagonal and Band-Diagonal Systems of Equations
- Singular Value Decomposition, Cholesky Decomposition & QR-Decomposition
- Spare Liner Systems

Eigensystems

- Jacobi Transformations
- Real Symmetric Matrices
- Reductions to Tri- Diagonal From (Givens & Householder methods)
- Eigenvalues & Eigenvectors of Tri-Diagonal Matrices
- Hermitian Matrices

Modelling of data

- Least Squares as a Maximum Likelihood Estimator
- Non- linear Models
- Robust Estimation
- Markov Chain Monte Carlo
- Gaussian Process Regression

Integration of Ordinary Differential Equations

- Runge – Kutta Method
- Stiffness and Multistep Method
- Richardson Extrapolation
- Second Order Conservative Equations
- Multi – step, Multivalue and Predictor-Corrector Methods

Two- Point Boundary Value Problems

- Shooting Method
- Relaxation Methods
- Automated Allocation of Mesh Points
- Handling Internal Boundary Conditions or Singular Points

Partial Differential Equations

- Flux- Conservative Initial value Problems
- Diffusive Initial Value Problems
- Initial Value Problems in multi-Dimensions
- Fourier & Cyclic Reduction Methods, Relaxation Methods and Multi-grid Methods for Boundary Value Problems .