Teaching Scheme					Numerical Methods (20MA212T)					
					Examination Scheme					
L	T	P	C	Hours/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand and acquaint the concept of various numerical methods.
- To develop numerical skills in solving problem of engineering interest.
- To lay foundation of computational techniques for post graduate/specialized studies and research.
- To make familiar the numerical solution techniques for linear/nonlinear ODEs/PDEs.

UNIT I: Interpolation, numerical differentiation and integration **11 Hr.**

Finite differences: forward, backward and central differences; Introduction to Interpolation, Newton-Gregory forward interpolation formula, Newton-Gregory backward interpolation formula, Stirling's central difference interpolation formula, Lagrange's interpolation formula for unevenly spaced data, Newton's divided difference formula, numerical differentiation; Numerical integration: Newton-Cotes's quadrature formula, trapezoidal rule, Simpson's one-third rule and Simpson's three-eighth rule.

UNIT II: Numerical solution of ordinary differential & simultaneous equations **10 Hr.**

Euler's method, modified Euler's method, Runge-Kutta methods of various order and predictor corrector method; Adam's and Milne's method.

Systems of linear equations: Gauss elimination method, pivoting techniques, Thomas algorithm for tri diagonal system; Jacobi, Gauss-Seidel and SOR iteration methods; Conditions for convergence; Systems of nonlinear equations: Fixed point iterations and Newton's method.

UNIT III: Numerical solution of partial differential equations **11 Hr.**

Finite difference approximation of partial derivatives, classification of 2^{nd} order PDEs, different type of boundary conditions, solutions of elliptic, parabolic and hyperbolic equations, Crank-Nicholson method, Dirichlet's and Neumann conditions.

UNIT IV: Finite elements methods **10 Hr.**

Introduction to finite elements methods: Functionals and base functions; Methods of approximation: Rayleigh-Ritz method, Galerkin method; FEM for one dimensional problems and comparison of FDM and FEM.

Max. 42 Hr.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Apply a suitable numerical technique to extract approximate solution to the problem whose solution cannot be obtained by routine methods.
CO2: Analyze the accuracy of numerical methods by estimating error.
CO3: Analyze/interpret the achieved numerical solution of problems by reproducing it in graphical or tabular form.
CO4: Evaluate a polynomial using interpolation/extrapolation from the data generated by an experiment or an empirical formula.

CO5: Evaluate a sufficiently accurate solution of various physical models for petrochemical engineering whose governing equations can be approximated by nonlinear ODEs or PDEs.

CO6: Design/create an appropriate numerical algorithm for various problems of petrochemical engineering.

TEXT/REFERENCE BOOKS

1. Grewal, B.S., "Numerical Methods in Engineering and Science with Programs in C & C++", Khanna Publishers (2010).
2. Sastry, S.S., "Introductory Methods for Numerical Analysis", 4th Edition, Prentice Hall of India (2009).
3. Jain, M.K., Iyengar, S.R.K. and Jain, R.K., "Numerical Methods for Scientific and Engineering Computation", New Age International (2007).
4. Erwin K., "Advanced Engineering Mathematics", 9th Edition, Wiley publication (2005).
5. Jain, R.K. and Iyengar, S.R.K., "Advanced Engineering Mathematics", 3rd Edition, Narosa (2002).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hr.**
Part A: 10 Questions each carrying 5 marks	50 Marks
Part B: 5 Questions each carrying 10 marks	50 Marks