

PRICE Rs. 10/-

**NORTH MAHARASHTRA UNIVERSITY  
JALGAON - 425 001**

**SYLLABUS**

**FOR**

**M.Sc. [COMPUTATIONAL MATHEMATICS]  
(From June, 1997)**

**SEMESTER I TO IV**

**DEPARTMENT OF MATHEMATICAL SCIENCES  
SCHOOL OF MATHEMATICAL SCIENCES**

NORTH MAHARASHTRA UNIVERSITY, JALGAON

INFORMATION OF NEW SYLLABUS IN

M.Sc. (COMPUTATIONAL MATHEMATICS)

FROM ACADEMIC YEAR 1997-98

A) ELIGIBILITY

A candidate who has passed B.Sc. with Mathematics as a principle subject shall be eligible for admission to first year M.Sc. (Computational Mathematics).

B) STRUCTURE

1) Structure of the M.Sc. (Computational Mathematics) will be as under :-

SEMESTER-I

MT-101	:	ADVANCED CALCULUS
MT-102	:	METRIC SPACE & FRACTALS
MT-103	:	DISCRETE MATHEMATICAL STRUCTURES
MT-104	:	ABSTRACT ALGEBRA
MT-105	:	LAB COURSE

SEMESTER-II

MT-201	:	COMPLEX ANALYSIS ; THEORY & APPLICATIONS
MT-202	:	PROBABILITY & MEASURE THEORY
MT-203	:	COMBINATORICS & LINEAR ALGEBRA
MT-204	:	NUMERICAL ANALYSIS
MT-205	:	LAB COURSE

SEMESTER-III

MT-301	:	INTEGRAL TRANSFORMS & CALCULUS OF VARIATIONS
MT-302	:	DIFFERENTIAL GEOMETRY
MT-303	:	FUNCTIONAL ANALYSIS
MT-304	:	OPTIONAL
MT-305	:	OPTIONAL

OPTIONAL COURSES

- 1) DYNAMICAL SYSTEMS
- 2) FINITE ELEMENT METHODS
- 3) COMPUTATIONAL MECHANICS
- 4) THEORETICAL COMPUTER SCIENCE
- 5) GRAPH THEORY
- 6) DESIGN & ANALYSIS OF EXPERIMENTS
- 7) TOPICS IN ALGEBRA
- 8) TOPICS IN ANALYSIS
- 9) WAVELET THEORY & ITS APPLICATIONS
- 10) GENERALIZED HYPERGEOMETRIC FUNCTION TRANSFORMS

SEMESTER-IV

MT-401	:	OPTIMIZATION TECHNIQUES
MT-402	:	INTEGRAL EQUATIONS & PARTIAL DIFFERENTIAL EQUATION
MT-403	:	APPROXIMATION THEORY
MT-404	:	
MT-405	----	TECHNICAL COMMUNICATION & PROJECT

- 2) In the first year all the papers are compulsory.
- 3) In the third semester the student shall offer three compulsory courses & two courses from the list of optional courses.
- 4) The total work load for the student shall be 2000 marks (500 marks for each semester)

(C) EXAMINATION

1. There shall be examination during the semester which shall be called "Internal Examination". At the end of each semester there shall be an "External Examination". The "Internal Examination" in each subject will be of 40 marks. the "External Examination" of each subject will be of 60 marks.
2. The External Examination will be of three hours duration.
3. The program of the External Examination will be fixed by the University. The question papers for the External Examinations will be set by the University. The stationary such as answer books, graph papers, drawing papers etc. will be supplied by the University.

4. PRACTICAL EXAMINATION:

The practical examination will be of 100 marks (40 marks Internal Examination + 60 marks External Examination). The passing rule for this Examination will be the same as that of theory papers. For the External Examination, one Examiner will be internal & one Examiner will be external.

(External Examiner in this context means Examinees not belonging to the department, of Mathematics, North Maharashtra University, Jalgaon). The Department of Mathematics will take the responsibility of arranging the practical examination.

(D) STANDARD OF PASSING

1. The candidate who has secured at least 16 marks out of 40 in Internal Examination and 24 marks out of 60 in the External (Semester) Examination shall be declared to have passed in the paper.
2. The candidate failing to secure 16 marks out of 40 in Internal Examination or 24 marks out of 60 in the Semester Examination or both shall have to appear for subsequent Internal Examination or External Examination or both in that paper.
3. The student having the backlog of subject/subjects can be admitted to the second year M.Sc..

(E) AWARD OF CLASS

The class should be awarded to the student on the aggregate marks obtained by him during all the four semesters.

The award of class shall be as follows:

- |   |                              |
|---|------------------------------|
| 1) Aggregate 70% & above                      | First Class with Distinction |
| 2) Aggregate 60% & above<br>but less than 70% | First Class                  |
| 3) Aggregate 50% & more<br>but less than 60%  | Second Class                 |
| 4) Aggregate 40% & above<br>but less than 50% | Pass Class                   |
| 5) Below 40%                                  | Fail                         |

(F) UNIVERSITY TERMS

The date for the commencement & conclusion of the first & second Semester shall be determined by the University Authorities.

(G) VERIFICATION & REVALUATION

A candidate may apply for verification/revaluation by paying the necessary fees to the University. This provision shall be applicable only for External Examination of theory papers.

## SEMESTER-I

### MT-101 : ADVANCED CALCULUS

1. Sequences of function, uniform convergence, infinite series of functions, space filling curves, uniform convergence of series, double sequences, mean convergence, multiplication of power series, reciprocal of power series. Bernstein's theorem, Binomial series.
2. Multivariable differential calculus, partial, directional & total derivatives Jacobians, chain, rule, mean value theorem. Taylor formula for functions of  $n$  variables. Implicit functions & Extremum problems, Inverse function theorem, Implicit function theorem, Extrema of real valued functions of several variables.
3. Multiple integrals, Evaluation as a repeated integrals, Greens theorem, Divergence, Curl, surface integrals, Stokes theorems, Gauss theorem.

#### Books Recommended

1. T.M. Apostol : Mathematical Analysis (2nd Edition Narosa Publishing House).
2. A. Devinatz : Advanced Calculus (Holt Rinehardt, Winston)
3. T.M. Apostol : Calculus Vol. II (Blaisdell Co.)
4. W. Rudin : Principles of Mathematical Analysis.

### MT-102 : METRIC SPACE & FRACTALS

1. Metric spaces  
Definitions & examples, Holder & Minkowski's inequalities,  $l_p$  spaces, function spaces, convergence, separable space, complete spaces, continuity, compactness, connectedness & completion, category, equicontinuity, contractions & applications, normal families. Arzela Ascoli theorem.

2. Fractals

Dynamics of simple maps, Smale Horse shoe map, fractal basin boundary, Julia sets, Mandelbort sets, Fractals, iterated system.

Books Recommended

1. C. Goffmann & Pedrick : First course in Functional Analysis
2. Chaos & Fractals (The mathematics behind the Computer graphics) Proceedings symposia in Applied Mathematics Vol. 39 American Math. Society 1985.
3. G.F. Simmons. Introduction to Topology & Modern Analysis.
4. J.R. Munkres : Topology a first course
5. Benoit B. Mandelbort : The fractal, geometry of nature (Academic Press)
6. Barnsley : Fractals everywhere (Academic press)

MT-103 : DISCRETE MATHEMATICAL STRUCTURES

1. Mathematical logic, statements, connectives, normal forms, the theory of inference for the statement calculus, predicate calculus & inference theory for the predicate calculus.
2. Graphs, subgraphs isomorphic, connected graphs. Euler graphs, Hamiltonian paths. Trees, spanning trees, Dijkstra's & Kruskal's algorithms for spanning trees, Dijkstra's algorithm, for minimum distance, counting labeled trees.
3. Divisibility, congruences, theorems of Fermat, Euler & Wilson squares & the Law of quadrature. Reciprocity, cost of Arithmetic operations, primes & factoring, pseudo random numbers.



#### Books Recommended

1. J.P. Tremblay & R. Manchar : Discrete Mathematical Structure with Applications to Computer Science.
2. Narsing Deo : Graph Theory (Prentice Hall)
3. L. Garding & Tambour Algebra for Computer Science.
4. E. Harary : Graph Theory (Narosa Publication)
5. K.R. Parthasarathy : Basic graph theory (Tata McGraw Hill)
6. Iniven & H.S. Zuckermann: An introduction to the theory of numbers (Wiley Eastern)
7. G.R. Hardy & E.M. Wright : An introduction to the theory of numbers (Oxford University Press).

#### MT-104 : ABSTRACT ALGEBRA

1. Groups : Counting principle, Normal subgroups & quotient groups, permutation groups, Class equation, Sylow's theorems.
2. Rings: Ideals & Quotient rings, Euclidian rings, polynomial Rings.
3. Fields : Extension Fields, Roots of Polynomials, Finite fields, Application to Codes.

#### Books Recommended

1. I.N. Herstein : Topics in Algebra (Wiley Eastern Ltd. Second edition)
2. Garrett Birkhoff & Thomas C. Bartee : Modern Applied Algebra
3. J.B. Fraleigh : A first course in Abstract Algebra (Addison Wesley)
4. M. Artin : Algebra (Prentice Hall India)
5. L. Garding & T. Tambour : Algebra for Computer Science (Narosa)
6. N.S. Gopalkrishnan: University Algebra (Wiley Eastern)

MT-105 : LAB COURSE

1. Programming with Fortran-77

Standard Functions, Sequential Structures, Selective structure, Repetitive Structures, subscripted variables, Format, Subprograms, File processing, additional features. (10 Lect)

2. Draw the flow chart & write a programme to find the root of the equation  $f(x) = 0$  by

- i) Bisection Method
- ii) Newton Raphson Method
- iii) Iteration Method
- iv) Method of False Position

3. Draw a Flow Chart & write a programme to solve a given set of simultaneous equations using

- i) Gauss Elimination Method
- ii) Gauss Siedal Elimination method

4. Draw a flowchart & write a program for finding the

- i) Inverse of a given matrix
- ii) Determinant of a given matrix

5. Draw the Flow chart & write a programme to integrate the given function using.

- i) Trapezoidal rule
- ii) Simpsons 1/3 rule
- iii) Simpsons 3/8 rule.

6. Problems on Residues arithmetic & finite fields.

Books Recommended

1. V. Rajaraman "Commuter programming in Fortran-77, PHI (1990).
2. M.K. Jain, SRK Iyengar & R.K. Jain : Numerical Methods for Scientific & Engg. Computation (Wiley Eastern Ltd.)
3. E. Balaguruswamy : Computer Oriented Statistical & Numeral methods (MacMillan Pub. Ltd.)

SEMESTER-II

MT-201 : COMPLEX ANALYSIS : THEORY & APPLICATIONS

1. Complex numbers & the point at infinity, Analytic function, Cauchy - Riemann condition, harmonic functions, mappings by elementary functions, Conformal mapping, Geometry of Conformal mappings, Explicit construction of Conformal mappings.
2. Cauchy's Argument principle, Rouché's theorem, Residue calculus, Applications to evaluation of integrals.
3. Power series, Radius of convergence, Liouville's theorem, Fundamental theorem of algebra, Maximum modulus principle, open mapping theorem, Schwartz lemma.

Books Recommended

1. N. Levinson & T. Redheffer : Complex variables.
2. P. Henrici : Applied & Computational Complex Analysis (Vol. I John Wiley & Sons)
3. J.B. Conway : Functions of one complex variables (Narosa).
4. E.T. Copson : Theory of functions of a complex variables (Oxford University press)
5. R.V. Churchill : Complex variables & Applications.

MT-202 : PROBABILITY & MEASURE THEORY

1. Simple functions, Lebesgue Integral on the real line, Dominated convergence theorem, Absolutely continuous functions, Functional theorem of integration.
2. Events, sigma-finite measures on sigma-algebra of sets.
3. Probability measures, discrete measure, Borel & Lebesgue measure.
4. Measurable functions, random variables, Integration, expectation, moments, moment inequalities.
5. Fatous lemma, monotone convergence theorem, bounded convergence theorem.

6. Convergence in Measures, Weak convergence law of large numbers central limit theorem.

Books Recommended

1. H. Royden : Real Analysis (MacMillan)
2. De Barra : Measure & Integration
3. Halmose : Measure theory.
4. W. Rudin : Real & Complex Analysis (3rd Edition McGraw Hill)
5. B.R. Bhat : Modern Probability Theory (Wiley Eastern)
6. P. Billingsley : Probability and Measure, (John Wiley)
7. Kingman and Taylor : Introduction to measure and Probability, (Cambridge Press), Paper Back, (Tata McGraw Hill).

MT-203 : COMBINATORICS & LINEAR ALGEBRA

1. Generating functions, recurrence relations, principle of inclusion & exclusion, poly's enumeration formula.
2. Matrices, canonical forms, triangular form Jordan form, rational canonical form.
3. Quadratic forms, reducing a quadratic form to canonical form by Lagrange's method, reducing a quadratic form to canonical form by Jacobi's methods, Sylvester's Criterion for a quadratic form to be positive definite.
4. Representation of finite groups, examples, characters, character tables, irreducible representations, schur's orthogonally relations, schur's lemma.

Books Recommended

1. Alan Tucker : Applied combinatorics (Wiley 1984)
2. I.N. Herstein : Topics in Algebra (Wiley Eastern)
3. N.V. Efimov & E.R. Rozenodorn : Linar Algebra & Multidimensional Geometry (Mir Publishers, Moscow).
4. A.W. Joshi : Group theory for physicist.

5. Artin : Algebra (Prentice Hall India)
6. V. Krishnamurthy : Combinatorics (Wiley Eastern)
7. D.K. Paddeev & V.N. Paddeev : Computational Methods in Linear Algebra (Freeman).
8. K. Hoffman & R. Kunze : Linear Algebra (Prentice Hall, India)

MT-204 : NUMERICAL ANALYSIS

1. Computing : numbers & their representations, Floating point arithmetics error analysis algorithms.
2. Eigenvalues, reduction to tridiagonal or Hessenberg form. Jacobi rotation & eigenvalue estimates, power method, OR algorithm.
3. Integration; Interpolating quadrature, extrapolation, Gauss quadrature, special quadrature methods, optimality & convergence.
4. Iteration : General iteration methods, examples of convergent iterations, convergence of iterative methods, Lipschitz constants, error bounds, Newtons method, iterative solution of Linear system of equations, more on convergence.
5. Numerical Differentiation : methods based on interpolation, finite differences & undermined coefficients.
6. Solutions to differential equations : Numerical methods, Euler method, Backward Eulers method, Single step method, Taylor series method, Runge Kutta method, multistep methods, stability analysis.

Books Recommended

1. Gunther Hammerlin & Harl-Heinz Hoffman : Numerical Mathematics (Springer Verlag).
2. M.K. Jain, SRK Iyengar, R.K. Jain : Numerical methods for scientific & Engg. computations (Wiley Eastern Ltd.)

3. E. Balagruswamy : Computer Oriented Statistical & Numerical Methods (McMillon Publication).
4. S.S. Sastry : Introductory Methods of Numerical Analysis, PHI 1992.
5. H.M.Antia : Numerical Methods for scientists & Engineers, TMH, 1991.

MT-205 : LAB COURSE

1. Introduction to graphics
2. Construction of Fractals & special sets.
3. Draw a flowchart & write a programme to solve a given differential equation by
  - i) Euler's simplex method
  - ii) Modified Euler method
  - iii) Runge Kutta method
4. Numerical verification of Weigrstass' approximation theorem for several functions.
5. Curve fitting
  - i) Cubic
  - ii) Quintic Hermite
  - iii) Lagrange's interpolation
  - iv) Newtons difference formulae
6. Constructing Berizer curves using de Csteljau algorithm & the Bernstein form.
7. Digonalization & reduction of matrix to a standard forms
  - i) Upper triangular form
  - ii) Jordan canonical form
  - iii) Diagonal form
  - iv) QR decomposition.
8. Determination of dominant eigenvalue by iterative method.
9. Determinant of matrix by Laplace & other methods.

### Books Recommended

1. N.M.Jain, SKR Iyenger R.K. Jain : Numerical methods for scientific & Engg. computation (Wiley Eastern Ltd.)
2. B.A. Barasky : Computer graphics & geometric modeling using beta splines.
3. Efimov & Rozendorl : Linear Algebra & multidimensional geometry.
4. Rogers: Mathematical Elements of Computer Graphics (McGraw Hill).
5. Newman & Sproull : Computer Graphics (McGraw Hill).

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