BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI – 620 024

M.Sc. MATHEMATICS SYLLABUS (ANNUAL PATTERN)
(FOR DISTANCE EDUCATION CANDIDATES ONLY)

(For the candidates admitted from the academic year 2006-2007 batch onwards)

FIRST YEAR

PAPER I : Algebra

PAPER II : Real Analysis

PAPER III: Complex Analysis

PAPER IV: Classical and Fluid Mechanics

PAPER V: Ordinary and Partial Differential Equations

SECOND YEAR

PAPER VI: Topology and Functional Analysis

PAPER VII: Discrete Mathematics

PAPER VIII: Numerical Methods

PAPER IX: Mathematical Programming

PAPER X: C - Programming Language

FIRST YEAR -- PAPER – I – ALGEBRA

Unit I

Another counting principle – Sylow's theorems – Direct products – Finite abelian groups, Polynomial rings – Polynomials over the rational field – Polynomial rings over commutative rings.

Unit II

Extension fields – roots of polynomials – More about roots – The element of Galois theory – Finite fields – Wedderburn's theorem on finite division rings – A theorem of Frobenius.

Unit III

The algebra of linear transformations – Isomorphism of vector spaces – Representations of linear transformations by matrices – Linear functionals- the double dual – the transpose of a linear transformation.

Unit IV

The algebra of polynomials – Lagrange Interpolation – Polynomial ideals – the prime factorization of a polynomial – Commutative rings – Determinant functions- Permutations and the uniqueness of determinant – classical adjoint of a matrix – Inverse of an invertible matrix using determinats.

Unit V

Characteristic values – Annihilating polynomial – Invariant subspaces – Simultaneous triangulation – Simultaneous diagonalization – Direct sum decompositions.

Text books:

1. I.N. Herstein, "Topics in Algebra" Second Edition, Vikas Publishing House Pvt. Ltd., New Delhi.
   Unit I: Chapter 2 (2.11,2.12,2.13,2.14) Chapter 3 (3.9,3.10,3.11)
   Unit II: Chapter 5 (5.1,5.3,5.5,5.6) Chapter 7 (7.1,7.2,7.3)

2. K.Hoffman and R. Kunze, " Linear Algebra", Second Edition, Prentice – Hall of India Pvt. Ltd.
   Unit III: Chapter 3 (all sections)
   Unit IV Chapter 4 (all sections) Chapter 5 (5.1 to 5.4)
   Unit V: Chapter 6 (6.1 to 6.6)

Books for References:

1. P.B. Bhattacharya, S.K. Jain, S.R. Nagpaul "Basic Abstract Algebra", Cambridge University Press, Second Edition, 1995.
2. J.b. Fraleigh, "A First Course in Abstract Algebra", Narosa Publishing House, New Delhi
3. N. Jacohson, Basic Algebra, Volume I and II, Freeman 1980.

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PAPER II - REAL ANALYSIS

Unit I

Basic topology: Finite, Countable sets – Metric spaces - Compact sets – Perfect sets – Connected sets.

Numerical sequences and series, sequences – convergence – subsequences – Cauchy sequences – Upper and Lower limits – some special sequences – Tests of Convergence – Power series – Absolute convergence – Addition and Multiplication series.

Unit II

Continuity: Limits of functions – Continuous Functions - Continuity and Compactness – Continuity and connectedness – discontinuities – Monotonic functions- Infinite limits and Limit at infinity.

Differentiation: Derivative of real functions – mean value theorems – intermediate value theorems for derivatives – L' hospital rule – Taylor's Theorem – differentiation of vector – valued functions.

Unit III

Riemann – Stieltjes integrals: definition and existence – properties – integration and differentiations – Integration of vector valued functions.

Unit IV

Sequence and Series of functions – Discussions of main problem – uniform convergence – Uniform convergence and continuity – Uniform convergence and integration – Uniform convergence and different ion – equi continuous – family of functions – Stone – Weierstrass theorem.

Unit V

The Lebesgue theory – set functions. Construction of Lebesgue measure – measure spaces – measurable functions – simple functions – integration – comparisons with the Riemann integral – integration of Complex function – function of class L_2.

Text Books:

1. Walter Rudin, "Principles of Mathematical Analysis", Third edition, Mc-Graw Hill, 1976

Unit I: Chapter 2 and 3
Unit II: Chapter 4 and 5
Unit III: Chapter 6
Unit IV: Chapter 7
Unit V: Chapter 11

Books for Reference:

1. T.M. Apostol, "Mathematical Analysis", Second edition, Addison Wesley publication, Tokyo 1981.
2. V.Ganapathy Iyer, "Introduction to Real Analysis", PHI.

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PAPER III - COMPLEX ANALYSIS

Unit I

Analytic functions as mappings: Elementary point set topology – Conformality – Linear transformations – Elementary conformal mappings.

Unit II

Complex Integration: Fundamental theorems – Cauchy's integral formula – Local properties of analytic functions – General form of Cauchy's theorem.

Unit III

Complex Integration: Calculus of residues – Harmonic functions

Unit IV

Series and Product Development: Power series expansion – Partial fractions and factorization – Entire functions – Riemann zeta function – Normal; families.

Unit V

Riemann Mapping theorem – Elliptic functions: Simply periodic functions – Doubly periodic functions – the Weierstrass theory

Text Books:

1. L.V. Alfors, "Treatment as in Complex Analysis ", III Edition, I.S.E., McGraw Hill.

Unit I : Chapter 3
Unit II : Chapter 4, Sections: 1,2,3 and 4
Unit III: Chapter 4, Sections 5 and 6
Unit IV: Chapter 5
Unit V : Chapter 6 – Section 1, Chapter 7

Books for Reference :

1. E.Hille, " analytic Functions", Vol.I and II.
2. J.B.Conway, "Functions of one Complex Variable".
3. Nevalinna and Paatro, "Complex analysis".

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PAPER IV - CLASSICAL AND FLUID MECHANICS

Unit I

Introductory concepts – the mechanical systems – Generalized Coordinates – Constraints – Virtual work – Energy and momentum – Lagrange's equation – Integrals of the motion – Small oscillation.

Unit II

Special applications of Lagrange's equation – Rayleigh's dissipation function – impulsive motion – Gyroscopic systems – Velocity dependent potentials – Hamilton's equations – Hamilton's principles – Other variational principles – Phase space.

Unit III

Real fluids and ideal fluids – Velocity of a fluid at a point – Stream lines and path lines – Steady and unsteady flows – the velocity potential – The vorticity vector – Local and particle rate of change – The equation of continuity – worked examples – Acceleration of a fluid – Pressure at a point in a fluid at rest – Pressures at a point in a moving fluid – Conditions at a boundary of the inviscid invisible fluids – Euler's equation of motions – Bernoulli's equation – worked examples.

Unit IV

Some flows involving Aerial symmetry – Some special two dimensional flows – Impulsive motion – some three dimensional flows – Sources, sinks and doublets – Images in a rigid infinite plane – Axi symmetric flows – Stokes streams functions.

Unit V

Some two-dimensional flows – Meaning of a two dimensional flow – Use of cylindrical polar coordinates – the stream function – The complex potential for two dimensional irrotational, incompressible flow – complex velocity potentials for standard two dimensional flows – Some worked examples – the Milne's Thomson circle theorem and applications – the theorem of Blasius.

Text Books:

1. Donald T. Greenwood, "Classical Dynamics" PHI Pvt. Ltd., New Delhi, 1985
   Unit I: Chapter 1 (1.1 to 1.5) Chapter 2 (2.1 to 2.4)
   Unit II: Chapter 3 (3.1 to 3.4) Chapter 4 (4.1 to 4.4)
2. F. Chorton,"Text Book of Fluid Dynamics", CBS Publications, New Delhi, 1985
   Unit III: Chapter 2 (2.1 to 2.9) Chapter 3 (3.1 to 3.6)
   Unit IV: Chapter 3 (3.9 to 3.11) Chapter 4 (4.1, 4.2, 4.3, 4.5)
   Unit V: Chapter 5 (5.1 to 5.6, 5.8, 5.9)

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PAPER V – ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS

Unit I

The general solution of the homogeneous equation – The use of one known solution to find another – The method of variation of parameter – Power series solutions – series solutions of first order equations – Second order linear equations – ordinary points – Regular singular points – Gauss hyper geometric equations – the point oat infinity.

Unit II

Legendre Polynomials - Properties of Legendre polynomials – Bessel functions – The gamma function – Properties of Bessel function – linear systems – Homogeneous Linear system with constant coefficients.

Unit III: The existence and uniqueness of solutions

The method of Successive approximation – Picard's theorem – Types of critical points – Critical points and stability for linear systems – Stability by Liapunov's direct method.

Unit IV

First order partial differential equations – Linear equations of the first order – Pfafian differential equations – Compatible systems – Charpit's method – Jacobi's method – Integral surface through a given circle.

Unit V

Genesis of second order PDE – Classifications of second order PDE – one dimensional wave equation – Vibration of an infinite string, Vibrations of semi-infinite string, Vibrations of a string of finite length (Method of separation of Variables) - Heat conduction problem – Heat conduction – Infinite rod case and heat conduction – finite rod case.

Text Book:

1. G.F. Simmons – Differential Equations with Applications and Historical Notes, TMH, New Delhi

   Unit I - Chapter 3: Sections – 15, 16, 19, Chapter 5: Sections - 26 to 31

   Unit II: Chapter 6: Sections – 32 to 36, Chapter 7 : Sections – 37,38.

   Unit III: Chapter 8: Sections – 41 to 43, Chapter 7: Sections – 56, 57.

2. T.Amarnath, "An Elementary Course in Partial Differential Equations", Narosa, New Delhi, 1997.

   Unit IV – Chapter 1: Sections – 1.4 to 1.9

   Unit V - Chapter 2: Sections – 2.1, 2.2, 2.3.1, 2.3.2, 2.3.3, 2.3.5, 2.5.1, 2.5.2

References

1. W.T.Reid, Ordinary Differential Equations, John Wiley, New York, 1971.
2. E.A.Coddington and E.Levinson, Theory of ODE, Mc Graw Hill Publishing Company, New york, 1955
3. J.N. Sneddon, Elements of Partial Differential Equations, Mc Graw Hill Publishing Company, New york, 1957.

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PAPER VI – TOPOLOGY AND FUNCTIONAL ANALYSIS

Unit I
Topological spaces and continuous functions – Product topology – metric topology – The metric topology (continued) – connectedness.

Unit II
Compactness – Count ability axioms and Separation axioms.

Unit III
The Tychonoff theorem – Completer metric spaces and Function spaces

Unit IV
Banach spaces

Unit V
Hilbert spaces – finite dimensional spectral theory.

TEXT BOOK:

1. James R. Munkres, "Topology – A First Course", PHI (Second edition)

Unit 1: Chapter 2 (Sec 2.1 to 2.10)
Chapter 3 (Sec 3.1 to 3.4)

Unit II: Chapter 3 (Sec 3.5 to 3.7)
Chapter 4

Unit III: Chapter 5
Chapter 7 (Sec 7.1 to 7.3)

Functional Analysis

Text Book
1. G.F. Simmons, "Introduction to Topology and Modern Analysis", Mc-Graw Hill. 1963

Unit IV: Chapter 9.
Unit V : Chapter 10 and 11.

References:

1. J. Dugundji, "Topology", PHI, New Delhi, 1975
2. Goffman and Pedrick, "First course in Functional Analysis", PHI
3. B.V. Limays, "Functional Analysis", Wiley Eastern.

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PAPER VII – DISCRETE MATHEMATICS

Unit I
Mathematical Logic: Basic Notation, Connectives, Normal forms.

Unit II
Inference Theory: The inference theory for the statement calculus, Predicate Calculus, Inference 'Theory of the Predicate Calculus.

Unit III
Algebraic Structures: Algebraic Systems, Semi groups and Monoids, Grammars and languages, Groups.

Unit IV
Lattices and Boolean Algebra: Lattices as partially ordered sets, Boolean Algeabra, Boolean Functions.

Unit V
Basic concepts of Graph Theory, Storage representation and Manipulation of Graphics, Simple Procedence Grammars, Fault Detection in Combinational Switching Circuits.

Text Book:
1. J.P. Tremblay and R. Manohar, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill, Edition 1997, New Delhi.

References

1. Kenneth H.Rosen, "Discrete Mathematics and its Applications", McGraw Hill Book Company, 1999, New Delhi.
2. Kolman, Busby and Ross, "Discrete Mathematical Structures", Prenctice Hall of India, Fourth Edition 2002, New Delhi.

Unit I : Sections 1 – 1 to 1 – 3.5
Unit II : Sections 1 – 4 to 1 – 6.5
Unit III : Sections 3 - 1to 3 – 3.3 and 3 – 5 to 3 – 5.5
Unit IV : Sections 4 – 1 to 4 – 3.2
Unit V : Sections 5 – 1 to 5 – 4.4

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PAPER VIII – NUMERICAL METHODS

Unit I: Transcendental and Polynomial equations

Iteration methods based on second degree equation – Muller method, chebyshev method. Multi point iteration methods, Rate of convergence - Secant method, Newton-Raphson method, Cahebyshev method, Methods of multiple roots systems of non-linear equation-Newton-Raphson method, Methods for complex roots polynomial equations – Descarte's rule of signs, Birge-vieta method, Bairstow method and graffe's roots squaring method.

Chapter 2: Sections 2.4, 2.5 (except muller method), 2.6 (methods of multiple rules only) 2.7. (Newton -Raphson method only) 2.8, 2.9

Unit II: System of linear algebraic equations and eigen value problems..

Linear systems of equations-Direct methods-Triangularization method, Cholesky method, Partition method-Error analysis for direct methods, Iteration methods-Convergence analysis of iterative methods, eigen values and eigen vectors- Jacobi methods for symmetric matrices, Givens methods for symmetric matrices, House holder's method, Rutihauser method, Power method.

Chapter 3: Sections 3.2, 3.3, 3.4, 3.5, 3.7, 3.8, 3.9, 3.10, 3.11.

Unit III: Interpolation and approximation

Higher order Interpolation, finite difference operators, interpolating polynomial using finite differences, Hermite interpolation, Piecewise and spline interpolation, Bivariate interpolation, least square approximation, Gram-schmidt orthogonalizing process, Legendre polynomials, Chebyshev polynomials.

Chapter 4: Sections 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.9.

Unit IV: Differentiation and Integration:

Numerical differentiation – Optimum choice of step length-Extrapolation method – Partial differentiation – Numerical integration – Methods based on interpolation, Method based on undermined coefficients – Trapezoidal method, Simpson's method, Gauss Legendre integration method, Gauss Chebyshev integration method, Raau, integration methods, Lobalto integration methods, composite integration methods – Romberg integration methods – Double integration.

Chapter 5: Sections 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11.

Unit V: Ordinary and Partial Differential Equations:

Numerical methods – Single step methods – Multistep method – Predictor – corrector method – Boundary value problems – Introduction, Initial value problem method shooting methods, Finite difference method – Finite element method.
Chapter 6: Sections 6.3, 6.4, 6.6, 6.7.
Chapter 7: Sections 7.1, 7.2, 7.3, 7.4.

Text Book:
M.K. Jain, S.R.K. Iyengar and R.K. Jain, "Numerical Methods for Scientific and Enginering Computation", New age International publishers, Fourth Edition, 2003.

References:
1. Corte S.D. and de Boor, "Elementary Numerical analysis – An Algorithmic approach", 3rd Edition., McGraw Hill International Book Company, 1980.
2. James B. Scarboraugh, "Numerical Mathematical Analysis", Oxford & IBH Publishing Company, New Delhi.
3. F.B. Hildebrand, "Introduction to Numerical Analysis:, McGraw Hill, New York, 1956.

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PAPER IX - MATHEMATICAL PROGRAMMING

Unit I

Formulation of Linear Programming problem – Graphical solution - Simplex procedure – method of penalty – Two – Phase technique – special cases in simplex method applications – Duality – Economic interpretation of duality – Primal Dual Computations – Dual simplex method.

Unit II

Generalized simplex Tableau in Matrix form – Efficient Computational algorithm – Deterministic Dynamic Programming

Unit III

Parametric Programming and Integer Linear Programming

Unit IV

Classical Optimization Theory

Unconstrained Problem – Necessary and Sufficient conditions, Constrained Problems – Equality (Jacobi method and Lagrangian method) and un equality constrains (Extension of Lagrangian method and Kuhn-Tucker Conditions)

Unit V

Non-Linear Programming

Unconstrained non-linear algorithms – Direct search Method and Gradient Method – Constrained algorithms – Separable, quadratic, geometric programming.

Text Books:

Hamdy A. Taha, "Operations Research", (sixth edition) Prentice – Hall of India Private Limited, New Delhi, 1997.

Unit I
Chapter 2 : Section 2.1 to 2.3
Chapter 3 : Section 3.1 to 3.5
Chapter 4 : Section 4.1 to 4.6
Chapter 7 : Section 7.6 only

Unit II
Chapter 4 : Section 4.7 only
Chapter 7 : Section 7.4, 7.5.1 and 7.5.2
Chapter 10 : Section 10.2 to 10.5

Unit III
Chapter 7 : Section 7.7
Chapter 9 : Section 9.1 to 9.3

Unit IV
Chapter 20 : Section 20.1 to 20.3 omit 20.2.2.

Unit V
Chapter 21 : Section 21.1, 21.2 omit 21.2.4, 21.2..5 and 21.2.6.

References:

1. F.S. Hiller and J.Lieberman, Introduction to Operation Research (7^{th} Edition) Tata – McGraw Hill Publishing Company, New Delhi, 2001.
2. C. Beightler, D. Philips and B. Wilde, Foundations of Optimization (2^{nd} Edition) Prentice Hall Pvt. Ltd., New York, 1979.
3. M.s. Bazaraa, J.J. Jarvis and H.D. Sharall, Linear Programming and Network flow, John Wiley, New York, 1990
4. S.S. Rao. Optimization Theory and Applications, Wiley Eastern Ltd., New Delhi.

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PAPER X – C – PROGRAMMING LANGUAGE

Unit I :

Overview of C: Introduction, importance of C, sample C programs, Basic structure, Programming style, executing a C-programme.
Constants, Variables and data types: Introduction, character set, C-tokens, key words and identifiers, constants, variables, data types, declaration of variables, assigning values to variables, defining symbolic constants.
Operators and Expressions: Introduction, Arithmetic, Relational, Logical, Assignment, Increment and Decrement and Special operators, arithmetic expressions, evaluations of expressions, precedence of arithmetic operators, type conversions in expressions, operator precedence and mathematical functions.
Managing input and output operators: Introduction, reading a character, writing a character, formatted input and formatted output.

Unit II :

Decision making and branding: Introduction, Decision making with IF statement, simple IF statement, the IF-ELSE statement, nesting of IF-ELSE statement, the ELSE-IF ladder, the SWITCH statement, the ? operator, GOTO statement.
Decision making and Looping: Introduction, the WHILE statement, the DO statement, FOR statements, jumps in loops.

Unit III :

Arrays: Introduction, One dimensional arrays, two dimensional arrays, initializing Two dimensional arrays, Multi dimensional arrays.
User defined functions: Introduction, need for user defined functions, a multi function program, the form of C-functions, Return values and their types, calling a function, category of functions, no arguments and no return values, arguments but no return values, arguments with return values, handling of non-integer functions, nesting of functions, Recursion, Function with arrays, the scope and life time of variables in functions, ANSI C functions.

Unit IV :

Structures and Unions: Introduction, Structure definition, giving values to members, Structure initialization, comparison of structures, variables, arrays of structures, structures within structures, structures and functions, Unions, size of structures, Bit fields.
Pointers: Introduction, understanding pointers, accessing the address of variables, declaring and initializing pointers, accessing through its pointers, pointer expression, pointer increments and scale factor, pointers and arrays, pointer and character strings, pointer and function, pointer and structures, pointers on pointers.

Unit V :

Dynamic memory allocation and Linked lists: Introduction, Dynamic memory allocation, concepts of linked lists, advantage of linked lists, types of linked lists, pointers revisited, basic test operators, application of linked lists.
The Preprocessors: Introduction, Macro substitution, file inclusion, compiler control directives, ANSI addition.

Text Book:

1. E. Balagurusamy, "Programming in ANSI C', Tata MCGraw Hill, Publishing Company Ltd., (2^{nd} edition), New Delhi.
2. Chapters 1 to 7, 9, 11 and 14.

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C – Practicals

1. Solution of transcendental and polynomial equations in one variables.
   (i) Newton's method
   (ii) Deflected Newton's method
   (iii) Method of Bisection
   (iv) Method of Regula - Falsi

2. Solution of Linear equations
   (i) Jacobi's iteration method
   (ii) Gauss-Seidal iteration method

3. Numerical solution of ODE
   (i) Euler's method
   (ii) Modified Euler's method
   (iii) Runge-Kutta method of order two
   (iv) Runge-Kutta method of order three
   (v) Runge-Kutta method of order four
   (vi) Predictor-Corrector method: Milne's method

4.Numerical integration
   (i) Simpson's 1/3 rd rule
   (ii) Simpson's 3/8 the rule
   (iii) Weddle,s rule