MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI

Department of Mathematics

M.Sc. MATHEMATICS (CBCS)

(For those who join during 2017-18 and onwards)

SYLLABUS

1.OBJECTIVES: Mathematics is one of the fundamental disciplines in science. It is the basic for all the disciplines. This two year program, consisting four semesters,aims at providing basic tools and exposure to students who intend to pursue Master Degree in Mathematics at the international level.

2.Eligibility and mode of Admission: Any graduate with an aggregate of 50% marks in Mathematics or Applied Mathematics is eligible to apply for admission to the course. Relaxation for SC/ST students will be given as per norms of the Government of Tamil Nadu.

An entrance examination (objective type questions) will be conducted for eligible applicants. The merit list will be prepared with 50% marks for entrance examination and 50% marks for Part III score in B.Sc. Then admission will be based on merit and reservation policy of the Government of Tamil Nadu.

3. SCHEME OF THE EXAMINATION

This program is under Choice Based Credit System of the University and a successful candidate should score a minimum of 90 credits in 4 semesters. Each paper is evaluated for 100 marks with Internal 25 marks and External 75 marks. The internal assessment comprises of 3 components -15 marks for written test (average of the best two of 3 tests), 5 marks for Seminar and 5 marks for Assignment.

The semester Question paper pattern for external examination is as follows :

Section A - 10 x 1 = 10 (no choice)

Section B - 5 x 5 = 25 (Internal choice questions)

Section C - 5 x 8 = 40 (Internal choice questions)

The duration of the examination is 3 hours. In order to train the students for National level examinations and Research, End semester examination question paper for each course shall contain 20% questions from problems and 80% questions from theory in Part B and Part C.

Passing minimum in the external examination is 38 out of 75 (that is 50 %). Passing minimum in the aggregate (internal and external marks put together) is 50 out of 100 (that is 50 %). No passing minimum for the internal marks.

Examination, evaluation and classification will be made as per the rules and regulations of the University in force.

Semester	Course Code	Paper Title	Hours Per Week	Exam Hours	Credits	Marks		
						Internal	External	Total
I	1	GROUP THEORY	4	3	4	25	75	100
	2	ANALYSIS I	4	3	4	25	75	100
	3	ORDINARY DIFFERENTIAL EQUATIONS	4	3	4	25	75	100
	4	NUMBER THEORY	4	3	4	25	75	100
	5	ELECTIVE I	3	3	3	25	75	100
	6	PRACTICAL	2	3	2	25	75	100
II	1	RINGS AND MODULES	4	3	4	25	75	100
	2	ANALYSIS II	4	3	4	25	75	100
	3	GRAPH THEORY	4	3	4	25	75	100
	4	PROBABILITY AND STATISTICS	4	3	4	25	75	100
	5	ELECTIVE II	3	3	3	25	75	100
	6	SUPPORTIVE COURSE I	3	3	3	25	75	100
III	1	TOPOLOGY	4	3	4	25	75	100
	2	COMPLEX ANALYSIS	4	3	4	25	75	100
	3	LINEAR ALGEBRA	4	3	4	25	75	100
	4	MEASURE THEORY AND INTEGRATION	4	3	4	25	75	100
	5	ELECTIVE III	3	3	3	25	75	100
	6	SUPPORTIVE COURSE II	3	3	3	25	75	100
IV	1	FUNCTIONAL ANALYSIS	4	3	4	25	75	100
	2	DIFFERENTIAL GEOMETRY	4	3	4	25	75	100
	3	FIELD THEORY AND LATTICES	4	3	4	25	75	100
	4	COMBINATORIAL THEORY	4	3	4	25	75	100
	5	ELECTIVE VII	3	3	3	25	75	100
	6	PROJECT	4	-	6	25	75	100
		TOTAL			**90**			**2400**

INTERNAL - Continuous Internal Assessment External – End Semester Examination

.**LIST OF ELECTIVE PAPERS**

1. Programming in C++
2. Partial Differential Equations

3. Design and Analysis of Algorithms

4. Calculus of variations and Integra Equations
5. Mechanics

6. Representation theory of finite groups

7. Coding Theory
6. Graph Algorithms

8.MATLAB Programming

9. Cryptography

10. Numerical Analysis

SUPPORTIVE COURSE FOR OTHER DEPARTMENT STUDENTS

1. Numerical Methods
2. Introduction to Mathematical Biology
3. Discrete Mathematics
4. Mathematics for Competitive Examinations

First Semester

1. Group Theory

Unit I: Introduction to groups – Dihedral groups –Symmetric groups – Matrix groups- The Quaternion group - Homomorphisms and Isomorphisms – Group actions.

Unit II: Subgroups: Definition and Examples – Centralizers and Normalizer, Stabilizers and Kernels - Cyclic groups and Cyclic subgroups of a group – Subgroups generated by subsets of a group - Quotient Groups and Homomorphisms: Definitions and Examples – more on cosets and Lagrange's Theorem.

Unit III: The isomorphism theorems - Transpositions and the Alternating group -Group Actions: Group actions and permutation representations – Groups acting on themselves by left multiplication- Cayley's theorem. Groups acting on themselves by conjugation – The class equation - Automorphisms.

Unit IV: The Sylow theorems – The simplicity of A_n – Further topics in group theory: p-groups, Nilpotent groups and Solvable groups – Applications in groups of Medium order.

Unit V: Direct and semi-direct products and abelian groups: Direct Products – The fundamental theorem of finitely generated abelian groups – Table of groups of small order – semi direct products.

Text Book: Abstract Algebra (Second Edition) by **David S. Dummit and Richard M. Foote**, Wiley Student Edition (1999),

Unit 1: Chapter 1: (Sections 1.2, 1.3. 1.4, 1.5, 1.6, and 1.7)
Unit 2: Chapter 2: (Sections 2.1, 2.2, 2.3, 2.4) and Chapter 3: (Sections 3.1, 3.2)
Unit 3: Chapter 3: (Sections 3.3, 3.5) and Chapter 4: (Sections 4.1, 4.2, 4.3, 4.4)
Unit 4: Chapter 4: (Sections 4.5, 4.6) and Chapter 6: (Sections 6.1, 6.2)
Unit 5: Chapter 5: (Sections 5.1, 5.2, 5.3, 5.4, 5.5)

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2. Analysis – I

Unit I: Basic Topology: Finite, Countable and uncountable sets – Metric Spaces – Compact Sets – Perfect sets – Connected Sets.

Unit II: Numerical sequences and series: Convergent sequences – Subsequences – Cauchy sequences – Upper and lower limits – Some special sequences - Series – Series of nonnegative terms.

Unit III: The number e – The root and ratio tests – Power series – Summation by parts – Absolute convergence - Addition and multiplication of series – Rearrangements.

Unit IV: Continuity: Limits of functions – Continuous functions – Continuity and compactness – Continuity and connectedness - Discontinuities – Monotonic functions – Infinite limits and limits at infinity.

Unit V: Differentiation: The Derivative of a real function – Mean value theorems - The continuity of derivatives – L'Hospital's rule – Derivatives of Higher order – Taylor's theorem – Differentiation of vector valued functions.

Text Book: Principles of Mathematical Analysis (Third edition) by **Walter Rudin**, McGraw Hill, 1976. Chapters 2, 3, 4 and 5.

3. Differential Equations

Unit I: Linear equations with constant co-efficients – Introduction - Second Order non-homogeneous Equations –Initial value problems – linear dependence and independence – formula for Wronskian.

Unit II: Nonhomogeneous equations of order two - Homogeneous and Non-homogeneousequations of order n –Initial value problems – annihilator method to solve anon-homogeneous equation.

Unit III: Linear equations with variable co-efficents – Initial value problems for the homogeneous equation – solution of the homogeneousequations –Wronskian and linear independence – reduction of the order of a homogeneous equation irst order.

Unit IV: Linear equations with regular singlular points–Euler equation – Second order equations with regular singular points – solutions and properties of Legendre and Bessles equation.

Unit V: Existence and uniqueness of solutions of first order equations –introduction – Equations with variables separated – Exact equations – method of successive approximations – Lipschitz condition – convergence of successive approximations.

Text Book E.A.Codington, An introduction to Ordinary Differential Equations, Prentice Hall of India, New Delhi, 2007. Chapter 2 (Sections 1-8, 10 &11), Chapter 3 (Sections 1-5 & 8) Chapter 4 (Sections1-5) Chapter 5 (Sections 1-6)

4. Number Theory

Unit I: Divisibility and Congruence: Divisibility, Primes, Congruence.

Unit II: Solutions of congruence – the Chinese Remainder theorem-Congruence of degree two, the function $\varphi(n)$ - Congruence of higher degree.

Unit III: Congruence and Quadratic Reciprocity: Prime power Moduli - Prime modulus-congruence of degree two - Power Residues - Quadratic residues - Quadratic reciprocity-The Jacobi symbol.

Unit IV: Some functions of number theory: Greatest integer function - Arithmetic functions -The Moebius inversion formula -The multiplication of Arithmetic functions - Recurrence functions.

Unit V: Primes and Multiplicative Number Theory: Elementary prime number estimates – Dirichlet series – Estimates of arithmetic functions.

Text Book : Content and treatment as in **An Introduction to the Theory of Numbers**, by Ivan Niven and H. S. Zuckerman, Fifth Edition, Wiley Eastern Limited, New Delhi,1994.

Chapter 1(Sections 1 to 3), Chapter 2 (Sections 1 to 3, 5 to 9), Chapter 3 (Sections 1 to 3) Chapter 4 (Sections 1 to 4) and Chapter 8 (Sections1 to 3).

5. Elective – I

6. Practical

Second Semester

1. Rings and modules

Unit I: Introduction to Rings: Examples: Polynomial rings- Matrix rings and group rings -Ring Homomorphisms and quotient rings - Properties of Ideals - Rings of fractions.

Unit II: The Chinese remainder theorem – Euclidean domains, principal ideal domains and unique factorization domains: Euclidean domain - Principal ideal domains.

Unit III: Unique factorization domains - Polynomial rings: Definitions and basic properties – Polynomial rings over fields.

Unit IV: Polynomial rings that are unique factorization domains – Irreducibility criteria – Polynomial ring over fields.

Unit V: Introduction to Module Theory: Basics definitions and examples – Quotient modules and Module homomorphism – Generation of modules, Direct sums, and free modules.

Text Book: Abstract Algebra (Second Edition) by **David S. Dummit and Richard M. Foote**, Wiley Student Edition (1999),

Unit 1: Chapter 7: (Sections 7.2, 7.3. 7.4, 7.5 and 1.6)
Unit 2: Chapter 7: (Sections 7.6) and Chapter 8: (Sections 8.1, 8.2)
Unit 3: Chapter 8: (Section 8.3) and Chapter 9: (Sections 9.1, 9.2)
Unit 4: Chapter 9: (Sections 9.3.5, 9.4, 9.5)
Unit 5: Chapter 10: (Sections 10.1, 10.2, 10.3)

2. **Analysis – II**

Unit I: The Riemann-Stielitjes integral: Definition and existence of the integral- Properties of the integral - Integration and Differentiation - Integration of vector - Valued functions-Rectifiable Curves.

Unit II: Sequences and Series of functions: Discussion of Main problem - Uniform convergence - Uniform convergence and continuity-Uniform convergence and Integration.

Unit III: Uniform convergence and differentiation- Equicontinuous families of functions-The Stone-Weierstrass theorem.

Unit IV: Functions of Several Variables: Linear transformations - Differentiation -The Contraction Principle –The Inverse function theorem-The Implicit function theorem.

Unit V: Determinants - Derivatives of higher order – Differentiation of Integrals -Integration of Differential forms: Integration - Primitive Mappings-Partitions of unity - Change of Variables.

Text Book: Principles of Mathematical Analysis (Third Edition) by **Walter Rudin,** Mc Graw Hill, 1976, Chapters 6, 7, 9 (except 9.1-9.5, 9.30, 9.31 and 9.32) and Chapter 10 (10.1 to 10.9 only).

3. Graph Theory

Unit I: Graphs - Graph isomorphism-Incidence and adjacency matrices – Subgraphs - Vertex degrees - Path and Connection cycles -Trees - Cut edges and bonds - Cut vertices - Cayley's formula.

Unit II: Connectivity - Blocks - Euler tours – Hamilton cycles.

Unit III: Matchings - Matching and coverings in bipartite graphs-Perfect matchings –. Edge colorings: Edge chromatic number - Vizing's theorem.

Unit IV: Independent sets-Ramsey's theorem-Vertex colorings: Chromatic number-Brook's theorem-Hajos' conjecture-Chromatic polynomials-Girth and chromatic number.

Unit V: Plane and planar graphs -Dual graphs-Euler's formula- The Five Color theorem and The Four Color conjecture -Directed graphs.

Text Book: Graph Theory with Applications by **J.A.Bondy and U.S.R.Murty**, The Macmillan Press Ltd, (1976)Sec. 1.1 - 1.7 2.1 - 2.4, Sec.3.1 &3.2, 4.1& 4.2, Sec. 5.1- 5.3, 6.1 &6.2, Sec. 7.1, 7.2, 8.1 – 8.5, Sec,9.1 - 9.3 & 9.6 and 10.1.

4. Probability and Statistics

Unit I: The probability set function – Random variables – Probability density function – Distribution function – Mathematical expectation – Special mathematical expectations – Chebyshev's Inequality.

Unit II: Conditional probability – Marginal and conditional distributions – Stochastic independence Some special distributions: The Binomial, Trinomial and Multinomial distributions – The Poisson distribution.

Unit III: The Gamma and Chi-Square Distributions – The Normal distribution- The Bivariate normal distribution. Distributions of functions of random variables - Sampling theory – Transformations of variables of the discrete type – Transformations of variables of the continuous type.

Unit IV: The β, t and F distributions- Distributions of order statistics- The moment generating function technique. The distributions of $\overline{X}$ and nS^2/σ^2 - Expectations of functions of random variables.

Unit V: Limiting distributions, Stochastic convergence- Limiting moment generating functions – The Central limit theorem – Some theorems on limiting distributions.

Text Book: Introduction to Mathematical Statistics (Fourth Edition) by Robert V. Hogg and Allen T. Craig. Chapters 1, 2 (except 1.1, 1.2, 1.3, 1.8 and 2.3), Chapters 3, 4 (except 4.5) and Chapter 5.

5. Elective – II

6. Supportive course

Third Semester

1. Topology

Unit I: Topological spaces - Basis for a topology – The order topology – The product topology on X x Y – The subspace topology - Closed sets and limit points - Continuous functions.

Unit II: The product topology – connected spaces, components and local connectedness.

Unit III: Compact spaces - Local compactness.

Unit IV: The Countability axioms – The Separation axioms - Normal spaces.

Unit V: The Uryshon lemma- The Tietze Extension theorem - Tychonoff theorem .

Text Book: Topology (second edition) by **J. R. Munkres**, Pearson Prentice hall, (2000), Sections 12 to 19, 23, 25, 26, 29 to 33, 35 and 37.

2. Complex Analysis

Unit I: Analytic Functions-Power Series.

Unit II: Conformality -Linear Transformation - Elementary Conformal mapping.

Unit III: Fundamental Theorems-Cauchy's Integral formula-Local properties of Analytic Functions.

Unit IV: General form of Cauchy's theorem (except proof of Cauchy's theorem) -Calculus of Residues – Harmonic functions.

Unit V: Power Series Expansions – Partial fractions and factorizations.

Text Book: Complex Analysis (Third edition) by **Lars V. Ahlfors**, MacGraw Hill, 1979, Chapters 2 to 4 (except section 4.5) and Chapter 5 (Sections 5.1, 5.2 (except 5.2.4and 5.2.5)).

3. Linear Algebra

Unit I : Systems of linear Equations – Matrices and Elementary Row operations – Row - Reduced echelon Matrices – Matrix Multiplication – Invertible Matrices – Vector spaces – Subspaces – Bases and Dimension – Computations concerning Subspaces.

Unit II : 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 III : Commutative rings – Determinant functions – Permutations and the uniqueness of determinants – Classical Adjoint of a (Square) matrix – Inverse of an invertible matrix using determinants.

Unit IV: Characteristic values – Annihilating polynomials, Invariant subspaces.

Unit V: Simultaneous triangulation and simultaneous Diagonalization – Direct-sum Decompositions - Invariant Direct sums – The Primary Decomposition Theorem.

TEXT BOOK : Kenneth Hoffman and Ray Kunze, **Linear Algebra**, Second Edition, Prentice – Hall of India Private Limited, New Delhi :1975.

Chapters 1 to 3, Chapter 5 (5.1 to 5.4) and Chapter 6.

4. Measure Theory and Integration

Unit I: Lebesgue Measure: Introduction-Outer measure-Measurable sets and Lebesgue measure- The non-measurable set - Measurable functions-Littlewood's three principles.

Unit II: The Lebesgue Integral: The Riemann integral-The Lebesgue integral of a bounded function over a set of finite measure-The integral of a nonnegative function-The general Lebesgue integral.

Unit III: Differentiation and Integration: Differentiation of monotone functions-Functions of bounded variation-Differentiation of an integral-Absolute continuity.

Unit IV: Measure and Integration-Measure spaces-Measurable functions-Integration-Signed measures-The Radon-Nikodym theorem.

Unit V: Measure and Outer Measure: Outer measure and measurability-The Extension Theorem-Product measures.

Text Book: Real Analysis by H.L. Royden,Third Edition, Macmillan, New York, 1988

Chapters 3,4 (except 4.5),5 (except 5.5),11(except 11.4 and 11.7) and 12 (Sections 12.1, 12.2 and 12.4 only).

5. Elective – III

6. Supportive course – II

Fourth Semester

1. Functional Analysis

Unit I : Normed Spaces, Banach Spaces – Further properties of normed spaces – finite dimensional normed spaces and Compactness - Linear operators – bounded linear operators .

Unit II : Linear functionals – linear operators and functionals on finite dimensional spaces – normed spaces of operators and dual spaces - Inner product space, Hilbert space – Further properties of inner product spaces.

Unit III : Orthogonal complements and direct sums – Orthonormal sets and sequences – series related to orthonormal sets and sequences – Total orthonormal sets and sequences – Representation of functionals on Hilbert spaces – Hilbert Adjoint operator - self adjoint operators, unitary and normal operators.

Unit IV : Hahn-Banach theorem for complex vector spaces and normed spaces – Adjoint operator - Self adjoint, Unitary and Normal operators - reflexive spaces – Uniform boundedness theorem.

Unit V : Strong and weak convergence – Convergence of sequences of operators and functional - Open mapping theorem - Closed graph theorem.

Text Book : Introductory Functional Analysis with Applications by **Erwin Kreyszig**, John Wiley & Sons Publication (2006). Chapter 2, Chapter 3 (except 3.7) and Chapter 4 (except 4.4, 4.10 and 4.11).

2. Differential Geometry

Unit I: Graphs and Level sets - Vector fields-Tangent space.

Unit II: Surfaces - Vector field on surfaces.

Unit III: Gauss map - Geodesics.

Unit IV: Parallel Transport - Weingarten map.

Unit V: Curvature of plane curves-Curvature of surface - Arc length and Line Integrals.

Text Book: Elementary topics in Differential Geometry by A. Thorpe, Chapters 1 to 12.

3. Field Theory and Lattices

Unit I: Field theory: Basic Theory of field extensions - Algebraic Extensions.

Unit II: Splitting fields and Algebraic closures - Separable and inseparable extensions - Cyclotomic polynomials and extensions.

Unit III: Galois Theory: Basic definitions - The fundamental theorem of Galois Theory - Finite Fields.

Unit IV: Composite extensions and simple extensions - Cyclotomic extensions and abelian extensions over Q.

Unit V: Lattices and Boolean algebra - posets – semilattices – sublattices -distributive lattices – modular lattices.

Text Book:

1. Abstract Algebra (Second Edition) by **David S. Dummit and Richard M. Foote**, Wiley Student Edition (1999) for Units I to IV.
2. Applied Modern Algebra, by Birkhoff and Bartee for Unit V

Unit I: Chapter 13: (Sections 13.1, 13.2)
Unit II: Chapter 13: (Sections 13.4,13.5, 13.6)
Unit III: Chapter 14: (Sections 14.1,14.2, 14.3)
Unit IV: Chapter 14: (Sections 14.4, 14.5)
Unit V: Chapter 9 (Sections 9.1- 9.6)

4. Combinatorial Theory

Unit I: Permutations and Combinations - rule of sum and product – distributions of distinct objects – Distributions of non-distinct objects.

Unit II - Generating functions for combinations – Enumerators for permutations – Distributions of distinct objects into non-distinct cells – partitions of integers – Ferrers graph – elementary relations.

Unit III: Recurrence relations – Linear recurrence relations with constant co-efficients – solution by the technique of generating functions – a special class of non-linear difference equation - recurrence relations with two indices.

Unit IV: The principle of inclusion and exclusion – general formula – derangements – rook polynomials – permutations with forbidden positions.

Unit V: Polya's theory of counting Equivalence classes under a permutation groups – Equivalence classes of functions – Weights and inventories of functions – Polya's fundamental theorem – Generalization of Polya's theorem. .

Text Book: Introduction to Combinatorial Mathematics by C.L. Liu, McGraw Hill(1968) Chapters 1 to 5.

5. Elective – IV

6. Project

Syllabus for Elective Papers

1. Programming in C++

Unit I: Tokens, Expressions and Control structures-Functions in C++.

Unit II: Classes and Objects.

UnitIII: Constructors and Destructors- Operator overloading and type conversions.

Unit IV: Inheritance: Extending classes-Pointers, \virtual Functions and Polymorphism.

Unit V: Working with files.

Text Book: Objected Oriented Programming with C++ by E. Balagurusamy (Third Edition), Chapters 3 to 9 and 11.

2. Partial Differential Equations

Unit I : Non-linear partial differential equations of the first order – Cauchy's method of characteristics – compatible system of first order equations –Charpits method –special types of first order equations –Jacobi'smethod.

Unit II: Partial differential equations of second order – the origin of second orderequations – linear partial differential equations with constant co-effieients – Equations with variable coefficients –Characteristic curves of second order equations –characteristics of equations in three variables.

Unit III: The solution of linear hyperbolic equations – separation of variables – the method of integral transform – non-linear equations of the second

Unit IV: Laplace's equation – the occurrence of Laplace's equation in Physics – Elementary solutions of Laplace's equation – Families of equipotential surfaces Boundary value problems – separation of variables – Problems with axial symmetry.

Unit V: The wave equation: the occurrence of wave equation in Physics – elementary solutions of the one dimensional wave equation –Vibrating membranes: Applications of the calculus of

variations – three dimensional problems. The diffusion equations: Elementary solutions of the diffusion equation – separation of variables – the use of integral transform

Text Book:

Ian N. Sneddon, Elements of Partial Differential Equations, International edition, McGraw Hill, Singapore 1957.
Chapter 2 (Sections7-11 &13), Chapter 3 Sections 1,4- 11) Chapter 4 (Sections 1-6), Chapter5 (Section 1,2,4 &5), Chapter 6 (Sections 3-5)

3. MATLAB Programming

Unit I: MATLAB ENVIRONMENT: MATLAB windows - Variables - Working with Matrices - Saving Variables - Script M-files. PREDEFINED MATLAB FUNCTIONS: Elementary Math functions - Trigonometric functions - Data analysis functions - Defining matrices - Using the colon operator - Special values and functions.

Unit II: PLOTTING: Two dimensional plots - Basic plotting - Line, color, and mark style- Axes scaling - Other types of two dimensional plot - Three dimensional plotting - Three dimensional line plot - Surface plots.

Unit III: PROGRAMMING IN MATLAB: Problems with two variables - Input/output - User defined Input - Output options - Functions - Statement level control structures - Relational and logical operators – Loops.

Unit IV: MATRIX COMPUTATIONS: Matrix operations and functions -Solutions to system of linear equations - Special Matrices. SYMBOLIC MATHEMATICS: Symbolic Algebra - Equation Solving - Differentiation and Integration.

Unit V: NUMERICAL TECHNIQUES: Interpolation - Numerical Integration - Numerical Differentiation.

Text Books: Delores M. Etter, David C. Kuncicky and Holly Moore, Introduction to MATLAB, Dorling Kindersley (India) Pvt. Ltd. New Delhi (2009).

Sec. 1.1 - 1.5, Sec. 2.1 to 2.7, Sec. 3.1 - 3.9, Sec. 4.1 - 4.9Sec. 5.1 - 5.3, Sec. 6.1 - 6.3,Sec. 7.1 - 7.3.

4. Design and Analysis of Algorithms

Unit I: Growth of functions-Recurrences

Unit II: Heap sort- Quick sort.

Unit III: Elementary data structures-Binary search trees-Red black trees.

Unit IV: Elementary graph algorithms-Minimum spanning trees.

Unit V: Single source shortest paths–All-pairs shortest paths.

Text Book: Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Chapters 3 , 4, 6 (6.1 to6.4) 7 (7.1, 7.2), 10 (except 10.3), 12 (12.1-12.3), 13, 22, 23, 24 (except 24.5) and 25.

5. Numerical Analysis

Unit I: Number Systems and Errors: The Representation of Integers-The Representation of Fractions-Floating point arithmetic- Loss of Significance and Error Propagation – Computational Methods for error estimation-Some comments on convergence of sequences-Some mathematical preliminaries

Unit II: Interpolation by polynomials: Polynomial forms- Existence and Uniqueness of the Interpolating polynomial-The divided difference table- The error of the interpolating polynomial-Interpolation in a function table based on equally spaced points.

Unit III: The solution of nonlinear equations: A survey of iterative methods-Fixed point iteration-Polynomial Equations: Real roots-Complex roots and Muller's Method.

Unit IV: Matrices and Systems of Linear equations: The solution of linear systems by elimination-The pivoting strategy - The triangular factorization.

Unit V: Differentiation and Integration: Numerical differentiation-Numerical Integration: Some basic rules-Composite rules.

Text Book: Elementary Numerical Analysis-An algorithmic approach by Samuel D. Conte and Carl de Boor, Sections 1.1 to 1.7, 2.1 to 2.3, 2.5, 2.6, 3.1, 3.3, 3.6, 3.7, 4.2 to 4.4, 7.1, 7.2 and 7.4.

6. Mechanics

Unit I: Statics in space.

Unit II: Kinematics, Kinetic Energy and Angular Momentum.

Unit III: Methods of Dynamics in space.

Unit IV: Applications in Dynamics in space-Motion of a particle.

Unit V: Applications in Dynamics in space-Motion of a rigid body.

Text Book: Principles of Mechanics by John A. Synge and Byron A. Griffith, Chapters 10 to 14.

7. Representation Theory of finite groups

Unit I: Foundations: Introduction – Group characters – Representation modules – Regular representation. Representation theory of rings with identity: Some fundamental lemmas.

Unit II: The principle indecomposable representations – The radical of a ring – Semi-simple rings – The Wedderburn structure theorems for semi-simple rings – Interwining numbers.

Unit III: Multiplicities of the indecomposable representation – The generalized Burnside theorem. The representation theory of finite groups: The group algebra – The regular representation of a group- Semi-simplicity of the group algebra- The centre of the group algebra.

Unit IV: The number of in-equivalent irreducible representations – relations on the irreducible characters – The module of characters over the integers – The Kronecker product of two presentations – Linear characters – Induced representations and induced characters.

Unit V: Applications of the theory of characters: Algebraic numbers – Some results from the theory of characters – Normal subgroups and the character table – Some classical groups.

Text book: Representation Theory of Finite groups by Martin Burrow, Chapters 1(except section 4), 2, 3, and 4.

8. Coding Theory

Unit I: Mathematical Background: Algebra – Krawtchouk Polynomials – Combinatorial theory- Shannon's Theorem: Introduction - Shannon's Theorem.

Unit II: Linear codes: Block codes – Linear codes – Hamming codes - Majority logic decoding – Weight Enumerators – The Lee metric.

Unit III: Some good codes: Hadamard codes and generalizations – The binary Golay code – The ternary Golay code- Constructing codes from other codes - Reed-Muller code – Kerdock codes.

Unit IV:. Bound on codes: The Gilbert bound – Upper bounds – Cyclic codes: Definitions- Generator matrix and check polynomial – Zeros of a cyclic code.

Unit V: The idempotent of a cyclic code – Other Representations of cyclic codes – BCH codes – Decoding BCH codes- Binary cyclic codes of length 2n (n odd).

Text Book: Introduction to Coding Theory by J. H. Van Lint, Chapters 1 (except 1.4), 2 (Sections 2.1 and 2.2 only), 3, 4, 5 (except 5.3), and Chapter 6 (except 6.8, 6.9 and 6.11).

9. Graph Algorithms

Unit I: An introduction to algorithms: Algorithmic complexity. Trees: Depth-First search- DFS: a tool for finding blocks – Breath - First search.

Unit II: Minimum spanning tree problem - Paths and Distance in graphs: Distance in graphs – Distance in weighted graphs.

Unit III: Matchings and factorizations : An introduction to matching – Maximum Matchings in bipartite graphs – Maximum matchings in general graphs.

Unit IV: Eulerian graphs : An introduction to Eulerian graphs – Characterizing Eulerian graphs again – The Chinese Postman problem – Eulerian Digraphs.

Unit V: Hamiltonian graphs: An introduction to Hamiltonian graphs – Characterizing Hamiltonian graphs- The Travelling salesman problem

Text Book: Applied and Algorithmic Graph Theory by Gary Chartrand and Ortrud R. Oellermann, Sections 2.1, 3.2 - 3.6, 4.1, 4.2, 6.1 - 6.3, 7.1 - 7.4, 8.1 to 8.3.

10. Cryptography

Unit I: Euclidian Algorithm, Extended Euclidian Algorithm and itsefficiency for huge numbers. Factoring in primes. Congruences and Residue Class Rings, Order of group elements, Multiplicative group of residues mod n (large). Euler-FermatTheorem, Fast Exponentiation.(Chapter 1 & 2).

Unit II: Encryption, Symmetric and Asymmetric Cryptosystems, Linear Block Ciphers and its Crypto analysis.Probability and Perfect Secrecy, One-Time-Pad.Prime Number Generation with probabilistic algorithm for huge primes: Fermat Test, Carmichael Numbers, Miller-Rabin-Test. (Chapters 3, 4 & 7).

Unit III: Public Key Encryption: Idea, Security, RSA-Cryptosystem, Diffie-Hellmann Key Exchange. (Chapter 8).

Unit IV: Cryptographic Hash functions, Compression functions: Birthday attack, Message Authentification Code (MAC) (Chapter 11)

Unit V: Digital Signatures: Idea, Security, RSA signatures. Elliptic curves over a finite field. (Chapters 12 & 13).

Text Book : Johannes A. Buchmann, Introduction to Cryptography, Second edition, Springer, 2001.

11. Calculus of Variations and Integral Equations

Unit I: Calculus of Variations and Applications: Maxima and Minima - The Simplest case-Illustrative examples-Natural boundary conditions and transition conditions – The variational notation-The more general case.

Unit II: Constraints and Lagrange multipliers-Variable end points - Sturm- Liouville problems-Hamilton's principle-Lagrange's equations

Unit III: Integral Equations: Introduction – Relations between differential and integral equations – The Green's function – Alternative definition of the Green's function.

Unit IV: Linear equation in cause and effect: The influence function – Fredholm equations with separable kernels – Illustrative example.

Unit V: Hilbert – Schmidt theory – Iterative methods for solving equations of the second kind – Fredholm theory.

Text Book: Methods of Applied Mathematics by Francis B. Hildebrand (Second Edition) Sections 2.1 to 2.11, 3.1 to 3.9 and 3.11.

Syllabus for Practical

List of programs for Practical (Programming in C++)

1. Programs to evaluate sin x, cos x, e^{-x} to 0.0001% accuracy.
2. Program to calculate the variance and standard deviation of a set of numbers.
3. Program to find product of matrices, inverse of a matrix using functions.
4. Macro that obtains largest of three numbers.
5. Define a class of students and prepare a statement containing name, total marks of Ranks(using functions).
6. Program to check whether a number/ string is a palindrome without using the corresponding standard function.
7. Define a class string and exhibit the use of string manipulations.
8. Create a class FLOAT that contains one float data. Overload all the four arithmetic operators so that they operate on the objects of FLOAT.

9. Define a class String. Use overload = = operator to compare two strings.
10. Program to illustrate interpolation of constructors when the classes are inherited.
11. Program to illustrate multilevel and multiple inheritance.
12. Program using array of functions.
13. Program using function pointers.
14. Create a data file showing how to add a new item to the file, how to modify the details of an item and how to display the contents of the file.
15. Program that reads a text file and creates another file that is identical except that every sequence of consecutive blank spaces is replaced by a single space.

Syllabus for Supportive Course

(for other Department students)

1.Numerical Methods

Unit I: Introduction: Errors in numerical calculations – Mathematical preliminaries – Solution of Algebraic and Transcendental equations: The Bisection method – The method of false position.

Unit II: Newton-Raphson method – Introduction - The Iteration method - Muller's method – Graffes' root squaring method

Unit III: Interpolation: Newton's Formulae for interpolation – Central difference interpolation formulae.

Unit IV: Numerical Differentiation and integration: Numerical differentiation – Numerical integration

Unit V: Matrices and Linear systems of equations: Solution of Linear systems – Iterative methods - The Eigen value problem

Text Book: Introductory Method of Numerical Analysis (Third Edition) by S.S. Sastry, Sections 1.3, 2.1 to 2.5, 2.7, 2.8, 3.6, 3.7, 5.2, 5.4(5.4.1 to 5.4.3 only), 6.4 and 6.5.

2. Introduction to Mathematical Biology

Unit I: Cell growth-Exponential growth and Decay – Determination of growth or decay rates-The method of least squares – Nutrient Uptake by a cell –Inhomogeneous Differential equations.

Unit II: Growth of a Microbial colony – Growth in a Chemo stat – Interacting Populations – Mutation and Reversion in Bacterial growth.

Unit III: Enzyme Kinematics: The Michaelis – Menton Theory – Enzyme Substrate – Inhibitor system – Cooperative dimmer – Allosteric enzymes – Other alloseteric theories.

Unit IV: The Cooperative dimmer – Allosteric enzymes – Other alloseteric theories.

Unit V: Hemoglobin – Graph theory and Steady state Enzyme Kinetics – Enzyme – Substrate – Modifier system – Enzyme Substrate – Activator system.

Text Book: Introduction Mathematical Biology by S.I. Rubinow (Dover publications), Chapter I and Chapter 2 (Sections 2.1,2.3, to 2.11).

3. Discrete Mathematics

Unit I: Sets and Relations.

Unit II: Functions.

Unit III: Logic

Unit IV: Algebra of propositions.

Unit V: Boolean algebra.

Text Book: Seymour Lipschutz and Marc Lipson, Discrete Mathematics (Second Edition, 1999), Chapter 1 - 4, and 15.

4. Mathematics for Competitive Examinations

Unit I: Problems on Ages – Percentage.

Unit II: Profit and Loss – Ratio and Proportion.

Unit III: Time and Work – Simple Interest.

Unit IV: Compound Interest – Calendar.

Unit V: Stocks and Shares – Bankers' Discount.

Text Book: Quantitative Aptitude by R.S. Aggarwal (Edition 1996), Chapters 8, 10 to 12, 15, 21, 22, 27, 29 and 31.

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MANONMANIAM SUNDARANAR UNIVERSITY

TIRUNELVELI

Integrated M.Sc Mathematics (CBCS)

(For those who join the course from the Academic year 2017-18)

REGULATIONS, SCHEME OF EXAMINATIONS AND SYLLABUS

A. Regulations

A1 : Course objectives:

- The idea of the course is to attract the young talents to Mathematics keeping in line with the policy of the Government of India to promote education in pure sciences. The syllabus is framed keeping this goal in mind.
- Elective subjects in the fourth and fifth years are planned to suit competitive examinations like NET and SLET.
- Students undergoing this course will have the opportunity of choosing research / teaching at leading research institutions or a career in corporate sectors.
- To enable the students to have a thorough exposure to the different branches of Mathematics so as to gain a comprehensive knowledge of Mathematics.
- To cultivate logical thinking and analytical skills which sharpens their concentration and provides patience to grapple with life outside the campus.

A2 : Duration of the Course :

The duration of the course is 5 years under choice based credit system. The minimum number of credits to be earned during the first three years of the course is 140. Students who have passed all the papers for the first three years of the course will be given a B.Sc Degree at the end of the third year. Students who have passed all the papers for the fourth and fifth years of the course will be given M.Sc Degree. Students have an option to exit from the program with a B.Sc Degree alone.

Students who have passed all the papers for the first three years of the course alone will be permitted to continue the course in the 4^{th} year. Students who are not successful at the end of the third year will not be permitted to continue or rejoin the course in future under the integrated mode. The minimum number of credits to be earned during the last two years of the course to get M.Sc Degree is 90.

A3 : Eligibility norms for admission:

Those who seek admission to Integrated M.Sc. Mathematics Degree Course must have passed the Higher Secondary Examinations (+ 2) conducted by the Board of Higher Secondary Examination, Tamil Nadu with the subjects Mathematics, Physics and Chemistry or

an equivalent course of study with 60% of marks in Mathematics (55% for SC/ST/SCA applicants)

A4: Mode of Admission: An entrance examination (objective type questions) will be conducted for eligible applicants. The merit list will be prepared for a total of 100 marks with 50 marks for entrance examination and 50 marks for mathematics paper in + 2. Then admission will be based on merit and reservation policy of the Government of Tamil Nadu.

B. Scheme of examinations :

Each paper is for 100 marks with Internal 25 marks and External 75 marks.

For Semesters I – VI, the internal assessment comprises of 2 components – 20 marks for written test (average of the best two of 3 tests) and 5 marks for Assignment.

For Semesters VII – X, the internal assessment comprises of 3 components -15 marks for written test (average of the best two of 3 tests), 5 marks for Seminar and 5 marks for Assignment.

The semester Question paper pattern for external examination is as follows :

Section A - 10 x 1 = 10 (Objective type questions)

Section B - 5 x 5 = 25 (Internal choice questions)

Section C - 5 x 8 = 40 (Internal choice questions)

The duration of the examination is 3 hours. Passing minimum in the external examination – 38 out of 75 (50 %). Passing minimum in the aggregate (internal and external marks put together) – 50 out of 100 (50 %). No passing minimum for the internal examinations.

Examination, evaluation and classification will be made as per the rules and regulations of the University in force.

C. SYLLABUS

The syllabi for Part – I (Language) , Part – II (English) and Part IV (Environmental Studies and Value based education etc) are as in B.Sc. Mathematics Program of affiliated Colleges.

The structure and syllabi of other subjects are as below :

	Part	Su	Sub.	Subject Title	Hrs/	L	T	P	Cre

Sem (1)	I/II/III /IV/V (2)	b. No (3)	Status (4)	(5)	wee k (6)	Hrs/ wee k (7)	Hrs/ week (8)	Hrs/ wee k (9)	dits (10)
I	I	1	Language	Tamil / Other Language	4	4	0	0	4
	II	2	Language	English	4	4	0	0	4
	III	3	Core -1	Theory of Equations	4	4	0	0	4
	III	4	Core- 2	Calculus	4	4	0	0	4
	III	5	Allied - I	Physics – I	3	3	0	0	3
	III	6	Allied - I	Practical	4	0	0	4	2
	IV	7	Common	Environmental Studies	2	2	0	0	2
II	I	8	Language	Tamil / Other Language	4	4	0	0	4
	II	9	Language	English	4	4	0	0	4
	III	10	Core -3	Analytical Geometry	4	4	0	0	4
	III	11	Core- 4	Vector Calculus	4	4	0	0	4
	III	12	Allied - I	Physics – II	3	3	0	0	3
	III	13	Allied - I	Physics – II (Practical)	4	0	0	4	2
	IV	14	Common	Value based education / Social Harmony	2	2	0	0	2
III	I	15	Language	Tamil/ Other Language	4	4	0	0	4
	II	16	Language	English	4	4	0	0	4
	III	17	Core -5	Real Analysis	4	4	0	0	4
	III	18	Allied – II	Chemistry – I	3	3	0	0	3
	III	19	Allied – II	Practical	4	0	0	4	2
	III	20	Skill based Subject	Programming in C	4	4	0	0	4
	IV	21	Non-major Elective	Basic Mathematics	3	3	0	0	3
	IV		Mandatory	Yoga	2	2	0	0	2
	I	22	Language	Tamil / Other Language	4	4	0	0	4
	II	23	Language	English	4	4	0	0	4
	III	24	Core - 6	Differential Equations	4	4	0	0	4
	III	25	Allied – II	Chemistry – II	3	3	0	0	3

IV	III	26	Allied – II	Chemistry II – Practical	4	0	0	4	2
	III	27	Skill based Subject	Latex and Matlab	4	4	0	0	4
	IV	28	Non-major Elective	Discrete Mathematics	3	3	0	0	3
	IV		Mandatory	Computers for digital era	2	2	0	*	2
	V		Extension activity	NCC/NSS/YRC/YWF	2	0	0	2	1
V	III	29	Core – 7	Abstract Algebra	4	4	0	0	4
	III	30	Core – 8	Theory of Metric Spaces	4	4	0	0	4
	III	31	Core – 9	Statics	4	4	0	0	4
	III	32	Major Elective-I		3	3	0	0	3
	III	33	Major Elective-II		3	3	0	0	3
	IV	34	Skill based Subject (common)	Personality Development/ Effective Communication/ Youth Leadership	4	4	0	0	4
VI	III	35	Core -10	Complex Analysis	4	4	0	0	4
	III	36	Core -11	Linear algebra	4	4	0	0	4
	III	37	Core -12	Graph Theory	4	4	0	0	4
	III	38	Core -13	Dynamics	4	4	0	0	4
	III	39 40.	Major Elective-III Group Project		3 4	3 4	0 0	0 0	3 4
				Total	154				140

* 10 hours for practical.

L- Lecture T- Tutorials P- Practicals

List of Major Elective Papers

1. Elementary Number Theory
2. Statistics - I
3. Statistics – I
4. Numerical Methods
5. Linear Programming
6. Combinatorial Mathematics
7. Coding Theory
8. Operations Research
9. Mathematical Programming Using JAVA
10. Integral transforms and applications
11. Special Functions
12. Mathematical Logic
13. Astronomy

DETAILED SYLLABUS

Semester I

Core Paper - 1 : Theory of Equations (60 hours)

Unit I : Theory of equations : Remainder theorem – imaginary roots – irrational roots – relations roots and coefficients **(12 hours)**

Unit II : Symmetric function of the roots - Sum of the powers of the roots – Newton's theorem **(12 hours)**

Unit III : Transformations of equations - Transformations of equations in general **(12 hours)**

Unit IV : Reciprocal equations - Descarte's rule of signs - Rolle's theorem – multiple roots. **(12 hours)**

Unit V : The Cubic equation - Cardan's method - The Biquadratic equation – Ferrari's method. **(12 hours)**

Text Books : 1. Algebra (Volume I) – T.K.Manicavachagom Pillay, T. Natarajan and K.S. Ganapathy, S.Viswanathan (Printers and Publishers) Pvt. Ltd. 2008 (Unit I : Chapter 6 - Sections 1 to 12, Unit II : Chapter 6 – Sections 13 to 15, 21 Unit III : Chapter 6 – Sections 16, 24, 25, 26)

2. Set theory, Number System and theory of equations, S. Arumugam and A. Thangapandi Isaac, New gamma publishing house, 1992 (For Unit IV; Chapter 5 – Sections 5.8 and 5.9)

Core Paper - 2 : Calculus (60 hours)

Unit I : Limit of a real function – Continuity. **(12 hours)**

Unit II: Derivative - Simple examples - Rolle's theorem - Mean value theorem. **(12 hours)**

Unit III : Envelopes – Curvature – Circle, radius and centre of curvature - Radius of Curvature in Cartesian, parametric and polar co-ordinates. **(12 hours)**

Unit IV : Evolutes and involutes – Pedal equation of a curve. **(12 hours)**

Unit V : Linear asymptotes – Tracing of curves. **(12 hours)**

Text Books:

1. Methods of Real Analysis : Richard R. Goldberg , Oxford & IBH Publishing (for Units I and II)

2. Calculus Vol. I : S. Narayanan and T.K.Manicavachagom Pillay, S.Viswanathan Printers and Publishers Pvt. Ltd. (for Units III,IV and V ; Chapters X, XI, XIII).

Allied – I
Physics - I
Physics I : Practical

(Syllabus as prepared by Physics BoS).

Semester II

Core Paper - 3 : Analytical Geometry (60 hours)

Unit I : . Direction cosines – direction ratios – equation of planes – standard form - normal form – intercept form **(12 hours)**

Unit II : Angle between two planes - Lines – symmetrical form. Angle between two planes- image of a point – image of a line **(12 hours)**

Unit III : Skew lines – shortest distance between two lines – coplanar lines. **(12 hours)**

Unit IV: Sphere – plane section of a sphere – tangent plane - intersection of two spheres- intersection of a plane with sphere **(12 hours)**

Unit V : Cone and Cylinder..

Text books:

1. A text book of Analytical Geometry - Part II – Three dimensions - T.K Manicavachagom Pillay and T. Natarajan - S.Viswanathan Printers and Publishers Pvt. Ltd. - 2008. (for Units III, IV and V , Chapters I to IV and Chapter V- Sections 1 to 7.)

Core Paper - 4 : Vector Calculus (60 hours)

Unit I : Vector differentiation – gradient – divergence – curl – solenoidal and irrotational vector – formulae involving gradient, divergence and curl. **(12 hours)**

Unit II : Vector integration – line integral – double and triple integral. **(12 hours)**

Unit III: Jacobians – change of variables . **(12 hours)**

Unit IV: Line and surface integrals **(12 hours)**

Unit V: Theorems of Green, Stokes and Gauss. **(12 hours)**

Text book: Vector calculus - S. Arumugam and A.Thangapandi Isaac, New gamma publishing house, 2006 (For units I, II,and III- Chapters 5, 6 and & 7) .

Allied – I
Physics II
Physics II - Practical

(Syllabus as prepared by Physics BoS).

Allied - I

Mathematics I (45 hours)

(For students who studied Mathematics at + 2)

Unit I: Theory of equations - Relation between roots and coefficients - symmetric function of the roots in terms of coefficients. **(9 hours)**

Unit II: Matrices - Characteristic equation of a matrix - Eigen values and eigen vectors -Cayley Hamilton theorem and simple problems. **(10 hours)**

Unit III: Differential equation of first order but of higher degree - Equations solvable for p, x, y.

(10 hours)

Unit IV: Laplace transformation - Inverse Laplace transform **(8 hours)**

Unit V: Solving linear differential equations using Laplace transforms. **(8 hours)**

Text: Allied Mathematics, S. Arumugam and Others.

Mathematics I : Practical (30 hours)

MATLAB

1. To find the roots of the quadratic polynomial.
2. To find the reciprocal roots of the polynomial.
3. To find the roots of the symmetric function.
4. To find the eigen value of the square matrix.
5. To find the eigen vector of the square matrix.
6. Solve the first order differential equation using MATLAB.

7. Solve the second order differential equation using MATLAB.
8. To find integration when limits are not given.
9. To find integration when limits are given.
10. Simple 2-D, 3-D plots by using MATLAB.

Mathematics II (45 hours)

(For students who studied Mathematics at + 2)

Unit I: Vector differentiation – Gradient - Divergence and curl. **(10 hours)**

Unit II: . Evaluation of double and triple integrals. **(10 hours)**

Unit III: Vector integration – Line integral, **(8 hours)**

Unit IV: Surface and volume integrals. **(8 hours)**

Unit 5: Green's, Stoke's and Divergence Theorems (statement only) - simple problems. **(9 hours)**

Text Books: 1. Vector Calculus, S. Arumugam & Others.

2. Calculus (Volume II), T.K.Manicavachagom Pillay.

Mathematics – II Practical (30 hours)

MATLAB

1. To calculate exponential and logarithm.
2. To calculate values of Trigonometric function.
3. Creating and working with arrays of numbers.
4. To use trigonometric functions with array arguments.
5. To find sum of geometric series.
6. To compute dot product of vectors and cross product of vectors.
7. To compute box and vector triple product.
8. To compute angle between two vectors.
9. To calculate interest of your money.
10. To define the function using variable as symbol.
11. To find out left and right limit of the given function.
12. To find limit of a function.

Semester III

Core Paper- 5 : Real Analysis (60 hours)

Unit I : Bounded sets – upper and lower bounds - LUB axiom – Archimedean property – Density of rational and irrationals - Positive n^{th} root of a positive real number. **(12 hours)**

Unit II : Sequences- Bounded sequences -monotonic sequences – convergent sequences – divergent and oscillating sequences **(12 hours)**

Unit III : -The algebra of limits. Behaviour of monotonic sequences – some theorems on limit sub sequences – limit points. **(12 hours)**

Unit IV: Cauchy sequences – Cauchy general principle of convergence of sequences. **(12 hours)**

Unit V : Series – infinite series - comparison test - D'Alembert's ratio test - Root test - Cauchy's condensation test. **(12 hours)**

Text book: Sequences and series – S.Arumugam and A. Thangapandi Isaac, New gamma publishing house.

Allied II

Chemistry I

Chemistry I – Practical

(Syllabus as prepared by the BoS in Chemistry)

Skill Based Elective

PROGRAMMING IN C (60 hours)

Unit I : Constants – variables - Data types – operations and Expressions – managing input and output operations **(15 hours)**

Unit II: Decision making and branching - Decision making and looping **(15 hours)**

Unit III: Arrarys - Handling of character strings **(10 hours)**

Unit IV: Structures and unions **(10 hours)**

Unit V: Pointers. **(10 hours)**

Text Book: Programming in ANSI C – E. Balagurusamy, IV Edition, TMH Publishing Company Limited Chapters 2 to 7, 9 - 11.

Non - major Elective

Basic Mathematics (45 hours)

UNIT I : Numbers - Face value and place value of a digit in a number - test of divisibility, Applications of algebraic formulae, unit digit - series. **(10 hours)**

UNIT II : H.C.F. and L.C.M. of numbers - factorization method - common division method, H.C.F. and L.C.M. of decimal fraction - comparison of fractions. **(10 hours)**

UNIT III : Decimal fraction- conversion of decimal into vulgar fraction-operation son decimal fractions- comparison of fractions-recurring decimal-mixed recurring decimal. **(9 hours)**

UNIT IV: Simplification - BODMAS Rule - modulus of a real number - virnaculum - Some real life problems - missing numbers in the expression. **(8 hours)**

UNIT V: Square root and cube root - finding square root by factorization method- perfect square and perfect cube. **(8 hours)**

Text Book: Quantitative Aptitude – R.S. Aggarwal (2014), S. Chand & Co., Chapters 1 to 5

Semester IV

Core Paper 6 - Differential Equations (60 hours)

Unit I : Differential Equations of first order and first degree: Variable separable equation - Homogeneous equations – Non-homogeneous equations – Exact equations. **(12 hours)**

Unit II : Linear differential equations with constant coefficients: Linear differential equations of second order – Homogeneous equations – Fundamental Theorem for the homogeneous equation – Initial value problem – Linear dependence and linear independence of solutions.

(14 hours)

Unit III : General solutions of linear equation $f(D)y = Q(x)$ – Methods for finding the PI in special cases – Euler Cauchy equations – Legendre's linear equations. **(12 hours)**

Unit IV: Formation of Partial Differential Equation – Method of solving First order PDE—Some standard forms – Charpit's. **(12 hours)**

Unit V : Partial Differential Equation of Higher order :Homogeneous Differential equations **(10 hours)**

Text Books:

1. E. Rukmangadachari, Differential Equations Peaerson edition (2012).
2. Arumugam & Isaac, Differential Equations, New Gamma Publishing House, Palayamkottai (2003).

Allied II

Chemistry II

Chemistry II – Practical

(Syllabus as framed by the BoS in Chemistry)

Skill Based Elective

LaTex and MATLAB (60 hours)

Unit I : Document Layout and organization – Document class, Page style, Parts of the document, Text formatting, TeX and its offspring, what's different in latex 2(, Distinguishing LaTeX 2(and basics of LaTeX file. **(12 hours)**

Unit II : Commands and environments-command names and arguments, Environments, Declarations, Lengths, Special characters, Fragile Commands, Exercise. Table of contents, Fine - Tuning text, Word division, Labelling, Referencing, Displayed text – Changing font, Centering and identifying, Lists, Generalized Lists, Theorem like declarations, Tabular stops, Boxes. **(14 hours)**

Unit III : Tables, Printing literal text, Footnotes and marginal notes. Drawing pictures using LaTeX, Mathematical formulas – mathematical environments, Main elements of math mode, Mathematical symbols, Addition elements, Fine – tuning Mathematics. **(12 hours)**

Unit IV : Introduction – Basics of MATLAB , Input-output, File types- Platform dependence – General commands. **(10 hours)**

Unit V : Interactive Computation : Matrices and Vectors – Matrix and array operation-creating and using inline functions-using built – in functions and on-line help-saving and loading data-plotting simple graphs, Basic programming in MATLAB, creating cps files using MATLAB. **(12 hours)**

Text Books :

1. A Guideline to LaTeX - H. Kopka and P.W. Daly, Third edition, Addison – Wesley, London, 1999.

2. Getting started with MATLAB – A quick Introduction for Scientists and Engineers- Rudra Pratap, Oxford University Press, 2003

Non- Major Elective

Discrete Mathematics (45 hours)

Unit I : Mathematical logic: Logical statement or proposition- type of propositions- the propositional calculus - the negation of a proposition- disjunction- conjunction- tautologies and contradictions- logical equivalence - the algebra of propositions- conditional propositions-

converse inverse and contrapositive propositions-the negation of a conditional proposition- biconditional propositions- arguments. **(10 hours)**

Unit II : Set theory: Set- set designation- null sets and unit sets- special sets of numbers- universal set- subsets, proper subsets and equal sets- set operations- union operations- properties of union operation- intersection- properties of intersection operation. **(10 hours)**

Unit III : Distributive properties- complementation- relative complement- properties of complement- properties of difference- symmetric difference- power set- Cartesian products. **(9 hours)**

Unit IV : Relation and functions: Relation- equivalence relation- partition- partial order relation. **(8 hours)**

Unit V : Function – inverse mapping- composition mappings- binary operations- countable and uncountable sets. **(8 hours)**

Text book: Discrete Mathematics - B. S. Vatssa , 3rd Edition , Wishwa Prakashan , Chapters 1, 2 (except 2.20) and 3.

SEMESTER V

Core Paper 7 - Abstract Algebra (60 hours)

Unit I : Semigroups and groups - homomorphisms – subgroups and cosets **(12 hours)**

Unit II : Cyclic groups - Normal subgroups - quotient groups – isomorphism theorems – automorphisms. **(12 hours)**

Unit III : Permutation groups : Cyclic decomposition – alternating group A_n **(12 hours)**

Unit IV : Rings: Types of rings – Subrings and characteristic of a ring – additional examples of rings **(12 hours)**

Unit V : Ideals – homomorphisms – sum and direct sum of ideals – maximal and prime ideals. **(12 hours)**

Text book: Basic Abstract Algebra – P. B. Bhattacharya, S.K.Jain and S.R.Nagpaul , Second Edition , Cambridge University Press

Unit I - Chapter 4 (Sections 1- 3), Unit II - Chapter 4 (Section 4, Chapter 5 (Sections 1 - 3), Unit III - Chapter 7 (Sections 1 & 2), Unit IV- Chapter 9 (Sections 3 - 5), Unit V - Chapter 10 (Sections 1 - 4).

Core paper 8 - Theory of Metric spaces (60 hours)

Unit I : Metric spaces : Definitions and examples- Bounded sets in a metric space- open ball in a metric space- open sets- subspaces. **(12 hours)**

Unit II: Interior of a set - Closed sets - closure, limit point, dense sets – complete metric space: Introduction - Completeness - Baire's category theorem. **(12 hours)**

Unit III: Continuity : Introduction – Continuity – homeomorphism - uniform continuity.

(12 hours)

Unit IV: Connectedness: Introduction- definition and examples- connected subsets of R- connectedness and continuity. **(12 hours)**

Unit V: Compactness: Introduction- compact space- compact subsets of R – equivalent characterization for compactness-compactness and continuity.

(12 hours)

Text Book : Modern Analysis – S. Arumugam and Thangapandi Isaac, New gamma publishing house . Chapters 2, 3, 4 (except section 4.4) ,5 and 6.

Core Paper 9 - Statics (60 hours)

Unit I: Forces acting at a point: Resultant and components: Definition- simple cases of finding the resultant-parallelogram of forces: theorem-analytical expression for the resultant of two forces acting at a point- triangle of forces- perpendicular triangle of forces- converse of the triangle of forces- the polygon of forces- Lami's theorem-an extended form of the parallelogram law of forces-resolution of a force- components of a force along two given directions-theorem on resolved parts- resultant of any number of forces acting at a point: Graphical method- resultant of any number of forces acting at a point: Analytical method- conditions of equilibrium of forces acting upon a particle. **(12 hours)**

Unit II: Parallel forces and moments-: Introduction- to find the resultant of two like parallel forces acting on a rigid body- to find the resultant of two unlike and unequal parallel forces acting on a rigid body- resultant of a number of parallel forces acting on a rigid body- conditions of equilibrium of three coplanar parallel forces-centre of two parallel forces- moment of a force- physical significance of the moment of a force- geometrical representation of a moment- sign of the moment-unit of moment - Varignon's theorem of moments- generalized theorem of moments. **(12 hours)**

Unit III: Couples: Couples- equilibrium of two couples- equivalence of two couples- couples in parallel planes- representation of a couple by a vector- resultant of coplanar couples- resultant of a couple and a force**.** **(12 hours)**

Unit IV: Equilibrium of three forces acting on a rigid body: Rigid body subjected to any three forces-three coplanar forces-conditions of equilibrium-procedure to be followed in solving any statics problem- two trigonometrical theorems - some artifices -problems on parallel forces - miscellaneous problems. **(12 hours)**

Unit V: Coplanar forces: Introduction- reduction of any number of coplanar forces - conditions for a system of forces to reduce to a single force or to a single couple- alternative conditions for a system of forces to reduce to a single force or to a single couple- change of the base point- equation to the line of action of the resultant - conditions of equilibrium of a system of coplanar forces - second form of the conditions of equilibrium- third form of the conditions of equilibrium – solution of problems**.** **(12 hours)**

Text Book: A text book of .Statics – M.K. Venkataraman, Agasthiar publications (Chapters 2 - 6).

Semester VI

Core Paper - 10 : Complex Analysis (60 hours)

Unit I :nth roots of a complex number – circles and straight lines – regions in the complex plane – Riemann's stereographic projection. **(12 hours)**

Unit II : Differentiability – Cauchy Riemann equations – Analytic functions – Harmonic functions – Power series. **(12 hours)**

Unit III : Bilinear transformations – cross ratio – fixed points of Bilinear transformations – Mapping properties. **(12 hours)**

Unit IV:: Complex Integration – Definite integral – Cauchy's theorem – Cauchy's integral formula – higher derivative. **(12 hours)**

Unit V :: Residues, Cauchy's residue theorem – evaluation of definite integrals – Type I and Type II integrals. **(12 hours)**

Text Book: Complex Analysis – S. Arumugam and Isaac , Scitech Publications,

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Core Paper - 11 Linear Algebra (60 hours)

Unit I : Systems of linear equations – Vector spaces – Definitions and examples – Vector subspaces. (12 hours)

Unit II : Basis and dimension of a vector space - Definition of a line – Quotient space. (12 hours)

Unit III : Linear transformations – Representation of linear maps by matrices – Kernel and Image of a linear transformation – Linear isomorphism. (12 hours)

Unit IV : Inner product spaces – Orthogonality – Orthogonal projection onto a line – Orthonormal basis – Gram-Schmidt orthogonalization process. (12 hours)

Unit V : Eigen values and eigen vectors – Cayley–Hamilton theorem – Diagonalization of symmetric matrices. (12 hours)

Text book : Linear algebra – A geometric approach : S. Kumaresan, Prentice-Hall of Indian Pvt. Ltd

Core Paper - 12 Graph Theory (60 hours)

Unit I: Definition and Examples of Graphs – Degrees – subgraphs – isomorphism – independent sets and coverings – intersection graphs and line graphs – matrices – operation on graphs. **(12 hours)**

Unit II: Degree sequences – Graphic sequences – Walks – Trials and Paths – connectedness and components – connectivity. **(12 hours)**

Unit III: Eulerian graphs – Hamiltonian graphs – characterization of trees – centre of a tree – Matchings. **(12 hours)**

Unit IV: Definition and Properties of planar graphs – characterization of planar graphs – chromatic number and chromatic index. **(12 hours)**

Unit V: Chromatic polynomials – definition and basic properties of digraphs – paths and connectedness in digraphs - digraphs and matrices. **(12 hours)**

Text Book: Invitation to Graph Theory – S. Arumugam and S. Ramachandran, Scitech Publications Pvt. Ltd. (Chapters 2 to 10).

Core paper - 13 : Dynamics (60 hours)

Unit I : Projectiles: Definitions – two fundamental principles- to show that the path of a projectile is a parabola- characteristics of the motion of a projectile- projection of a particle from a point at a certain height above the ground –to determine when the horizontal range of a projectile is maximum- two possible directions of projection to obtain a given horizontal range. **(12 hours)**

Unit II : To find the velocity of the projectile- two directions of projection for the particle so as to reach a given point- range on an inclined plane- greatest distance of the projectile- maximum range- two directions of projection for the particle so as to obtain a given range - motion on the surface of a smooth inclined plane- enveloping parabola. **(12 hours)**

Unit III: Collision of elastic bodies: Definitions- fundamental laws of impacts - impact of a smooth sphere on a fixed smooth plane - direct impact of two smooth spheres- loss of kinetic energy due to impact of two smooth spheres. **(12 hours)**

Unit IV: Oblique impact of two smooth spheres- loss of kinetic energy due to oblique impact of two smooth spheres – dissipation of energy due to impact - compression and restitution- impact of a particle on a rough plane. **(12 hours)**

Unit V: Simple Harmonic motion: Simple harmonic motion in a straight line - geometrical representation of a simple harmonic motion - change of origin- composition of two simple harmonic motions - motion of a particle suspended by a spiral spring - horizontal oscillations - simple harmonic motion on a curve- simple pendulum- period of oscillation of a simple pendulum - equivalent simple pendulum - the seconds pendulum - loss or gain in the number of oscillations made by a pendulum. **(12 hours)**

Text Book: A text book of .Dynamics – M.K. Venkataraman, Agasthiar publications

(Chapters 6 (except 6.18) , 8, and 10).

MAJOR ELECTIVE PAPERS

1. Elementary Number Theory (45 hours)

Unit I : The natural numbers - Peano's postulates - Law of trichotomy -Second principle of induction. **(9 hours)**

Unit II : Construction of integers - Divisibility in Z - Division algorithm - Euclidean algorithm. **(9 hours)**

Unit III : Construction of rational numbers - Archimedean ordered field - countability of Q and other properties - Construction of R as a completion of Q. **(9 hours)**

Unit IV : Congruences - The Chinese remainder theorem - Fermat's theorem - Euler's theorem - Wilson's theorem. **(9 hours)**

Unit V : Primes and their distribution - The fundamental theorem of arithmetic - The Sieve of Eratosthenes. **(9 hours)**

Text Books:

1. Number System - S.Arumugam and A.Thangapandi Isaac, New gamma Publishing house (for units I to IV)
2. Elementary number theory - David M.Burton, Tata McGraw Hill(for unit V)

2. Statistics – I (45 hours)

Unit I : Moments, Skewness and Kurtosis – Curve fitting – Method of least squares-Fitting lines - Parabolic, Exponential and logarithmic curves. **(9 hours)**

Unit II : Correlation and regression – Scatter diagram – Karl Pearson's coefficient of correlation – Properties – Lines of regression, Regression coefficient and properties – Rank correlation. **(9 hours)**

Unit III : Theory of attributes: Attributes - Consistency of data – independence and association of data – Yule's coefficient of association. **(9 hours)**

Unit IV : Discrete Probability Distributions: Geometric, Binomial and Poisson distributions – Their moment generating function, Characteristic function, Properties and simple application. **(9 hours)**

Unit V : Continuous Probability Distributions: Beta and Gamma Distributions, Normal distribution – Standard normal distribution – Their properties – Simple Problems – Importance of normal distribution. **(9 hours)**

Text Book: Statistics – S. Arumugam and A. Thangapandi Isaac, New gamma publishing house, June 2007 (Chapters 4, 5,6,8 and 13)

3. Statistics – II (45 hours)

Unit I : Tests of Significance (Large samples) : Sampling distribution – Testing of Hypothesis – Type I and Type II errors – Critical region, level of significance – Test of significance for large samples – Testing a single proportion – Difference of proportions – testing a single mean – Difference of means. **(9 hours)**

Unit II : Tests of Significance (Large samples) : Tests based on t – distribution – Single mean – Difference of means – Tests based on F - distribution. **(9 hours)**

Unit III : Test based on chi square distribution –Goodness of fit - Independence of attributes. **(9 hours)**

Unit IV : Analysis of time series : Time series – Components of a time series _ measurement of trends. **(9 hours)**

Unit V : Analysis of Variance – One criterion of classification - Two criteria of classification – Three criteria of classification. **(9 hours)**

Text Book : Statistics – S.Arumugam and A. Thangapandi Isaac, New gamma publishing House, June 2007 (For Unit I – III - Chapters 14, 15 and 16, For Unit IV – Chapter 10, For Unit V – Chapter 17).

4. Numerical Methods (45 hours)

Unit I: Errors in Numerical Calculations: Errors and their computations - A general error formula - Error in a series. Approximation Solution of Algebraic and Transcendental equations: The Bisection method – The Method of False position - Iteration method - Newton - Raphson method. **(9 hours)**

Unit II: Interpolation: Finite differences - Forward Differences – Backward Differences - Central Differences - Symbolic Relations and Separation of Symbols. Newton‘s Formulae for Interpolation - Gauss‘s central difference formulae - Stirling‘s formula - Interpolation with unevenly spaced points: Lagrange‘s interpolation formula - Inverse Interpolation. **(9 hours)**

Unit III: Numerical Differentiation: Derivatives using Newton‘s Forward Difference Formula – Derivatives using Newton‘s Backward Difference Formula - Derivatives using Stirling‘s Formula - Maxima and Minima of Tabulated Function. Numerical Integration: General Quadrature Formula - Trapezoidal Rule - Simpson‘s 1/3 Rule - Simpson‘s 3/8 Rule. **(9 hours)**

Unit IV : Numerical Solutions of System of Linear Equations: Gauss elimination method - Gauss - Jordan method - Jacobi‘s method - Gauss - Seidel method. **(9 hours)**

Unit V : Numerical Solutions of Ordinary Differential Equations: Solution by Taylor‘s series - Picard‘s method of successive approximations – Runge - Kutta Methods - Milne‘s Predictor -Corrector Method. **(9 hours)**

Text Book : S. S. Sastry, “Introductory Methods of Numerical Analysis”, Prentice Hall of India, Pvt. Ltd., New Delhi (Fourth Edition, 2005).

5. Linear Programming (45 hours)

Unit I : Definition - examples - Mathematical formulation – standard form - Theorems (statements only) - Graphical solution - simplex method. **(9 hours)**

Unit II : The Big-M method – Two phase simplex method **(9 hours)**

Unit III : Duality – The dual of the dual is the primal – Duality theorems (Statements only) – Dual simplex method. **(8 hours)**

Unit IV : Transportation problem – Mathematical formulation – North west corner rule – method of matrix minima - Vogel's Approximation method – MODI optimality test - Assignment problem. **(10 hours)**

Unit V : Integer Programming : Gomory's cutting plane method - Branch and bound method. **(9 hours)**

Text Book : Operations Research – Kanti Swarup , P.K. Gupta and Man Mohan. (Relevant Sections from Chapters 2, 3, 4, 6, 7 and 14). .

6. Combinatorial Mathematics (45 hours)

Unit I : Selections and binomial coefficients - permutations – ordered selections – unordered selections. **(9 hours)**

Unit II : Pairing problems – pairings within a set -pairing between sets – an optional assignment problem. **(9 hours)**

Unit III : Recurrence – Fibonacci type relations – using generating functions. **(9 hours)**

Unit IV : The Inclusion – Exclusion principle – the principle – Rook polynomials. **(9 hours)**

Unit V : Block design and error correcting codes – Block designs – square block designs. **(9 hours)**

Text Books : 1. A first course in combinatorial mathematics – Ian Anderson.

2.Discrete Mathematics and its applications. – Kenneth H. Rosen.

7. Coding Theory (45 hours)

Unit I : Basic assumptions – correcting and detecting error patterns-information rate – effects of error correction and detection – finding the most likely code word transmitted. **(9 hours)**

Unit II : Linear codes – two important sub-spaces-independence –basic, dimension – matrices-Bases for C and C^+ generating matrices on coding. **(9 hours)**

Unit III : Parity check matrices-equivalent codes-distance of a linear code – Linear codes

– cosets – MLD for linear codes - Reliability of IMLD for linear codes. **(9 hours)**

Unit IV : Some bounds for codes – perfect codes-hamming codes-extended codes-The extended Golay code – decoding the extended Golay code – Golay code. **(9 hours)**

Unit V : Polynomials and words-introduction to cyclic codes – Polynomial encoding and decoding –finding cyclic codes – Dual cyclic codes. **(9 hours)**

Text Book : Coding Theory, the essentials - Hoffman et.al.- (Chapters 1 to 4 except sections 3.8,3.9) Marcel Dekker, Inc. Madtrison Avenue, Newyork.

8. Operations Research (45 hours)

Unit I : Inventory – deterministic models - uniform rate of demand, infinite state of production and no shortage - Uniform rate of demand, finite rate of replenishment and no shortage - Uniform rate of demand, instantaneous production with shortages. **(9 hours)**

Unit II : Queuing Theory – General concepts and definitions – classification of Queues – Poisson process – properties of Poisson process models:

i. (M/M/1) : (∞/FCFS)
ii. (M/M/1) : (N/FCFS)
iii. (M/M/S): (∞/FCFS) **(9 hours)**

Unit III : Network Analysis – Drawing Network diagram – critical path method – labelling method – concept of slack and floats on network – PERT – Difference in PERT and CPM. **(9 hours)**

Unit IV : Non – linear Programming : General Non-linear Programming Problem – Problem of constrained maxima and minima – graphical solution – saddle point problems – saddle points and N. L.P.P. **(9 hours)**

Unit V : Non – linear Programming Techniques : Kuhn – Tucker conditions – Non-negative constraints – Quadratic Programming – Wolfe's modified simplex method- Beale's method – Separable convex programming. **(9 hours)**

Text Book : Operations Research – Kanti Swarup, P.K. Gupta and Man Mohan. (Relevant Sections from Chapters 12, 13, 16, 17 and 19).

9. Mathematical Programming Using JAVA (45 hours)

Unit I : Introduction to JAVA – History – overview – JAVA application programs – JAVA Applets – commands line arguments – Data types – variables – comments. **(9 hours)**

Unit II : Objects and Classes – Defining a class – constructors – multiple constructors – wrapper classes – conversion of data types – command live and keyboard input – Attributes and methods – Attributes – overriding – object composition with a simple example. (9 hours)

Unit III : If structure – nested if structure – break and labelled break – switch structures

while loop – do loop – for loop – natural sum and partial sum of series using loops – Divergent series verification using loops – nested loop. (9 hours)

Unit IV : HTML entity encoding in JAVA – JAVA string encoding- attributes – encoding schemes that are supported by the JAVA platform – character encoding – objects , Images and applets in HTML documents. (9 hours)

Unit V : JAVA script – Grammar - objects –functions – inheritance – arrays. (9 hours)

Reference Books:

1. JAVA 2 programming – C. Xavier , Scitech Publication
2. The Complete Reference JAVA 2 – Herbert Schildt.

10. Integral transforms and applications (45 hours)

Unit I: The Laplace transforms : Definition – sufficient conditions for the existence of the Laplace transform – Laplace transform of periodic functions – some general theorems. **(9 hours)**

Unit II : The inverse transforms. **(9 hours)**

Unit III: Applications to differential equations – solving simultaneous equations and differential equations with variable coefficients. **(9 hours)**

Unit IV : Fourier series – even and odd functions – half – range Fourier series. **(9 hours)**

Unit V : Developments in Cosine series – sine series – Change of intervals – Combination of series. **(9 hours)**

Text Book : Calculus – Volume III- S. Narayanan and T. K. Manicavachagom Pillay- S. Viswanathan (Printers and Publishers) Pvt. Ltd.2008 (Chapters 5 and 6 (Sections 1 to 7)

11. Special Functions (45 hours)

Unit I : The exponential function - the logarithmic function – definition of x^a – the trigonometric functions. **(9 hours)**

Unit II : Beta and gamma functions. **(9 hours)**

Unit III : Applications of Gamma functions to multiple integrals. **(9 hours)**

Unit IV : Legendre 's equation - solution – Legendre's function of the first and second kinds - Orthogonal properties of Legendre's Polynomial. **(9 hours)**

Unit V : Bessel's equations and Bessel's functions – Definition and solution – Bessel's function of the first kind of order n – generating function- some trigonometric expansions involving Bessel's functions. **(9 hours)**

Text Book:

1. Methods of Real analysis – R.R.Goldberg (For Unit I – Chapter 8 –Sections 8.2 to 8.4)
2. Calculus - Volume II - S. Narayanan and T. K. Manicavachagom Pillay- S. Viswanathan (Printers and Publishers) Pvt. Ltd. 2008 (For Unit II – Chapter 7 – Sections 1 to 5 : For Unit III Chapter 7 – Section 6).
3. Differential Equations and Integral transforms – U.P. Singh, R.Y. Denis , S. K.D. Dubey and K.N.Singh , Dominant Publishers and Distributors (For Unit IV - 4.1 and for Unit V –

4.2).

12. Mathematical Logic (45 hours)

Unit I : Mathematical Induction – Techniques of proof. **(9 hours)**

Unit II : Mathematical logic – Statements and notations – connectives – statement formulas and truth tables – conditional and biconditional statements – well formed formulas. **(9 hours)**

Unit III : Tautology – equivalence of formulas- duality law – principal disjunctive and conjunctive normal forms. **(9 hours)**

Unit IV : Axiom of choice – Zorn's lemma – well –ordering – Zermelo's theorem – Schroder- Bernstein theorem. **(9 hours)**

Unit V : Ordinals and Cardinals. **(9 hours)**

Text Book:

1. Discrete Mathematics by M.K. Venkataraman . N. Sridharan and N. Chandrasekaran , The National Publishing Company (Edition – June 2006) (For units I, II and III).
2. Naïve set theory by Paul.R. Halmos, Springer International Edition
(For Unit IV –Chapters 15 to 17 and 22; For Unit V – Chapters 19 to 21,24 and 25).

13. Astronomy (45 hours)

Unit I : Spherical Trigonometry – Celestial sphere- Diurnal motion. **(9 hours)**

Unit II : Earth – the zones of Earth – Terrestrial latitudes and longitudes – radius of earth – rotation of earth – Dip of horizon – Twilight. **(9 hours)**

Unit III : Refraction laws of refraction – effects of refraction – cassini's formula horizontal refraction. **(9 hours)**

Unit IV : Geocetric parallax – effects – horizontal parallax of moon – angular diameter – comparison of geocentric parallax and refraction. **(9 hours)**

Unit V : Kepler's laws – longitude of perigee – eccentricity of earth's orbit – verification of Kepler's laws in the case of Earth Newton's deductions form Kepler's laws mean anomaly -Geocentric and heliocentric latitudes and longitudes. **(9 hours)**

Text Book: Astronomy – S. Kumaravelu and Susheela Kumaravelu.

Semester VII to X

Syllabus and scheme of examination as per that of the 2-year M.Sc (Mathematics) Degree program of the University Department of Mathematics.

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MANONMANIAM SUNDARANAR UNIVERSITY,

TIRUNELVELI

DEPARTMENT OF MATHEMATICS

M.Phil Mathematics (CBCS)

(From the academic year 2016-17)

Admission norms, scheme of examination and syllabus

1. OBJECTIVES

Mathematics is one of the fundamental disciplines in science. It is the basic for all the disciplines. This one-year program, consisting of two semesters, aims at providing basic tools and exposure to students who intend to pursue research in Mathematics at the international level.

2. ELIGIBILITY AND ADMISSION

Pass in M.Sc Mathematics with 55 % of marks. SC/ST students will be given 5% concession as per the norms of Government of Tamil Nadu. The students will be admitted to the course through an Entrance Examination. The selection will be based on 50% to marks for M.Sc Mathematics course and 50 % to marks obtained in the entrance examination.

3. SCHEME OF EXAMINATION

Sl. No	Sem-ester	Paper title	Max marks	Passing Minimum	Credits
	I	Commutative Algebra	100	50	8
	I	Banach Algebra & Spectral Theory	100	50	8
	I	Optional (One from the list)	100	50	8
	II	Dissertation	200	100	16

LIST OF OPTIONAL PAPERS

1 Advanced Graph Theory
2 Harmonic Analysis
3 Parallel Algorithms
4 Theory of Near-rings
5 Advanced Calculus
6 Algebraic Graph Theory.

4. EXAMINATION AND EVALUATION

The course will be offered through Choice Based Credit System. All the examination rules applicable to the CBCS of the University shall apply to this course also. Each theory paper will be evaluated for 100 marks in which internal assessment is for 25 marks and end semester examination is for 75 marks. The components for internal assessments are: 15 marks for 3 tests (average of best two tests), 5 marks for seminar and 5 marks for assignment. The passing minimum for each paper is 50 marks with a minimum of 38 marks in the end semester examination.

Question paper pattern for end semester examinations shall be as follows:

Answer All questions (5 x 15 = 75 marks)

Q. No 1 or 2 from Unit I
Q. No 3 or 4 from Unit II
Q. No 5 or 6 from Unit III
Q. No 7 or 8 from Unit IV
Q. No 9 or 10 from Unit V

Necessary number of sub-divisions may be created in each question as per the content of the unit.

The Dissertation & Viva-Voce together carry 200 marks with a passing minimum of 100 marks. The Dissertation carries 150 marks which consists of 75 marks by internal examiner (Guide) and 75 marks by external examiner. The passing minimum for dissertation by the external examiner is 38 marks. The viva-voce examination shall carry a maximum of 50 marks awarded by the two examiners and the passing minimum for Viva Voce together by the two examiners is 25 marks.

The classification of the candidates in the examination shall be on the basis of the system followed for the CBCS in the University Departments.

Paper- I **COMMUTATIVE ALGEBRA**

Unit I: Rings and Ideals – Modules
Unit II: Rings and Modules fractions – Primary Decomposition
Unit III: Integral Dependence and valuations – Chain conditions'
Unit IV: Noetherian Rings – Artin Rings
Unit V: Discrete valuation rings and Dedekind domains

Text Book: Content and Treatment as in Atiyah and Macdonald, Introduction to Commutative Algebra, Chapters 1 to 9.

PAPER II **BANACH ALGEBRA AND SPECTRAL THEORY**

Unit I: Banach algebras – Complex Homomorphisms – Basic properties of Spectra – Symbolic Calculus.
Unit II: Differentiation - Group of invertible elements – Commutative Banach algebra – Ideals and Homomorphisms – Gelfand transforms.
Unit III: Involutions – Applications to non commutative algebra – Positive Linear functionals.
Unit IV: Bounded Operators on Hilbert spaces – Bounded Operators – A commutativity theorem – Resolution of the Identity – Spectral theorem.
Unit V: Eigen values of normal operators – Positive operators and square roots – Group of invertible operators – Characterization of V* algebra.

Text Book: Content and Treatment as in Rudin, Functional Analysis, Tata McGraw Hill, Chapters 10,11 & 12.

Paper- III **Optional**

1. ADVANCED GRAPH THEORY

Unit I: Dominating sets in graphs - Bounds on the domination number: in terms of order, degree, size, degree, diameter and girth.
Unit II: Product graphs and Vizing's conjecture – Domatic number - Nordhaus-Gaddum type theorems - dominating functions.
Unit III: Decompositions and colorings of a graph – Generalizations of graph decompositions.
Unit IV: Necessary conditions for the existence of a G-decomposition of a graph-Cycle decompositions, Vertex labelings and graceful graphs.
Unit V: Perfect graphs: The perfect graph theorem – p-critical and partitionable graphs – A polyhedral characterization of perfect graphs and p-critical graphs – The strong perfect graph conjecture (and recent theorem).

Text Books: Content and Treatment as in

1) Teresa W. Haynes, Stephen T. Hedetniemi and Peter J. Slater, Fundamentals of Domination in graphs, Marcel Decker (1998), Section 1.2, 2.1to2.4 (For Unit I)
   Sections 2.6, 8.3, 9.1 and 10.1 to10.3 (for Unit II)
2) Juraj Bosak, Decompositions of graphs , Kluwar Academic Publishers, Chapters 2, 3 4, 6 and 7. (for Units III and IV)
3) Martin Charles Golumbic, Algorithmic graph theory, Academic Press, Chapter 3 (for Unit V)

2. HARMONIC ANALYSIS

Unit I: Fourier series and integrals – Definitions and easy results – The Fourier transform – Convolution – Approximate identities – Fejer's theorem – Unicity theorem – Parselval relation – Fourier Stieltjes Coefficients – The classical kernels.
Unit II: Summability – Metric theorems – Pointwise summability – Positive definite sequences – Herglotz;s theorem – The inequality of Hausdorff and Young.
Unit III: The Fourier integral – Kernels on R. The Plancherel theorem – Another convergence theorem – Poisson summation formula – Bachner's theorem – Continuity theorem.
Unit IV: Characters of discrete groups and compact groups – Bochners' theorem – Minkowski's theorem.
Unit V: Hardy spaces- Invariant subspaces – Factoring F and M. Rieza theorem – Theorems of Szego and Beuoling.

Text Book: Content and Treatment as in Henry Helson, Harmonic Analysis, Hindustan Book Agency, Chapters 1.1 to 1.9, 2.1 to 3.5 and 4.1 to 4.3.

3. PARALLEL ALGORITHMS

Unit I: Foundations of parallel computing – Elements of parallel computing.
Unit II: Data structures for Parallel Computing.
Unit III: Paradigms for Parallel Algorithms- Simple algorithms.
Unit IV: Tree algorithms
Unit V: Algebraic Equations and matrices

Text Book: Content and Treatment as in C. Xavier and S.S. Iyengar, Introduction to Parallel Algorithms, Chapters 1,2,3,4,5 and 10.

4. THEORY OF NEAR-RINGS

Unit I: The elements of theory of near-rings.
Unit II: Ideal theory
Unit III: Elements of structure theory
Unit IV: Near-fields
Unit V: More classes of near-rings.

Text Book: Content and Treatment as in G. Pilz, Theory of Near-rings, North Holland, Chapters 1,2,3, 8(a), 9(a) and 9(b).

5. ADVANCED CALCULUS

Unit I : Differentiation – Basic theorems – Partial derivatives – Derivatives – Inverse functions.
Unit II : Implicit functions – Integration – Measure zero and Content zero – Integrable functions.
Unit III : Fubini's theorem – Partitions of Unity – Change of Variables.
Unit IV : Integration on chains – Algebraic preliminaries – Fields and Forms – Geometric preliminaries – The fundamental theorem of Calculus.
Unit V : Manifolds – Fields and Forms on Manifolds – Stokes' theorem on Manifolds - The Volume element – The Classical theorems.

Text book : Calculus on Manifolds by Michael Spivak, The Benjamin / Cummings Publishing Company
References : (1) Mathematical Analysis by Tom M. Apostol, Narosa Publishing Company.
(2) Advanced Calculus by Gerald B.Folland, Pearson Publishing Company.

6. ALGEBRAIC GRAPH THEORY

Unit 1: Linear Algebra in graph theory: The spectrum of a graph – Regular graphs and line graphs - The homology of graphs.
Unit 2: Spanning trees and associated structures – Complexity – Determinant expansions.
Unit 3: Symmetry and regularity of graphs: General properties of graph automorphisms – Vertex-transitive graphs – Symmetric graphs – Trivalent symmetric graphs.
Unit 4: The Covering - graph construction – Distance-transitive graphs - The feasibility of intersection arrays.
Unit 5: The Laplacian of a graph: The Laplacian matrix – trees – representations – energy and eigenvalues – connectivity – the generalized Laplacian – Multiplicities – embedding.

Text Books:

1. **Norman Biggs,** Algebraic Graph Theory, Cambridge University Press, London, 1974.
   Chapters 2, 3 and 4 for Unit I.
   Chapters 5, 6 and 7 for Unit II.
   Chapters 15, 16, 17 and 18 for Unit III.
   Chapters 19, 20 and 21 for Unit IV.
2. **Chris Godsil, Gordon Royle,** Algebraic Graph Theory, Springer-Verlag, New York, 2006.
   Chapter 13 (Sections 13.1 to 13.6, 13.9 to 13.11) for Unit V.

http://www.msuniv.ac.in/Research-Guide.aspx