MA 503 T ADVANCED NUMERICAL TECHNIQUES AND COMPUTER PROGRAMMING

Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	2	8	6	30	60	10	--	--	100

COURSE OBJECTIVES

- To understand and acquaint the concept of various numerical methods.
- To develop numerical skills in solving problem of engineering interest.
- To enrich the concept of finite element techniques.
- To extract the roots of a polynomial equation.

UNIT I Concept of Error in Computation Interpolation **12 Hrs**

Introduction of Finite differences, Operators, Newton Gregory Forward Interpolation Formula, Newton Gregory Backward Interpolation Formula, Gauss's Forward and Backward Interpolation Formula, Stirling's Central Difference Formula, Lagrange's Interpolation Formula for unevenly spaced data, Inverse Interpolation, Divided Differences, Properties of Divided Differences, Newton's Divided Difference Formula, Relation between Divided Differences and Ordinary Differences.

Splines, Cubic Splines, Formulae for Derivatives, Newton-Cotes's Quadrature Formula, Trapezoidal rule, Simpson's one-third rule, Simpson's Three-Eighth rule, Weddle's rule, Romberg's method, Double Integration.

UNIT II CONCEPT OF RATE OF CONVERGENCE NUMERICAL SOLUTION OF ALGEBRAIC & TRANSCENDENTAL EQUATIONS 9 Hrs

Introduction, Descarte's Sign rule, Newton-Raphson method, it's applications, Solution of non linear simultaneous equations, Newton-Raphson method for multiple roots, Horner's method, Lin-Bairstow's method or Method for Complex Root, Graeffe's root squaring method, Comparison of various methods.

UNIT III NUMERICAL SOLUTION OF ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS: 9 Hrs

Picard's method, Taylor's method, Euler's method, Runge – Kutta method, Modified Euler's method, Predictor Corrector methods: Adam's method, Milne's method. Difference Quotients, Graphical representation, Classification of PDE's of 2nd order, Elliptic equations, Solutions of Laplace equation by Liebmann's, iteration method, Poisson's equation, Parabolic equation (One dimension heat equation), Bender-Schmidt method, Crank- Nicholson method.

UNIT IV **9 Hrs**

CURVE FITTING: Principle of Least Squares, Fitting a Straight line and other Curves for a given set of data points.

SOLUTION OF SIMULTANEOUS ALGEBRAIC EQUATIONS: Direct methods, Iterative methods: Gauss-Jacobi's method, Gauss-Seidal method, Relaxation method.

THE FINITE ELEMENT METHOD: Introduction, Method of Approximation, The Rayleigh-Ritz Method, The Galerkin Method, Application to One dimensional and two dimensional problems.

TOTAL: 39 Hrs

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 on which operations like division, differentiation and integration can be done smoothly from the data generated by performing an experiment or by an empirical formula.

CO5 – Evaluate a sufficiently accurate solution of various physical models of science as well as engineering interest whose governing equations can be approximated by linear/nonlinear ODEs or PDEs or system of ODEs or PDEs.

CO6 – Design /develop an appropriate numerical algorithm for various problems of science and engineering

Texts and References

1. Introductory Methods for Numerical Analysis by S.S. Sastry, Fourth edition, Prentice Hall of India (2009)
2. Numerical Methods in Engineering and Science with Programs in C & C++ by B.S. Grewal, Khanna Publisher (2010)
3. Numerical Methods for Scientific and Engineering Computation by M.K. Jain, S.R.K. Iyenger and R.K. Jain, 5th edition, New Age International (2007)
4. S.D. Conte & C. de Boor: Elementary Numerical Analysis - an algorithmic approach, Mc Graw Hill, 1980, 3rd Ed., New York.
5. Numerical Methods for Engineers, Steven C. Chapra and Raymond P. Canale, Tata McGraw-Hill Publishing Company Limited.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks