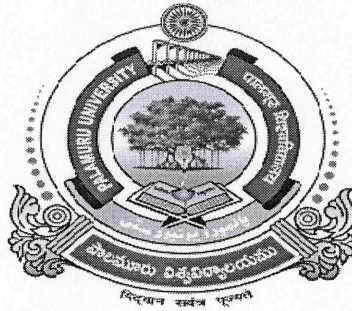


DEPARTMENT OF MATHEMATICS

PALAMURU UNIVERSITY
Mahabubnagar, Telangana State, INDIA



M.Sc. Mathematics Syllabus
Semester – I & II
(Choice Based Credit System)

(w.e.f. the academic year 2023-2024)

M.Sc. Mathematics Course Structure

(Choice Based Credit System)
(w.e.f. the academic year 2023-2024)

SEMESTER – I

Subjects	Code	Paper Title	THPW	CCE	Credits	IA	ESE	Total
Core	M 101	Abstract Algebra	4	2	4	40	60	100
Core	M 102	Mathematical Analysis	4	2	4	40	60	100
Core	M 103	Ordinary Differential Equations	4	2	4	40	60	100
Core	M 104	Linear Algebra	4	2	4	40	60	100
Core	M 105	Elementary Number Theory	4	2	4	40	60	100
		Total	20	10	20			500

SEMESTER – II

Subjects	Code	Paper Title	THPW	CCE	Credits	IA	ESE	Total
Core	M 201	Galois Theory	4	2	4	40	60	100
Core	M 202	Lebesgue measure and Integration	4	2	4	40	60	100
Core	M 203	Complex Analysis	4	2	4	40	60	100
Core	M 204	Topology	4	2	4	40	60	100
Core	M 205	Discrete Mathematics	4	2	4	40	60	100
			20	10	20			500

THPW = Teaching Hours Per Week.

CCE – Continuous Comprehensive Evaluation.

IA = Internal Assessment (Conducted 4 Internals for 50 marks should be scaled down to 10 marks).

ESE = End-Semester Examination. (Duration - 3 Hrs.)

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Paper-I: Abstract Algebra

Unit- I

Automorphisms - Conjugacy and G - sets - Normal series - Solvable groups - Nilpotent groups. (Page No. 104 to 128)

Unit- II

Structure theorems of groups: Direct products - Finitely generated abelian groups - Invariants of a finite abelian group - Sylow theorems. (Page No. 138 to 152)

Unit- III

Ideals and homomorphisms - Sum and direct sum of ideals, Maximal and Prime ideals - Nilpotent and nil ideals - Zorn's lemma. (Page No. 179 to 211).

Unit- IV

Unique factorization domains - Principal ideal domains - Euclidean domains - Polynomial rings over UFD. (Page No. 212 to 223)

Text Book:

Basic Abstract Algebra by P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul.
Second Edition

References:

1. **Topics in Algebra** by I.N. Herstein.
2. **Elements of Modern Algebra** by Gibert and Gilbert.
3. **Abstract Algebra** by Jeffrey Bergen.
4. **Basic Abstract Algebra** by Robert B Ash.

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Paper - II: Mathematical Analysis

Unit- I

Metric spaces - Compact sets - Perfect sets - Connected sets.
(Page No. 30-46)

Unit- II

Limits of functions - Continuous functions - Continuity and compactness, Continuity and connectedness
- Discontinuities - Monotonic functions.
(Page No. 83-102)

Unit- III

Riemann - Steiltjes integral - Definition and Existence of the Integral - Properties of the integral
- Integration and differentiation. The fundamental theorem of calculus. (Page No. 120-134
& 138-142)

Unit- IV

Sequences and Series of Functions: Uniform convergence - Uniform convergence and continuity
- Uniform convergence and integration - Uniform convergence and differentiation - The Stone-
Weierstrass theorem.
(Page No. 143-154, 159-161, 165-171 & 220-222)

Text Book:

Principles of Mathematical Analysis (3rd Edition) By Walter Rudin,
McGraw-Hill International Edition.

References:

1. **The Real Numbers** by John Stillwell.
2. **Real Analysis** by Barry Simon.
3. **Mathematical Analysis** Vol - I by D J H Garling.
4. **Measure and Integral** by Richard L. Wheeden and Antoni Zygmund.




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Paper - III: Ordinary Differential Equations

Unit- I

Existence and Uniqueness of Solutions: Preliminaries – Successive approximations – Picard's theorem – Some examples – Continuation and dependence on initial conditions – Existence of solutions in the large – Existence and uniqueness of solutions of systems.

Unit- II

Linear Differential Equations of Higher Order: Introduction – Higher order linear differential equations – A Mathematical model – Linear dependence and Wronskian – Homogeneous linear equations with constant coefficients – Equations with variable coefficients – Method of variation of parameters – Some standard methods – Laplace transforms.

Unit- III

Solutions in Power Series : Introduction – Second order linear equations with ordinary points – Legendre equation and Legendre Polynomials – Second order equations with regular singular points – Bessel functions.

Unit- IV

Oscillations of Second Order Equations: Introduction – Sturm's comparison theorem – Sturm's separation theorem-Elementary linear oscillations – Comparison theorem of Hille – Wintner – Oscillations of $x'' + a(t)x = 0$, Boundary value problems: Sturm – Liouville problem.

Text Book:

Ordinary Differential Equations by S.G. Deo, V. Raghavendra, Rasmita Kar and V. Lakshmikantham, Third Edition, *McGraw-Hill Education(India)Private Limited, New Delhi.*

References:

1. **Differential Equations with Applications with Historical Notes** by George F. Simmons, *Second Edition.*
2. **Ordinary Differential Equations** by Earl A Coddington.

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Paper-IV: Linear Algebra

Unit- I

Elementary Canonical forms - Introduction, Characteristic Values, Annihilating Polynomials, Invariant Sub-spaces, Simultaneous Triangulation and Simultaneous Diagonalization (Ch6, Sec 6.1 - 6.5).

Unit- II

Direct sum Decomposition, Invariant Direct sums, The Primary Decomposition Theorem (Ch6, Sec 6.6 - 6.8). The Rational and Jordan Forms: Cyclic Subspaces and Annihilators (Ch7, Sec 7.1)

Unit- III

Cyclic Decompositions and the Rational Form, The Jordan Form, Computation of Invariant Factors, Semi Simple Operators (Ch7, Sec 7.2 - 7.5)

Unit- IV

Bilinear Forms: Bilinear Forms, Symmetric Bilinear Forms, Skew-Symmetric Bilinear Forms, Groups Preserving Bilinear Forms (Ch10, Sec 10.1 - 10.4)

Text Book:

Linear Algebra by Kenneth Hoffman and Ray Kunze, (2e), PHI.

References:

1. **Advanced Linear Algebra** by Steven Roman (3e).
2. **Linear Algebra** by David C Lay.
3. **Linear Algebra** by Kuldeep Singh.

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Paper - V : Elementary Number Theory

Unit- I

The Fundamental Theorem of Arithmetic: Divisibility- GCD- Prime numbers, Fundamental theorem of arithmetic- the series of reciprocal of the primes- The Euclidean algorithm.

(Page No. 13 - 23)

Unit- II

Arithmetical Functions and Dirichlet Multiplication: The functions $\phi(n)$, $\mu(n)$ and a relation connecting them- Product formula for $\phi(n)$ - Dirichlet product- Dirichlet inverse and Mobius inversion formula -The Mangoldt function $\Lambda(n)$ - Multiplicative functions and Dirichlet multiplication- The inverse of a completely multiplicative function- Liouville's function $\lambda(n)$ - The divisor functions $\sigma_a(n)$.

(Page No. 24-39 & 46-51)

Unit- III

Congruences: Properties of congruences- Residue classes and complete residue system- Linear congruences-Reduced residue systems and Euler-Fermat theorem- Polynomial congruence modulo p - Lagrange's theorem- Application of Lagrange's theorem- Chinese remainder theorem and its applications.

(Page No. 106-120 & 126-128)

Unit- IV

Quadratic Residues and The Quadratic Reciprocity Law: Quadratic residues- Legendre's symbol and its properties- Evaluation of $(-1|p)$ and $(2|p)$ - Gauss' lemma- The quadratic reciprocity law and its applications-The Jacobi symbol.

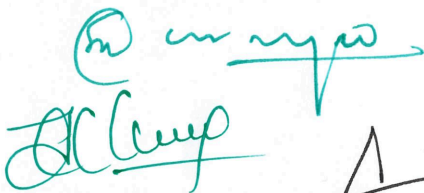
(Page No. 178-190 & 201-203)

Text Book:

Introduction to Analytic Number Theory by Tom M. Apostol. Narosa publishing house

References:

1. **Number Theory** by Joseph H. Silverman.
2. **Theory of Numbers** by K.Ramchandra.
3. **Elementary Number Theory** by James K Strayer.
4. **Elementary Number Theory** by James Tattusall.









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M. Sc. Mathematics

M 201

Semester-II

Paper - I: Galois Theory

Unit- I

Algebraic extensions of fields: Irreducible polynomials and Eisenstein criterion - Adjunction of roots - Algebraic extensions - Algebraically closed fields.
(Page No. 281- 299).

Unit- II

Normal and separable extensions: Splitting fields - Normal extensions - Multiple roots - Finite fields - Separable extensions.
(Page No. 300 - 321).

Unit- III

Galois theory: Automorphism groups and fixed fields - Fundamental theorem of Galois theory - Fundamental theorem of Algebra.
(Page No. 322 - 339).

Unit- IV

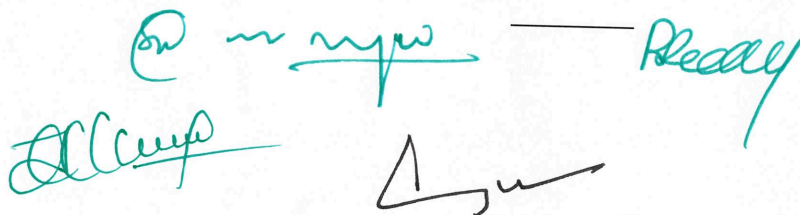
Applications of Galois theory to classical problems: Roots of unity and cyclotomic polynomials - Cyclic extensions - Polynomials solvable by radicals.
(Page No. 340 - 354).

Text Book:

Basic Abstract Algebra by P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul.
Second Edition

References:

1. **Topics in Algebra** by I.N. Herstein.
2. **Elements of Modern Algebra** by Gibert and Gilbert.
3. **Abstract Algebra** by Jeffrey Bergen.
4. **Basic Abstract Algebra** by Robert B Ash.

 Several handwritten signatures in blue ink are present. One signature is clearly legible as 'R. S. R.' and another as 'R. S. R.'. There are also some illegible scribbles and lines.

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Paper - II: Lebesgue Measure and Integration

Unit- I

Algebra of sets - Borel sets - Outer measure - Measurable sets and Lebesgue measure - A non-measurable set - Measurable functions - Littlewood's three principles.

Unit- II

The Riemann integral - The Lebesgue integral of a bounded function over a set of finite measure - The integral of a non-negative function - The general Lebesgue integral.

Unit- III

Convergence in measure - Differentiation of monotone functions - Functions of bounded variation.

Unit- IV

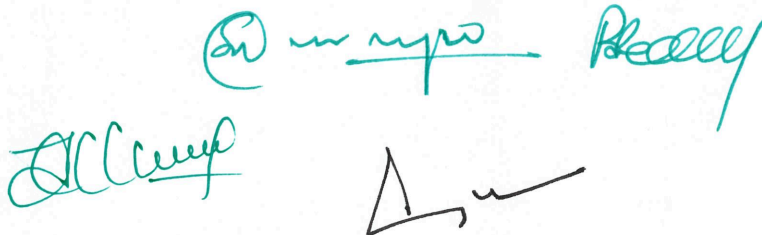
Differentiation of an integral - Absolute continuity - The L_p - spaces - The Minkowski and Holder inequalities - Convergence and completeness.

Text Book:

Real Analysis (3rd Edition)(Chapters 3, 4, 5) by H. L. Royden, *Prentice-Hall India*.

References:

1. **Lebesgue measure and Integration** by G.de Barra.
2. **Measure and Integral** by Richard L. Wheeden, Antoni Zygmund.





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Paper III: Complex Analysis

Unit- I

Regions in the Complex Plane - Functions of a Complex Variable – Mappings by exponential functions - Limits - Continuity – Derivatives - Cauchy – Riemann Equations - Sufficient Conditions for Differentiability – Polar coordinates.

Unit- II

Analytic Functions – Uniquely determined analytic functions Functions – Reflection Principle - The Exponential Function - The Logarithmic Function
Complex Exponents- Trigonometric functions- Hyperbolic functions- Inverse trigonometric-
Hyperbolic functions.

Unit- III

Derivatives of Functions $w(t)$ - Definite Integrals of Functions $w(t)$ - Contours - Contour Integrals
- Some Examples - Upper Bounds for Moduli of Contour Integrals – Anti derivatives.

Unit- IV

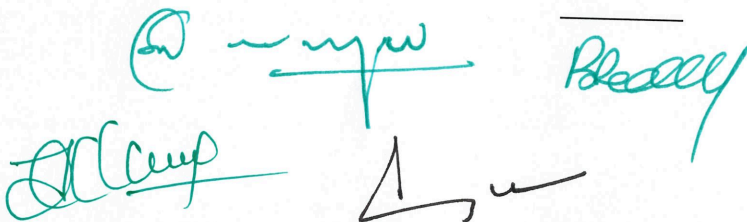
Cauchy – Goursat Theorem - Simply Connected Domains - Multiply Connected Domains -
Cauchy Integral Formula - An Extension of the Cauchy Integral Formula – Derivatives of analytic
functions - Liouville's Theorem and the Fundamental Theorem of Algebra - Maximum Modulus
Principle.


Text Book:

Complex Variables with Applications by James Ward Brown and Ruel V Charcill.
McGraw- Hill International Edition.

References:

1. **Complex Analysis** by Dennis G. Gill.
2. **Complex Analysis** by Steven G. Krantz.
3. **Complex Variables with Applications** by S. Ponnusamy, Herb Silverman.
4. **Complex Analysis** by Joseph Bak, Donald J. Newman.




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Paper - IV: Topology

Unit- I

Topological Spaces: The Definition and examples - Elementary concepts - Open bases and open subspaces- Weak topologies.
(Page No. 91-106)

Unit- II

Compactness: Compact spaces - Products of spaces - Tychonoff's theorem and locally compact spaces - Compactness for metric spaces - Ascoli's theorem.
(Page No. 110-128)

Unit- III

Separation: T_1 - spaces and Hausdorff spaces - Completely regular spaces and normal spaces - Urysohn's lemma and the Tietze extension theorem - The Urysohn imbedding theorem.
(Page No. 129-141)

Unit- IV

Connectedness: Connected spaces - The components of a spaces - Totally disconnected spaces - Locally connected spaces.
(Page No. 142-152)

Text Book:

Introduction to Topology and Modern Analysis By G.F. Simmons. Tata
Mc GrawHill Edition.

References:

1. **Introductory Topology** by Mohammed H. Mortad.
2. **Explorations in Topology** by David Gay.
3. **Encyclopedia of General Topology** by Hart, Nagata, Vaughan.
4. **Elementary Topology** by Michael C. Gemignani.




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Paper- V: Discrete Mathematics**Unit- I**

Propositional logic, Propositional Equivalences, Predicates and Quantifiers, Rules of Inference–Valid Arguments in Propositional Logic. Rules of Inference for Quantified Statements. Introduction to Proofs – Direct Proofs, Proofs by Contraposition, Proofs by Contradiction. Normal Forms– Disjunctive Normal Form, Conjunctive Normal Forms, Principal Disjunctive Normal Form, Principal Conjunctive Normal Form. Boolean Algebra – Boolean Functions and Boolean Expressions, Identities of Boolean Algebra, Representing Boolean Functions. Logic Gates, Minimization of Circuits–K- maps. (1.1 to 1.3, 1.5 to 1.7, 10.1 to 10.4 of [1])

Unit- II

Elementary Combinatorics – Basics of Counting, Two Basic Counting Principles, Indirect counting. Combinations and Permutations – Enumeration of Combinations and Permutations, Enumerating Combinations and Permutations with Repetitions, Enumerating Permutations with Constrained Repetitions. Binomial Coefficients – Pascal's Identity, Pascal's Triangle. Multinomial Theorem, The Principle of Inclusion–Exclusion and its Applications. (2.1 to 2.8 of [2])

Unit- III

Recurrence Relations – Generating Functions of Sequences, Generating Function Models, Calculating Coefficients of Generating Functions. Solutions of Recurrence Relations, the Fibonacci Relation. Solving Recurrence Relations by Substitution and by Generating Functions, Method of Characteristic Roots. Solution of Inhomogeneous Linear Recurrence Relations, the Method of Undetermined Coefficients: Solving Nonlinear Recurrence Relations. (3.1 to 3.6 of [2])

Unit- IV

Graphs – Graphs and Graph Models, Graph Terminology and Special Types of Graphs, The Hand shaking Theorem, Representing Graphs and Graph Isomorphism. Connectivity, Euler and Hamiltonian Paths and Circuits, Shortest Path Problems, Dijkstra's Algorithm, Planar Graphs, Euler formula. Trees – Introduction to Trees, Tree Traversal. Spanning Trees, DFS, BFS Algorithms, Minimum Spanning Trees. Prim's and Kruskal's Algorithms. (8.1 to 8.7, 9.1, 9.3, 9.5 of [1])

Text Book:

1. **Discrete Mathematics and its Applications** by Kenneth H Rosen, Seventh Edition, Mc GrawHill Education (India) Private Ltd, New Delhi.
2. **Discrete Mathematics for Computer Scientists & Mathematicians** by Joe L. Mott, Abraham Kandel and Theodore P. Baker, Second Edition, Prentice Hall of India, Private Ltd, New Delhi.

References:

1. **Elements of Discrete Mathematics** by C L Liu and D P Mohapatra, Third Edition, The McGraw-Hill Companies.
2. **Discrete and Combinatorial Mathematics** by Ralph P. Grimaldi and B. V. Ramana, 5th Edition, PEARSON education.

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