



Department of Mathematics
ADIKAVI NANNAYA UNIVERSITY
 Rajamahendravaram – 533 296

M.Sc. Mathematics

Syllabus { w.e.f. 2016 – 17 Admitted Batch }

I SEMESTER			
Code	Subjects	No. of Periods/ Week	Credits
M101	ALGEBRA - 1	6	4
M102	REAL ANALYSIS – 1	6	4
M103	DEFFERENTIAL EQUATIONS	6	4
M104	TOPOLOGY	6	4
M105	DISCRETE MATHEMATICS	6	4
		30	20
II SEMESTER			
M201	ALGEBRA – II	6	4
M202	REAL ANALYSIS-II	6	4
M203	COMPLEX ANALYSIS –I	6	4
M204	LINEAR ALGEBRA	6	4
M205	PROBABILITY THEORY & STATISTICS	6	4
		30	20
III SEMESTER			
M301	FUNCTIONAL ANALYSIS	6	4
M302	LEBESGUE THEORY	6	4
M303	ANALYTICAL NUMBER THROY	6	4
M304	PARTIAL DIFFERENTIAL EQUATIONS	6	4
M305	ELECTIVE – 1	6	4
		30	20
IV SEMESTER			
M401	MEASURE THEORY	6	4
M402	NUMERICAL ANALYSIS	6	4
M403	GRAPH THEORY	6	4
M404	LINEAR PROGRAMMING	6	4
M405	ELECTIVE – 1I	6	4
	PROJECT		4
		30	24

Note: For each subject, One Additional Hour per week shall be allotted for Seminar and Tutorial

ELECTIVE – 1	ELECTIVE – 1I
LATTICE THEORY	DISCRETE DYNAMICAL SYSTEMS
COMMUTATIVE ALGEBRA	OPERATOR THEORY
COMPLEX ANALYSIS -II	ADVANCED DIFFERENTIAL EQUATIONS
SEMI GROUPS-I	NONLINEAR FUNCTIONAL ANALYSIS
Any other Subject with the approval of BoS	Any other Subject with the approval of BoS



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Rajamahendravaram – 533 296

M.Sc. Mathematics

Syllabus { w.e.f. 2016 – 17 Admitted Batch }

Instructions for evaluation

1. Each theory subject is evaluated for 100 Marks out of which 75 Marks through end examination and internal assessment would be for 25 Marks. The minimum marks for qualifying in theory subject shall be 40% subject to securing minimum of 40% in the end examination.
2. End Examination Question Paper Pattern is as follows:

Sl. No.	Questions	Units of the Syllabus	Marks
1	Question1 and Question2	Form UNIT-I	15
2	Question3 and Question4	Form UNIT-II	15
3	Question5 and Question6	From UNIT-III	15
4	Question7 and Question8	From UNIT-IV	15
5	Question 9 Short answers from (a) to (e) (Three out of Five should be answered, each question is of 5 Marks)	Covers All Four Units of the Syllabus	3X5=15
Total:			75

3. Internal assessment for 25 Marks is as follows:
 - i) Mid Examinations : 15 Marks
(Two mid examinations shall be conducted and average of two should be considered as mid examinations marks).
 - ii) Assignments / Seminar : 5 Marks
 - iii) Attendance : 5 Marks
(% of attendance < 80: 4 Marks
% of attendance \geq 80: 5 Marks)



Department of Mathematics
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Rajamahendravaram – 533 296

M.Sc. Mathematics

Syllabus { w.e.f. 2016 – 17 Admitted Batch }

4. Student will be assigned with project work after the completion of II-Semester and should be carried out under the supervision of a guide, faculty with mathematics specialization in the department. The progress of the work would be continuously monitored by the members of departmental committee.
- 5 For the adjudication of project a committee will be constituted with the members of the departmental committee, project guide and external examiner. The adjudication is for 100 Marks and marks division is as follow:
 - i. Report adjudication: 50 Marks
 - ii. Oral presentation: 25 Marks
 - iii. Viva voce : 25 Marks



Department of Mathematics
ADIKAVI NANNAYA UNIVERSITY

Rajamahendravaram – 533 296

M.Sc. Mathematics

Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M101 ALGEBRA – I

Unit I

Automorphisms - Conjugacy and G-sets- Normal series solvable groups- Nilpotent groups.
(Sections 3 & 4 of Chapter 5, Sections 1, 2, 3 of Chapter 6)

Unit II

Structure theorems of groups: Direct product- Finitely generated abelian groups- Invariants of a finite abelian group- Sylow's theorems- Groups of orders p^2 , pq . (Sections 1 to 5 of Chapter 8)

Unit III

Ideals and homomorphisms- Sum and direct sum of ideals, Maximal and prime ideals- Nilpotent and nil ideals- Zorn's lemma (Sections 1 to 6 of Chapter 10)

Unit-IV

Unique factorization domains - Principal ideal domains- Euclidean domains-

Polynomial rings over UFD- Rings of traction. (Sections 1 to 4 of Chapter 11, Sections 1 of Chapter 12)

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

Reference: [1] Topics in Algebra by I.N. Herstein.



Department of Mathematics
ADIKAVI NANNAYA UNIVERSITY
Rajamahendravaram – 533 296
M.Sc. Mathematics
Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M102 REAL ANALYSIS-I

UNIT-I

Basic Topology: Finite, Countable, and Uncountable Sets, Metric spaces, Compact sets, Connected sets.

(Chapter 2 of the text book)

UNIT-II

Numerical Sequences and Series: Convergent sequences, Subsequences, Cauchy sequences, Upper and Lower limits, Some special sequences, Series, Series of non-negative terms , number, The Root and Ratio tests, Power series , Summation by parts , Absolute Convergence , Addition and Multiplication of series, Rearrangements.

(Chapter 3 of the text book)

UNIT-III

Continuity: Limits of Functions, Continuous Functions, Continuity and Compactness, Continuity and Connectedness, Discontinuities, Monotone Functions, Infinite Limits and Limits at Infinity.

(Chapter 4 of the text book)

UNIT-IV

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.

(Chapter 5 of the text book)

TEXT BOOK: Principles of Mathematical Analysis by Walter Rudin, International Student Edition, 3rd Edition, 1985.

REFERENCE: Mathematical Analysis by Tom M. Apostol, Narosa Publishing House, 2nd Edition, 1985.



Department of Mathematics
ADIKAVI NANNAYA UNIVERSITY
Rajamahendravaram – 533 296
M.Sc. Mathematics
Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M103 - DEFFERENTIAL EQUATIONS

UNIT-I

Second order linear differential equations: Introduction-general solution of the homogeneous equation - Use of a known solution to find another - Homogeneous equation with constant coefficients - method of undetermined coefficients - method of variation of parameters.

Chapter 3 (Sec 14-19)

UNIT-II

Oscillation theory and boundary value problems: Qualitative properties of solutions - The Sturm comparison theorem - Eigen values, Eigen functions and the vibrating string.

Chapter 4 (Sec 22-24, Appendix A)

UNIT-III

Power series solutions: A review of power series-series solutions of first order equations-second order linear equations - ordinary points-regular singular points.

Chapter 5 (Sec 25-29)

UNIT-IV

Systems of first order equations: Linear systems - Homogeneous linear systems with constant coefficients - Existence and Uniqueness of solutions - successive approximations - Picard's theorem - Some examples.

Chapter 7 (Sec 36-38) and Chapter 11(Sec 55-56)

TEXT BOOK: Differential Equations, George F. Simmons, Tata McGraw-Hill Publishing
Company Limited, New Delhi



Department of Mathematics
ADIKAVI NANNAYA UNIVERSITY

Rajamahendravaram – 533 296

M.Sc. Mathematics

Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M 104 - TOPOLOGY

UNIT-I

Sets and Functions: Sets and Set inclusion – The algebra of sets – Functions – Products of sets – Partitions and equivalence relations – Countable sets – Uncountable sets – Partially ordered sets and lattices. (Chapter I: Sections 1 to 8.)

UNIT-II

Metric spaces: The definition and some examples – Open sets – Closed sets – Convergence, Completeness and Baire's theorem – Continuous mappings. (Chapter 2: Sections 9 to 13.)

UNIT-III

Metric spaces (Continued): Spaces of continuous functions – Euclidean and unitary spaces.

Topological spaces: The definition and some examples – Elementary concepts – Open bases and open sub bases – Weak topologies – The function algebras $C(X, \mathbb{R})$ and $C(X, \mathbb{C})$.

(Chapter 2: Sections 14,15 and Chapter 3: 16 to 20.)

UNIT-IV

Compactness: Compact spaces – Product of Spaces – Tychonoff's theorem and locally Compact spaces – Compactness for metric spaces – Ascoli theorem.

(Chapter 4: Sections 21 to 25.)

TEXT BOOK: Introduction to Topology and Modern Analysis by G.F.Simmons, Mc.Graw-Hill book company.



Department of Mathematics
ADIKAVI NANNAYA UNIVERSITY
Rajamahendravaram – 533 296
M.Sc. Mathematics
Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M 105 - DISCRETE MATHEMATICS

UNIT-I:

Graphs, digraphs, network, multi graph, elementary results, structure based on connectivity, characterization, theorems on trees, tree distances, binary trees.

Chapters 1, 2 and 3 of Text Book I

UNIT-II:

Eulerian graphs, Hamiltonian graphs, Spanning trees, Fundamental cycles, Minimal spanning trees. (Chapter 4 of text book I)

Kruskal algorithm, Prims algorithm. (8.5 of Text Book II)

UNIT-III

Definitions of lattices, Modular lattices and distributive lattices.

(Chapter I of text book of III)

UNIT-IV

Basic properties, Boolean polynomials, ideals, minimal forms of Boolean polynomials,

(Chapter 2 of text book III)

TEXT BOOK I: Graph Theory applications By L.R.Foulds, Narosa publishing House,
New Delhi

TEXT BOOK II: Discrete mathematical structures by Kolman and Busby and Sharon Ross
Prentice Hall of India-2000, (Third Edition)

TEXT BOOK III: Applied Abstract Algebra by Rudolf Lidl and Gunter Pilz, Published by
Springer verlag.



Department of Mathematics
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Rajamahendravaram – 533 296
M.Sc. Mathematics
Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M201 ALGEBRA – II

UNIT - I

Algebraic extensions of fields: Irreducible polynomials and Eisenstein criterion- Adjunction of roots- Algebraic extensions-Algebraically closed fields. (Sections 1 to 4 of Chapter 15)

UNIT - II

Normal and separable extensions: Splitting fields- Normal extensions- Multiple roots- Finite fields- Separable extensions (Sections 1 to 5 of Chapter 16)

UNIT - III

Galois theory: Automorphism groups and fixed fields- Fundamental theorem of Galois theory- Fundamental theorem of Algebra (Sections 1 to 3 of Chapter 17)

UNIT - IV

Applications of Galois theory to classical problems: Roots of unity and cyclotomic polynomials- Cyclic extensions- Polynomials solvable by radicals - Ruler and Compass constructions. (Sections 1 to 3 and 5 of Chapter 18)

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

REFERENCE: Topics in Algrbra By I. N. Herstein.



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Rajamahendravaram – 533 296

M.Sc. Mathematics

Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M202 REAL ANALYSIS-II

UNIT-I

Riemann-Stieltjes Integral: Definition and existence of the Riemann Stieltjes Integral, Properties of the Integral, Integration and Differentiation, the fundamental theorem of calculus – Integral of Vector- valued Functions, Rectifiable curves.

(Chapter 6)

UNIT-II

Sequences and Series of the Functions: Discussion on the Main Problem, Uniform Convergence, Uniform Convergence and Continuity, Uniform Convergence and Integration, Uniform Convergence and Differentiation, Equicontinuous families of Functions, the Stone-Weierstrass Theorem.

(Chapter 7)

UNIT-III

Power Series: (A section in Chapter 8 of the text book)

Functions of Several Variables: Linear Transformations, Differentiation, The Contraction Principle, The Inverse Function theorem.

(First Four sections of chapter 9 of the text book)

UNIT-IV

Functions of several variables Continued: The Implicit Function theorem, The Rank theorem, Determinates, Derivatives of Higher Order, Differentiation of Integrals.

(5 th to 9 th sections of Chapter 9 of the text book)

TEXT BOOK: Principles of Mathematical Analysis by Walter Rudin, International Student Edition, 3rd Edition, 1985.

REFERENCE: Mathematical Analysis by Tom M. Apostol, Narosa Publishing House, second Edition, 1985.



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Rajamahendravaram – 533 296
M.Sc. Mathematics
Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M203 COMPLEX ANALYSIS -I

UNIT-I

Elementary properties and examples of analytic functions: Power series- Analytic functions- Analytic functions as mappings, Mobius transformations.

(1, 2, 3 of chapter-III)

UNIT-II

Complex Integration: Riemann- Stieltjes integrals- Power series representation of analytic functions- zeros of an analytic function- The index of a closed curve.

(1, 2, 3, 4 of chapter-IV)

UNIT-III

Cauchy's theorem and integral formula- the homotopic version of Cauchy's theorem and simple connectivity- Counting zeros; the open mapping theorem.

(5, 6,7of chapter-IV)

UNIT-IV

Singularities: Classifications of singularities- Residues- The argument principle.

(1,2,3 of chapter-V)

TEXT BOOK: Functions of one complex variables by J.B.Conway : Second edition,

Springer International student edition, Narosa Publishing House, New Delhi.



Department of Mathematics
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Rajamahendravaram – 533 296

M.Sc. Mathematics

Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M204 LINEAR ALGEBRA

UNIT-I

Elementary Canonical Forms: Introduction – Characteristic Values – Annihilating Polynomials – invariant subspaces – Simultaneous Triangulation – Simultaneous Diagonalization.

(Sections 6.1, 6.2, 6.3, 6.4, 6.5 of chapter-6)

UNIT-II

Direct – sum Decompositions – invariant direct sums – the primary decomposition theorem – cyclic subspaces and Annihilators – cyclic decompositions and the rational form.

(Sections 6.6, 6.7, 6.8 of chapter-6 and Sections 7.1, 7.2 of chapter - 7)

UNIT-III

The Jordan Form – Computation of Invariant Factors – Semi Simple Operators.

(Sections 7.3, 7.4, 7.5 of chapter - 7)

UNIT-IV

Bilinear Forms : Bilinear Forms – Symmetric Bilinear Forms – Skew Symmetric Bilinear Forms – Group Preserving Bilinear Forms.

(Sections 10.1, 10.2, 10.3, 10.4 of chapter - 10)

TEXT BOOK: Linear Algebra second edition By Kenneth Hoffman and Ray Kunze, Prentice Hall of india Private Limited, New Delhi.



Department of Mathematics
ADIKAVI NANNAYA UNIVERSITY

Rajamahendravaram – 533 296

M.Sc. Mathematics

Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M205 - PROBABILITY THEORY & STATISTICS

UNIT I

Sample spaces and events, The Axioms of probability, some elementary Theorems, Boole's Inequality, Conditional Probability, Baye's Theorem. [Text Book: 1]

UNIT II

Discrete & Continuous Random variables, mathematical Expectation, variance, covariance, moment generating functions, characteristic functions, Binomial, Poisson, Normal and Uniform Distributions [Text Book: 1]

UNIT III

Populations and samples, sampling distribution of the Mean (σ is known/unknown), sampling distribution of the variance and F distributions. Point estimation, Interval estimation, Tests of Hypotheses, Hypotheses concerning one and two means.

UNIT IV

Estimation of proportions, Hypotheses concerning one proportion, Hypotheses concerning several proportions, The analysis of $r \times c$ tables, Goodness of Fit.

Correlation & Regression, The method of least squares, inferences bases on the least – square estimators.

TEXT BOOKS:

1. Fundamentals of Mathematical Statistics, SC Gupta, VK Kapoor [Only for First Two Units]
2. Probability & Statistics for Engineers & Scientists, Walpole, Myers, Myers, Ye, Pearson Education

REFERENCE:

1. statistics and Random Processes by T. Veerarajan, Tata McGraw Hill
 2. Probability & Statistics, T. K. V. Iyengar, B. Krishna Gandhi and Others, S. Chand & Co.
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Department of Mathematics
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Rajamahendravaram – 533 296
M.Sc. Mathematics
Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M301 – FUNCTIONAL ANALYSIS

UNIT-I

Banach spaces: the definition and some examples, continuous linear transformation, the Hahn- Banach theorem, the natural imbedding of N in N^{**} , The open mapping theorem.

(Sections 46 – 50 of chapter 9)

UNIT-II

The conjugate of an operator, **Hilbert spaces:** The definition and some simple properties, orthogonal complements, orthonormal sets.

(Sections 51 of chapter 9 and Sections 52- 54 of chapter 10)

UNIT-III

The Conjugate space H^* , the ad joint of an operator, Self- ad joint operators, Normal and Unitary operators, Projections.

(Sections 55 - 59 of chapter 10)

UNIT-IV

Finite- dimensional spectral theory: Matrices, determinants and the spectrum of an operator, the spectral theorem, A survey of the situation.

(Sections 60 - 63 of chapter - 11)

TEXT BOOK: Introduction to Topology and Modern Analysis by G.F.Simmons, McGraw
Hill Book Company, Inc-International student ed.



Department of Mathematics
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Rajamahendravaram – 533 296
M.Sc. Mathematics
Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M302 – LEBESGUE THEORY

UNIT-I

Algebra of sets, Lebesgue measure, Outer measure, Measurable set and Lebesgue measure, a non-measurable set, measurable function, Little woods's Three principles.(Chapter 3)

UNIT-II

The Riemann integral, the Lebesgue integral of a bounded function over a set of finite measures, the integral of a non-negative function, the general Lebesgue integral convergence in measure. (Chapter 4)

UNIT-III

Differentiation of monotonic functions, functions of bounded variation, differentiation of an integral, absolute continuity. (Chapter 5)

UNIT-IV

L_p- Spaces the Holder's and Minkowski inequalities, convergence and completeness
(Chapter 6)

TEXT BOOK: H.L.Royden, Real Analysis, Macmillan Publishing Company, New York, Third Edition, 1988.



Department of Mathematics
ADIKAVI NANNAYA UNIVERSITY

Rajamahendravaram – 533 296

M.Sc. Mathematics

Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M303 – ANALYTICAL NUMBER THEORY

UNIT-I

ARITHMETICAL FUNCTIONS AND DIRICHLET MULTIPLICATION :-Introduction – The Mobius function $\mu(n)$. -The Euler quotient function $\varphi(n)$ -A relation connecting φ and μ - A product formula for $\varphi(n)$ -The Dirichlet product of arithmetical functions- Dirichlet inverses and the Mobius inversion formula- The Mangoldt function $\Lambda(n)$ - multiplicative functions- multiplicative function and Dirichlet multiplication – The inverse of a completely multiplicative function- Liouville's function $\lambda(n)$ - The divisor functions $\sigma_\alpha(n)$. Generalized convolutions.

(Sections 2.1 – 2.14 of chapter 2)

UNIT-II

AVERAGES OF ARITHMETICAL FUNCTIONS:- Introduction- The big oh notation. Asymptotic equality of functions – Euler's summation formula – Some elementary asymptotic formulas – The average order of $d(n)$ -The average order of the divisor functions $\sigma_\alpha(n)$ - The average order of $\varphi(n)$ -An application to the distribution of lattice points visible from the origin – the average order of $\mu(n)$ and $\Lambda(n)$ – The partial sums of a Dirichlet product Applications to $\mu(n)$ and $\Lambda(n)$ – Another identity for the partial sums of a Dirichlet product.

(Sections 3.1 – 3.12 of chapter 3)

UNIT-III

SOME ELEMENTARY THEOREMS ON THE DISTRIBUTION OF PRIME NUMBERS:- introduction – chebyshev's function $\psi(x)$ and $\vartheta(x)$ - Relations connecting $\vartheta(x)$ and $\pi(x)$ – Some equivalent forms of the prime number theorem 0- inequalities for $\pi(n)$ and p_n – Shapiro's Tauberian theorem – Applications of Shapiro's theorem – An asymptotic formula for the partial sums $\sum_{p \leq x} (1/p)$ - The partial sums of the Mobius function.

(Sections 4.1 – 4.9 of chapter 4)

UNIT-IV

CONGRUENCES :- Definition and basic properties of congruences – Residue classes and complete residue systems – linear congruences – Reduced residue systems and the Euler-Fermat theorem – Polynomial congruences modulo p . Lagrange's theorem –Applications of Lagrange's theorem – Simultaneous linear congruences. The Chinese remainder Theorem- Applications of the Chinese remainder Theorem – Polynomial congruences with prime power modulo. (Sections 5.1 – 5.9 of chapter 5)

TEXT BOOK: Introduction to Analytic Number Theory – By T.M.APOSTOL – Springer

Verlag, New York, Heidelberg – Berlin – 1976.



Department of Mathematics
ADIKAVI NANNAYA UNIVERSITY

Rajamahendravaram – 533 296

M.Sc. Mathematics

Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M304 - PARTIAL DIFFERENTIAL EQUATIONS

UNIT I

Introduction, Methods of Solution of $dx/P = dy/Q = dz/R$, Orthogonal trajectories of a system of curves on a surface, Pfaffian Differential forms and equations, Solutions of Pfaffian differential equations in three variables, Cauchy's problem for first order partial differential equations. (Sections 3 to 6 of Chapter 1, Sections 1 to 3 of Chapter 2)

UNIT II

Linear Equations of the first order, Integral surfaces, orthogonal surfaces, non-linear partial differential equations of the first order, Cauchy's method of characteristics, Compatible systems of first order equations, Charpit's Method, Special types of first order equations, Jacobi's method.(Sections 4 to 13 of Chapter 2)

UNIT III

Partial Differential Equations of the second order, their origin, Linear Partial Differential equations with constant and variable coefficients, Solutions of linear hyperbolic equations, Method of separation of variables, Monger's method.

(Sections 1 to 5 and Sections 8,9,11 of Chapter 3)

UNIT IV

Laplace Equation, elementary solutions, families of equipotential surfaces, Boundary value problems, Method of separation of variables of solving Laplace equation, problems with axial symmetry, Kelvin's inversion theorem, The wave equation, Elementary solution in one dimensional form, Riemann-Volterra solution of one dimensional wave equation.

(Sections 1 to 7 of Chapter 4 and Sections 1 to 3 of Chapter 5)

TEXT BOOK:

[1] Elements of Partial Differential Equations by I.N.Sneddon, Mc Graw Hill,
International Edition, Mathematics series.

REFERENCE BOOK:

1 Fritz John, Partial Differential Equations, Narosa Publishing House, New Delhi, 1979



Department of Mathematics
ADIKAVI NANNAYA UNIVERSITY

Rajamahendravaram – 533 296

M.Sc. Mathematics

Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M305.1 – LATTICE THEORY

UNIT-I:

Partially Ordered sets – Diagrams – Special subsets of a poset – length – lower and upper bounds – the minimum and maximum condition – the Jordan Dedekind chain conditions – dimension functions.

(Sections 1 – 9 of Chapter 1)

UNIT-II:

Algebras – lattices – the lattice theoretic duality principle – semi lattices – lattices as posets – diagrams of lattices – semi lattices, ideals – bound elements of Lattices – atoms and dual atoms – complements, relative complements, semi complements – irreducible and prime elements of a lattice – the homomorphism of a lattice – axioms systems of lattices.

(Sections 10 - 21 of Chapter 2).

UNIT-III:

Completer lattices – complete sub lattices of a completer lattice – conditionally complete lattices – lattices – compact elements, compactly generated lattices – sub algebra lattice of an algebra – closure operations – Galois connections, Dedekind cuts – partially ordered sets as topological spaces..

(Sections 22 - 29 of Chapter 3)

UNIT-IV

Distributive lattices – infinitely distributive and completely distributive lattices – modular lattices – characterization of modular and distributive lattices by their sub lattices – distributive sublattices of modular lattices – the isomorphism theorem of modular lattices, covering conditions- meet representations in modular and distributive lattices – some special subclasses of the class of modular lattices – preliminary theorems – modular lattices of locally finite length – the valuation of a lattice, metric and quasi metric lattices – complemented modular lattices.

(Sections 30 – 40 of Chapter 4)

TEXT BOOK: Introduction to Lattice Theory by Gabor Szasz, Academic Press, New York

REFERENCE : General Lattice theory by G.Gratzer, Academic Press, New York.



Department of Mathematics
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Rajamahendravaram – 533 296
M.Sc. Mathematics
Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M305.2 – COMMUTATIVE ALGEBRA

UNIT-I

Rings and ring homomorphism, ideals, quotient rings, zero divisors, Nilpotent elements, units, prime ideals and Maximal ideals, nil radical and Jacobson radical, operations on ideals, Extensions and contractions.

UNIT-II

Modules and module homomorphisms, Sub modules and quotient modules, operations on submodules, direct sum and product, finitely generated modules, exact sequences, Tensor product of modules, Restriction and extension of scalars, Exactness properties of the tensor product, algebras, tensor product of algebras.

UNIT-III

Local Properties, Extended and Contracted ideals in rings of fractions.

UNIT-IV

Primary decompositions.

(Content and extent of chapters 1 to 4 of the prescribed text book)

TEXT BOOK: Introduction to commutative algebra, M.F. ATIYAH and I.G. MACDONALD,
Addision – Wesley publishing Company, London.



Department of Mathematics
ADIKAVI NANNAYA UNIVERSITY
Rajamahendravaram – 533 296
M.Sc. Mathematics
Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M305.3 - COMPLEX ANALYSIS -II

UNIT-I

The maximum modulus theorem: The maximum principle – Schwarz's lemma – convex function's and hadamard's three circles theorem – Phragmén - Lindelöf Theorem.

(1,2,3,4 of chapter-VI)

UNIT-II

Compactness and Convergence in the Space of Analytic Functions: The space of continuous function $C(G, \Omega)$ – Spaces of Analytic functions – spaces of meromorphic functions – The Riemann Mapping Theorem – Weierstrass factorization theorem – Factorization of sine functions. .

(1,2,3,4,5,6 of chapter-VII)

UNIT-III

Runge's Theorem : Runge's Theorem – Simple connectedness – Mittag – Leffler's Theorem, Analytic Continuation and Riemann Surfaces, Schwarz Reflection Principle – Analytic Continuation Along A Path – Monodromy theorem..

(1,2,3 of chapter-VIII and 1,2,3 of chapter IX)

UNIT-IV

Harmonic Functions : Basic properties of Harmonic functions – Harmonic functions on a disk. Jensen's formula, the genus and the order of an entire function Hadamard's factorization theorem. .

(1,2, of chapter-X and 1,2,3 of chapter XI)

TEXT BOOK: Functions of one complex variables by J.B.Conway : Second edition,

Springer International student Edition, Narosa Publishing House, New Delhi.



Department of Mathematics
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Rajamahendravaram – 533 296

M.Sc. Mathematics

Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M 305.4- SEMI GROUPS- I

UNIT-I

Basic definition, monogenic semigroups, ordered sets, semilattices and lattices, binary relations, equivalences and congruences.

UNIT-II

Free semigroups, Ideals and Rees' congruences, Lattices of equivalences and congruences. Green's equivalences, the structure of D-classes, regular semigroups.

UNIT-III

Simple and 0-simple semigroups, Principal factors, Rees' theorem, Primitive idempotents.

UNIT-IV

Congruences on completely 0-simple semi groups, The lattice of congruences on a completely 0-simple semigroup, Finite congruence free semigroups.

Contents of the syllabus-Chapters 1,2 and 3 of the text book.

TEXT BOOK: An introduction to semi group theory by J.M. Howie, 1976, Academic press,
New York.



Department of Mathematics
ADIKAVI NANNAYA UNIVERSITY
Rajamahendravaram – 533 296
M.Sc. Mathematics
Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M401 – MEASURE THEORY

UNIT-I

Measure spaces, Measurable functions, Integration, general convergence theorems.
(Section 3 of Chapter 6, Sections 1 to 4 of Chapter 11)

UNIT-II

Signed Measures, The Radon–Nikodym theorem, the L^p Spaces
(Sections 5 to 7 of Chapter 11)

UNIT-III

Outer measure and measurability, The Extension theorem, Product measures.
(Sections 1 to 4 of Chapter 12)

UNIT-IV

Inner measure, Extension by sets of measure zero, Caratheodory outer measure, Hausdroff measure. (Sections 5 to 9 of Chapter 12)

TEXT BOOK: H.L.Royden, Real Analysis, Macmillan Publishing Company, New York,
Third Edition, 1988



Department of Mathematics
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Rajamahendravaram – 533 296
M.Sc. Mathematics
Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M 402 – NUMERICAL ANALYSIS

UNIT I

Transcendental and polynomial equations: Introduction, Bisection method, Iteration methods based on first degree equation; Secant method, Regula Falsi method, Newton- Raphson method, Iteration method based on second degree equation; Mullers method, Chebyshev method, Multipoint iterative method, Rate of convergence of secant method, Newton Raphson method,

Unit II

System of linear algebraic equation: Direct methods, Guass elimination method, Triangularization method, Cholesky method, Partition method, Iteration method: Gauss seidel Iterative method, OR method.

UNIT III

Interpolation and Approximation: Introduction, Lagrange and Newton's divided difference interpolation, Finite difference operators, sterling and Bessel interpolation, Hermite interpolation, piecewise and Spline Interpolation, least square approximation.

UNIT IV

Numerical Differentiation: methods based on Interpolation, methods based on Finite difference operators Numerical Integration: methods based on Interpolation, Newton's cotes methods, methods based on Undetermined coefficients, Gauss Legendre Integration method, Numerical methods ODE: Single step methods: Euler's method, Taylor series method, Runge kutta second and forth order methods, Multistep methods: Adam Bash forth method, Adam Moulton methods, Milne-Simpson method.

Text Book: [1] Numerical Methods for Scientific and Engineering computation by M.K.

Jain, S.R.K. Iyengar, R.K. Jain, New Age Int. Ltd., New Delhi.

Reference: [1] Introduction to Numerical Analysis, by S.S. Sastry, Prentice Hall Flied.



Department of Mathematics
ADIKAVI NANNAYA UNIVERSITY
Rajamahendravaram – 533 296
M.Sc. Mathematics
Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M403 - GRAPH THEORY

UNIT I

Basic concepts, Isomorphism, Euclidian and Hamilton Graphs, Trees, Properties of Trees, Spanning Trees, Connectivity and Separability, Network flows.

(Chapters 1,2,3 and Sections 4.1 to 4.6 of Chapter 4 of the text book 1)

UNIT II

Planar graphs, Kuratowski's two graphs, Different representations of planar graphs, Detection of Planarity, Geometric and Combinational Duals of a graph, Vector spaces of a Graph.

(Sections 5.1 to 5.7 Chapter 5 and Sections 6.5 to 6.9 of Chapter 6 of the text book 1)

UNIT III

Matrix representation of graphs, Incidence and circuit matrices of a graph, Fundamental Circuit matrix, Application to a Switching network, Cut set and Path Matrices, Adjacency matrices, Directed Graphs, Trees with directed Edges, Incidence and adjacency matrix of a digraph.

(Chapter 7 and Sections 9.1 to 9.6, 9.8 and 9.9 of Chapter 9 of text book 1)

UNIT IV

Coloring, Covering and Partitioning, Chromatic number, Chromatic Partitioning, Chromatic polynomial, Matchings, Coverings, The form color problem, Applications of graph theory in Operations Research.

(Chapters 8 and Sections 14.1 to 14.3 of chapter 14 of text book 1)

TEXT BOOK : Graph Theory with applications to Engineering and Computer Science by
Narasingh Deo; Prentice – Hall of India.

REFERENCES:

1. Graph Theory with applications by Bond JA and Murthy USR, North Holland, New York.
 2. Introduction to Graph Theory by Donglas B.West. Prentice Hall of India.
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Department of Mathematics
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Rajamahendravaram – 533 296
M.Sc. Mathematics
Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M404 - LINEAR PROGRAMMING

UNIT I

Formulation of Linear Programming problems, Graphical solution of Linear Programming problem, General formulation of Linear Programming problems, Standard and Matrix forms of Linear Programming problems, Simplex Method.

UNIT II

Two-phase method, Big-M method, Method to resolve degeneracy in Linear Programming problem, Alternative optimal solutions. Solution of simultaneous equations by simplex Method, Inverse of a Matrix by simplex Method, Concept of Duality in Linear Programming, Comparison of solutions of the Dual and its primal.

UNIT III

Mathematical formulation of Assignment problem, Reduction theorem, Hungarian Assignment Method, Travelling salesman problem, Formulation of Travelling Salesman problem as an Assignment problem, Solution procedure.

UNIT IV

Mathematical formulation of Transportation problem, Tabular representation, Methods to find initial basic feasible solution, North West corner rule, Lowest cost entry method, Vogel's approximation methods, Optimality test, Method of finding optimal solution, Degeneracy in transportation problem, Method to resolve degeneracy, Unbalanced transportation problem.

TEXT BOOKS:

[1] S. D. Sharma, Operations Research.

REFERENCE BOOKS:

[1] Kanti Swarup, P. K. Gupta and Manmohan, Operations Research.

[2] H. A. Taha, Operations Research – An Introduction.



Department of Mathematics
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Rajamahendravaram – 533 296
M.Sc. Mathematics
Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M405.1 - DISCRETE DYNAMICAL SYSTEMS

UNIT I

Phase Portraits, Periodic Points and Stable Sets, Sarkovskii's theorem, Differentiability and its Implications [Hyperbolic, Attractive and Repelling Periodic Points]

[Chapters 1, 4, 5, 6]

UNIT II

Parameterized Families of Functions and Bifurcations; The Logistic Function Part I [Cantor Sets], Symbolic Dynamics and Chaos.

[Chapters 7,8,9]

UNIT III

The Logistic Function Part II Topological Conjugacy, The Logistic Function Part III [Period Doubling Cascade], newton's Method

[Chapters 10, 11, 12]

UNIT IV

Numerical solutions of Differential Equations, The Dynamics of Complex functions [newton's Method in Complex Plane], the Quadratic Family and Mandelbrot Set

[Chapters 13, 15 and Sections 14.3, 14.5]

TEXT BOOK: Richard M. Holmgren, A First Course in Discrete Dynamical Systems,

Springer Verlag



Department of Mathematics
ADIKAVI NANNAYA UNIVERSITY
Rajamahendravaram – 533 296
M.Sc. Mathematics
Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M405.2 OPERATOR THEORY

UNIT I

Banach fixed point theorem- application of Banach's theorem to linear equations - application of Banach's theorem to differential equations-application of Banach's theorem to integral equations.

[Chapter 5 of the text book]

UNIT II

Approximation in normed spaces-Uniqueness, strict convexity-uniform approximation Chebyshev polynomials – Splines.

[Sections 6.1 to 6.4 and 6.6 of Chapter 6 of the text book]

UNIT III

Spectral theory in finite dimensional Normed spaces-basic concepts-spectral properties of bounded linear operators-further properties of Resolvent and spectrum-use of complex analysis in spectral theory.

[Sections 7.1 to 7.5 of Chapter 7 of the text book]

UNIT IV

Compact linear operator of normed spaces-Further properties of compact linear operators Spectral properties of compact linear operators on normed spaces-further spectral properties of compact linear operators.

[Sections 8.1 to 8.4 of Chapter 8 of the text book.]

TEXT BOOK:

Introductory Functional Analysis and Applications by Kreyszig, John Wiley and Sons, Delhi, 2001.



Department of Mathematics
ADIKAVI NANNAYA UNIVERSITY
Rajamahendravaram – 533 296
M.Sc. Mathematics
Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M405.3 - ADVANCED DIFFERENTIAL EQUATIONS

UNIT I

Boundary value problems: Preliminaries – Sturm – Liouville Problem – Green’s function – Application of Boundary Value Problem – Picard’s theorem.

[Chapter 7 of prescribed text book.]

UNIT II

Oscillations of second order equations: Fundamental results – Sturm’s Comparisons theorem – Elementary linear oscillations – Comparisons theorem of Hille – Wintner – oscillations of $x'' + a(t)x = 0$.

[Chapter 8 of prescribed text book.]

UNIT III

Stability of linear and nonlinear systems: preliminaries – Elementary critical points – system of equations with constant coefficients – Linear equation with constant coefficients – Lyapunov stability – stability of quasi linear systems – second order linear differential equations.

[Chapter 9 of prescribed text book.]

UNIT IV

Equations with deviating arguments: Preliminaries – equations with constant delay – Equations with piecewise constant delay – a few other types of delay equations.

[Chapter 11 of prescribed text book.]

TEXT BOOK:

S.G. Deo, V. Lakshmikantham and V. Raghavendra: Text book of ordinary Differential equations, Second edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1997.



Department of Mathematics
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Rajamahendravaram – 533 296
M.Sc. Mathematics
Syllabus { w.e.f. 2016 – 17 Admitted Batch }

M405.4 NONLINEAR FUNCTIONAL ANALYSIS

UNIT-I

Various forms of continuity- Geometry in normed spaces and duality mapping, Nemytskii, Hammerstein and Urysohn operators.

Chapter 1 of the textbook

UNIT-II

Gateaux and Frechet derivative, Properties of derivative, Taylor's theorem, Inverse function theorem and Implicit function theorem, Sub differential of convex functions.

Chapter 2 of the text book

UNIT-III

Banach's contraction principle and its generalization, Nonexpansive mappings, Fixed point theorems of Brouwer and Schauder.

Sections 4.1 to 4.3 of Chapter 4 of the text book.

UNIT-IV

Fixed point theorems for multifunctions, common fixed point theorems, Sequences of contractions, generalized contractions and fixed points.

Sections 4.4 to 4.6 of Chapter 4 of the textbook.

TEXT BOOK:

Joshi, Mohan C., and Ramendra K. Bose. *Some topics in nonlinear functional analysis*. John Wiley & Sons, 1985.
