ANDHRA UNIVERSITY
Department of Mathematics
M.A./M.Sc. Mathematics
Revised Syllabi
(w.e.f. 2018-19 admitted batch)

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Internal Assessment 20% and External Examination 80%
Question No. 1 is compulsory and it consists of 8 short answer questions each carries 2 marks.
Answer ONE question from each Unit and each question carries 16 marks.
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First Year

First Semester: (All papers are compulsory)
M101: Algebra – I
M102: Real Analysis – I
M103: Topology – I
M104: Differential Equations
M105: Linear Algebra

Second Semester: (All papers are compulsory)
M201: Algebra – II
M202: Real Analysis – II
M203: Topology – II
M204: Complex Analysis
M205: Discrete Mathematics
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Second Year

Third Semester:
M301: Functional Analysis **(Compulsory)**
M302: **(Stream A) (For Optional 1)**
    M302(1): Number Theory – I
    M302(2): Universal Algebra – I
    M302(3): Fuzzy Set Theory and Applications
M303: **(Stream B) (For Optional 2)**
    M303(1): Lattice Theory – I
    M303(2): Operations Research
    M303(3): Mathematical Biology
M304: **(Stream C) (For Optional 3)**
    M304(1): Commutative Algebra – I
    M304(2): Semigroups – I
    M304(3): Advanced Graph Th.
M305:   Calculus of Variations **(Compulsory)**

Fourth Semester:
M401: Measure and Integration **(Compulsory)**
M402: (Stream A) **(For Optional 1)**
    M402(1): Number Theory – II (Prerequisite Number Theory – I)
    M402(2): Universal Algebra – II (Prerequisite Universal Algebra – I)
    M402(3): Operator Theory
M403: (Stream B) **(For Optional 2)**
    M403(1): Lattice Theory – II (Prerequisite Lattice Theory – I)
    M403(2): Formal Languages and Automata Theory
    M403(3): Banach Algebra
M404: (Stream C) **(For Optional 3)**
    M404(1): Commutative Algebra–II (Prerequisite Commutative Algebra–I)
    M404(2): Semigroups – II (Prerequisite Semigroups – I)
    M404(3): Nonlinear Functional Analysis
M405: Partial Differential Equations **(Compulsory)**
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ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A/M.Sc. MATHEMATICS
I-SEMESTER
M 101 ALGEBRA – I
(Revised w. e. f. 2018-19 admitted batch)

UNIT I: Normal Subgroups: Normal subgroups and Quotient groups - Isomorphism theorems – Auto morphisms -Conjugacy and G-Sets Cyclic Decomposition - Alternating group A_n – Simplicity of A_n.
(Chapters 5 and 7) .

UNIT II: Direct Products - finitely generated abelian groups - Invariants of a finite abelian group - Sylow theorems - Groups of orders p^2, pq.   (Chapter 8).

UNIT III: Ideals, Homomorphisms, Sum and direct sum of ideals, Maximal and Prime Ideals.
(Sections 10.1, 10.2, 10.3, 10.4 of Chapter 10)

UNIT IV: Nilpotent and Nil Ideals, Zorn's Lemma, unique factorization domains, Principal ideal domains,
 Euclidean domains, Polynomial rings over UFD
(Sections 10.5 and 10.6 of Chapter 10 and Chapter 11).

Prescribed Book: Basic Abstract Algebra: P. B. Bhattacharya, S. K. Jain and S. R. Nagapaul, Second edition, reprinted in India 1997, 2000, 2001.

Reference Books:
1. Topics in Algebra : I. N. Herstein, 2nd Edition, John Wiley &Sons
2. Algebra : Thomas W. Hungerford, Springer
3.   Algebra : Serge Lang, Revised Third Edition, Springer
4. Modern Algebra: Qazi Zameeruddin & Surjeet Singh , Eighth Edition, Vikas Publications

ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A/M.SC MATHEMATICS
I-SEMESTER
M102 REAL ANALYSIS-I
(Revised w.e.f. 2018-19 admitted batch)

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 e , 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. Apostal, Narosa Publishing House, 2nd Edition, 1985.

ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A/M.Sc. MATHEMATICS
I-SEMESTER
M103 TOPOLOGY-I
(Revised w.e.f. 2018-19 admitted batch)

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, R) and C(X, 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).

Prescribed book: Introduction to Topology by G.F.Simmons, Mc.Graw-Hill book company.

ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A./M.Sc. MATHEMATICS
I-SEMESTER
M104 DEFFERENTIAL EQUATIONS
(Revised w.e.f. 2018-19 admitted batch)

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, Vibrations in mechanical systems.
(Chapter 3, Sections 14-20 of prescribed text book.)

UNIT-II

Oscillation theory and boundary value problems: Qualitative properties of solutions - The Sturm comparison theorem - Eigen values, Eigen functions and the vibrating string, Regular Sturm-Liouville problems. (Chapter 4, Sections 22-24 and Appendix A of prescribed text book.)

UNIT-III

Laplace transforms: Introduction, A few remarks on the theory, Applications to differential equations, Derivatives and integrals of Laplace transforms, Convolutions and Abel's mechanical problem. (Chapter 10, Sections 50 to 54 of the prescribed text book.)

UNIT-IV

Systems of first order equations: General remarks on systems, Linear systems - Homogeneous linear systems with constant coefficients – Nonlinear Systems – Volterra's prey-predator equations.
(Chapter 7, Sections 36-39 of prescribed text book.)

Existence and Uniqueness of solutions : The method of successive approximations - Picard's theorem - Some examples. (Chapter 11, Sections 55-56 of prescribed text book.)

Text book: George F. Simmons, Differential Equations, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1994.

ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A/M.SC MATHEMATICS
I-SEMESTER
M105 LINEAR ALGEBRA
(Revised w.e.f. 2018-19 admitted batch)

Unit - I

Introduction, Characteristic Values, Annihilating Polynomials, Invariant Subspaces, Simultaneous Triangulation; Simultaneous Diagonalization. (Sections 6.1 - 6.5 of Chapter 6 in the Prescribed Text Book)

Unit - II

Direct-Sum Decompositions, Invariant Direct Sums, The Primary Decomposition Theorem. Cyclic Subspaces and Annihilators, Cyclic Decompositions and Rational form.
(Sections 6.6 - 6.8 of Chapter 6 and sections 7.1 - 7.2 of Chapter 7 in the Prescribed Text Book)

Unit - III

The Jordan Form, Computation of Invariant Factors, Summary; Semi-Simple Operators (Sections 7.3 - 7.5 of Chapter 7 in the Prescribed Text Book)

Unit - IV

Bilinear Forms, Symmetric Bilinear Forms, Skew-Symmetric Bilinear Forms, Groups Preserving Bilinear Forms.   (Sections 10.1 - 10.4 of Chapter 10 in the Prescribed Text Book)

Prescribed Book: Linear Algebra by Kenneth Hoffman and Ray Kunze, prentice- Hall India Pvt. Ltd, 2nd Edition, New Delhi.

ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A/M.Sc. MATHEMATICS
II-SEMESTER
M 201 ALGEBRA – II
(Revised w.e.f. 2018-19 admitted batch)

UNIT I: Algebraic extension of fields: Irreducible polynomials and Eisenstein's criterion-Adjunction of roots-Algebraic extensions- Algebraically closed fields. (Chapter 15 – sections 15.1 – 15.4)

UNIT II: Normal and separable extensions: Splitting fields-Normal extensions-multiple roots-finite fields-separable extensions. (Chapter 16 – sections 16.1 – 16.5)

UNIT III: Galois Theory: Automorphism groups and fixed fields- fundamental theorem of Galois Theory-Fundamental theorem of algebra. (Chapter 17 – sections 17.1 – 17.3)

UNIT IV: Applications of Galois Theory to classical problems: Roots of unity and cyclotomic polynomials-cyclic extensions-polynomials solvable by radicals-symmetric functions.(Chapter 18 – sections 18.1 – 18.4)

Prescribed Text Book: Basic Abstract Algebra: P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Second edition, Cambridge University Press, printed and bound in India at Replika Press Pvt. Ltd., 2001.

Reference Books:
1. Topics in Algebra : <u>I.N.Herstein</u>, 2nd Edition, John Wiley &Sons
2. Algebra : Serge Lang, Revised Third Edition, Springer
3. Algebra : Thomas W. Hungerford, Springer
4. Modern Algebra : Qazi Zameeruddin & Surjeet Singh , Eighth Edition, Vikas Publications

ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A./M.Sc. MATHEMATICS
II-SEMESTER
M202: REAL ANALYSIS-II
(Revised w.e.f. 2018-19 admitted batch)

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 of the prescribed text book)

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.
(Chapter 7, Sections 7.1 to 7.18 of the prescribed text book)

UNIT-III

Sequences and Series of the Functions (continued): Equicontinuous families of Functions, the Stone-Weierstrass Theorem.
(Chapter 7, Sections 7.19 to 7.33 of the prescribed text book)

Power Series (Chapter 8, Sections 8.1 to 8.5 of the prescribed text book)

UNIT-IV

Functions of Several Variables: Linear Transformations, Differentiation, The Contraction Principle, The Inverse Function theorem, The implicit function theorem.
(Chapter 9, Sections 9.1 to 9.29 of the prescribed text book)

TEXT BOOK: Principles of Mathematical Analysis by Walter Rudin, International Student Edition, 3rd Edition, 1985.
REFERENCE BOOK: Mathematical Analysis by Tom M. Apostal, Narosa Publishing House, 2nd Edition, 1985.

ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A/M.Sc MATHEMATICS
II-SEMESTER
M203 TOPOLOGY II
(Revised w.e.f. 2018-19 admitted batch)

UNIT-I

Separation: T_1 – space and Hausdorff spaces – Completely regular spaces and normal spaces – Urysohn's lemma and the Tietze extension theorem – The urysohn imbedding theorem – The stone – chech compactification. (Chapter 5: Sections 26 to 30 Prescribed text book – 1).

UNIT-II

Connectedness: Connected spaces – The components of a space – Totally disconnected spaces – Locally connected spaces. (Chapter 6: Sections 31 to 34 Prescribed text book – 1).

UNIT-III

Approximation: The weierstrass approximation theorem – The stone-weierstrass theorems – Locally compact Hausdorff spaces – The extended stone-weierstrass theorems. (Chapter 7: Sections 35 to 38 Prescribed text book – 1).

UNIT-IV

Topological Groups: Neighborhoods of a point in topological group-Isomorphism and local isomorphisms-Subgroups-Quotient groups–Homomorphisms. (Chapter 3, sections 1 and 2.1 to 2.8, pages 219-237, of Prescribed text book 2.)

Prescribed book: 1. Introduction to Topology by G.F.Simmons, Mc.Graw-Hill book company.
2. General Topology by Bourbaki, Wesely publishing company.

ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A/M.SC MATHEMATICS
II-SEMESTER
M204 COMPLEX ANALYSIS
(Revised/w.e.f. 2018-19 admitted batch)

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 of prescribed text book)

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 of prescribed text book)

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, $7 of chapter-IV of prescribed text book)

UNIT-IV

Singularities: Classifications of singularities- Residues- The argument principle. ($1, $2, $3 of chapter-V of prescribed text book)

Prescribed text book: Functions of one complex variable by J.B.Conway : Second edition, Springer International student Edition, Narosa Publishing House, New Delhi.

ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A/M.SC MATHEMATICS
II-SEMESTER
M205 DISCRETE MATHEMATICS
(Revised w.e.f. 2018-19 admitted batch)

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History, Initial Concepts, Summary, Introduction, Elementary Results, Structure Based on Connectivity, Summary, Characterizations, Theorems on Trees, Tree Distances, Binary trees, Tree Enumeration, Spanning trees, Fundamental Cycles, Summary.
(Chapters – 1, 2 & 3 of Text Book 1)

Unit –II
Introduction, Eulerian Graphs, Hamiltonian Graphs, Minimal Spanning Trees, J.B.Kruskal's Algorithm, R.C.Prim's Algorithm. (Chapter 4 of Text Book 1 and Section 8.5 of Text Book 2)

Unit –III
Poset Definition, Properties of Posets, Lattice Definition, Properties of Lattices, Definitions of Modular and Distributive Lattices and its properties. (Chapter 1 of Text Book 3)

Unit –IV
Definition of Boolean Algebra, Basic properties, Boolean Polynomials, Ideals, Filters, Minimal forms of Boolean Polynomials, Applications of Lattices, Switching Circuits. (Chapter 2 of Text Book 3)

Text Book 1 : Graph Theory Applications by L.R.Foulds, Narosa Publishing House, New Delhi.

Text Book 2 : Discrete Mathematical Structures by Kolman and Busby and Sharen Ross, Prentic Hall of India – 2000, 3rd Edition

Text Book 3 : Applied Abstract Algebra by Rudolf Lidl and Gunter Pilz published by Springer- Verlag

ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A./M.Sc. MATHEMATICS
III-SEMESTER
M301 FUNCTIONAL ANALYSIS (COMPULSORY)
(Revised w.e.f. 2018-19 admitted batch)

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, Chapter 9).

UNIT-II
The conjugate of an operator, Hilbert spaces: The definition and some simple properties, orthogonal complements, orthonormal sets. Section 51, (Chapter 9 and Sections 52-54, Chapter 10).

UNIT-III
(Self) Adjoint, Normal, Unitary Operators: The conjugate space H^*, the adjoint of an operator, Self-adjoint operators, Normal and Unitary operators, Projections. (Sections 55-59, 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, Chapter 11).

Prescribed Text Book: Introduction to Topology and Modern Analysis by G. F. Simmons, McGraw Hill Book Company. Inc-International student edition.

STREAM – A
ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A./M.Sc. MATHEMATICS
III-SEMESTER
M302(1)-NUMBER THEORY- I
(Revised/w.e.f. 2018-19 admitted batch)

<u>UNIT-I</u>

ARITHMETICAL FUNCTIONS AND DIRICHLET MULTIPLICATION:
Introduction- The Mobius function function μ (n) – The Euler totient function φ(n)- A relation connecting φ and μ - A product formula for φ(n)- The Dirichlet product of arithmetical functions- Dirichlet inverses and the Mobius inversion formula- The Mangoldt function Λ (n)- multiplicative functions- multiplicative functions and Dirichlet multiplication- The inverse of a completely multiplicative function-Liouville's function $\lambda(n)$ - The divisor functions $\sigma_\alpha(n)$. (Chapter-2:- Articles 2.1 to 2.14).

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 φ(n). The partial sums of a Dirichlet product- Applications to μ (n) and Λ (n)- Another identity for the partial sums of a Dirichlet product.
(Chapter -3:- Articles 3.1 to 3.7).

<u>UNIT-II</u>

The partial sums of a Dirichlet product- Applications to μ (n) and Λ (n)- Another identity for the partial sums of a Dirichlet product. **SOME ELEMENTARY THEOREMS ON THE DISTRIBUTION OF PRIME NUMBERS:** Introduction- Chebyshev's functions $\psi(x)$ and $\vartheta(x)$ - Relations connecting $\vartheta(x)$ and $\pi(x)$ - Some equivalent forms of the prime number theorem-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 – The partial sums of the Mobius function. (Chapter -3:- Articles 3.10 &3.11 and Chapter-4:- Articles 4.1 to 4.9).

<u>UNIT-III</u>

CONGRUENCES: Definition and basic properties of congruences- Resudue classes and complete residue systems- Linear congruences- Reduced residue systems and the Euler- Fermat theorem- Polynomial congruences modulo p. Lagrange's theorem- Applications of Lagrage's theorem- Simultaneous linear congruences. The Chinese remainder theorem- Applications of the Chinese remainder theorem- Polynomial congruences with prime power moduli.
(Chapter -5:- Articles 5.1 to 5.9).

<u>UNIT-IV</u>

FINITE ABELIAN GROUPS AND THEIR CHARACTERS:
Characters of finite abelian groups- The character group- The orthogonality relations- for characters- Dirichlet characters- Sums involving Dirichlet characters-The nonvanishing of L(1, χ) for real nonprincipal χ .
DIRICHLET'S THEOREM ON PRIMES IN ARITHMETIC PROGRESSIONS: Introduction- Dirichlet's theorem for primes of the form 4n-1 and 4n+1- The plan of the proof of Dirichlet's theorem- Proof of Lemma 7.4- Proof of Lemma 7.5- Proof of Lemma 7.6- Proof of Lemma 7.7- Proof of Lemma 7.8- Distribution of primes in arithmetic progressions.   (Chapter 6:- Articles 6.5 to 6.10 and Chapter 7 :- 7.1 to 7.9).

TEXT BOOK: Introduction to Analytic Number Theory- By T.M.APOSTOL-Springer Verlag-New York, Heidalberg-Berlin-1976.

STREAM – A
ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A./M.Sc. MATHEMATICS
III-SEMESTER
M302(2) UNIVERSAL ALGEBRA-I
(Revised w.e.f. 2018-19 admitted batch)

UNIT-I

Lattices: Definitions of Lattices – Isomorphism's of Lattices and Sub lattices- Distributive and Modular Lattices- Complete lattices- Equivalence relations- Algebraic lattices- Closure operators.
(Sections 1, 2, 3,4,5, of Chapter-I of the prescribed text book)

UNIT-II

The Elements of Universal Algebra: Definition and examples of algebras- Isomorphic algebras and sub algebras – Algebraic lattices and sub universes – The irredundant Basis theorem. (Sections 1, 2, 3,4,, of Chapter-II of the prescribed text book)

UNIT-III

Congruences and Quotient algebras- Homomorphisms – The homomorphism and isomorphism theorems. (Sections 5, 6,, of Chapter-II of the prescribed text book)

UNIT-IV

Direct products- Factor congruences and Directly indecomposable algebras- Sub direct products- Subdirectly irreducible algebras and Simple algebras- Class operators- Varieties. (Sections 7, 8, 9,, of Chapter-II of the prescribed text book)

Prescribed Book: A course in Universal algebra- Stanley Burris, H.P. Sankappanavar, Springer-Verlag, New York- Heidelberg- Berlin.

STREAM – A
ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A./M.Sc. MATHEMATICS
III-SEMESTER
M302(3) FUZZY SET THEORY AND APPLICATIONS
(Revised w.e.f. 2018-19 admitted batch)

UNIT-I

From Clasical(Crisp) sets to fuzzy sets:- Introduction-Crispsets: An overview-fuzzyset:Basic types-Fuzzy sets. Basic Concepts-Characteristics and significance of the paradign shift(CH-1 of (I)). Fuzzysets versus Crisp sets-Additional Properties of a cuts-Representations of Fuzzysets-Extension principle for Fuzzysets (CH-2 of (I)).

UNIT-II

Operations on Fuzzysets - Types of Operations - Fuzzy Compliments - Fuzzy Inter sections: t-norms - Fuzzy unions; t-Conorms - Combinations of operations - Agreegation Operations (CH-3 of(I)).

UNIT-III

Fuzzy Arithmetic -Fuzzy Numbers - Linguistic variables - Arithmetic operations on intervals - Arithmetic operations on Fuzzy numbers - Lattice of fuzzy numbers - Fuzzy equations(CH -4 of (I)).

UNIT-IV

Fuzzy Relations - Crisp versus fuzzy relations - Projections and Cylindric Extensions - Binary Fuzzy Relations - Binary Relations and Singleset - Fuzzy Equivalence Relations - Binary Relations on a single set - Fuzzy Compatibility Relations - Fuzzy Ordering Relations - Fuzzy Morphisms - Sup - Compositions of Fuzzy Relations - Inf - Compositions of fuzzy Relations(CH-5 of (I)).

Prescribed Text Book: G.J.KLIR and BOYUAN, "Fuzzy sets and Fuzzy Logic, Theory and Applications" Prentice - Hall of India Pvt. Ltd., New Delhi., 2001.

M303(1) LATTICE THEORY-I
(Revised w.e.f. 2018-19 admitted batch)

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 – Dimention functions.
(Sections 1 to 9 of chapter I of the prescribed text book)

UNIT-II
Algebras-lattices- the lattice theoretic duality principle- semilattices- 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 to 21 of chapter II of the prescribed text book)

UNIT-III
Complete lattices- complete sublattices of a complete lattice- conditionally complete lattices- lattices – compact elements, compactly generated lattices- subalgebra lattice of an algebra-closure operations- Galois connections, Dedekind cuts- partially ordered sets as topological spaces. (Sections 22 to 29 of chapter III of the prescribed text book)

UNIT-IV
Distributive lattices-infinitely distributive and completely distributive lattices-modular lattices-characterization of modular and distributive lattices by their sublattices-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 to 40 of Chapters IV and V of the prescribed text book)

Prescribed Text Book: Introduction to Lattice Theorey, by Gabor Szasz, Academic Press, New York.

Book for reference: General Lattice Theory by G. Gratzer, Academic Press, New York.

STREAM – B
ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A./M.Sc. MATHEMATICS
III-SEMESTER
M303(2) OPERATIONS RESEARCH
(Revised/w.e.f. 2018-19 admitted batch)

UNIT-I
Linear Programming: The Simplex Method – Overall Idea of the Simplex Method – Development of the Simples Method – Primal Simplex method – Dual Simplex Method – Special cases in Simplex Method Applications – Sensitivity Analysis. (Sections 3.1 to 3.7 of the Chapter 3 in the Text Book)

UNIT-II
Revised Simplex Method and Duality: Mathematical Foundations – Revised (Primal) Simplex Method – Definition of the Dual Problem – Solution to the Dual Problem – Economic Interpretation of the Dual Problem. (Sections 4.1 to 4.3 of the Chapter 4 and sections 5.1 to 5.4 of Chapter 5 in the Text Book)

UNIT-III
Transportation Model and Net Works: Definitions and Applications of the Transportation – Solution of the Transportation Problem – The Assignment Model – The Transhipment Model – Network Definitions – Minimal Spanning Tree problem – Shortest – Route Problem. (Sections 6.1 to 6.5 of the Chapter 6 and sections 8.1 to 8.3 of the Chapter 8 in the Text Book)

UNIT-IV
Network Models: - Maximal Flow Problem – Minimum Cost Capacitated Flow Problem

Decision Theory and Games: Decisions Under Uncertainty – Game Theory – Optimal solution of Two-Person Zero-sum Games, Mixed strategies.

(Sections 8.4 to 8.6 of the Chapter 8 and sections 12.3, 12.4.1, 12.4.2 of the Chapter 12 in the Text Book).

Prescribed Text Book: Operations Research, An Introduction: Hamdy A Taha, Maxwell Macmillan International Edition, New York, 1992.

M303(3) MATHEMATICAL BIOLOGY
(Revised w.e.f. 2018-19 admitted batch)

UNIT-I

Autonomous differential equations - Equilibrium solutions - Stability nature of equilibrium solutions, single species growth models involving exponential, logistic and Gompertz growths. Harvest models – bifurcations and break points. (Sections 1 and 2 of the Text Book)

UNIT-II

Lotka Volterra predator – prey model – phase plane analysis, General predator prey systems – equilibrium solutions – classification of equilibria – existence of cycles – Bendixson-Dulac's negative criterion – functional responses. (Sections 7 and 8 of the text book)

UNIT-III

Global bifurcations in predator prey models – Freedman and Wolkowicz model - type IV functional response – Hopf bifurcation – Homoclinic orbits – Global bifurcations using Allee effect in prey – Competition models – Lotka – Voltrrra Competition model – exploitation competition models. (Sections 9 and 12 of the text book)

UNIT-IV

Mutualism models – various types of mutualisms – cooperative systems – Harvest models and optimal control theory – open access fishery – sole owner fishery – Pontryagin's maximum principle – Economic interpretation of Hamiltonian and adjoint variable. (Sections 13 and 14 of the text book)

Text book: Mark Kot, 2001, Elements of Mathematical Ecology, Cambridge University Press.
Reference: Nisbet and Gurney, 1982, Modelling Fluctuating Populations, John Wiley & Sons.

STREAM – C
ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A./M.Sc. MATHEMATICS
III-SEMESTER
M304(1) COMMUTATIVE ALGEBRA- I
(Revised w.e.f. 2018-19 admitted batch)

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).

Prescribed Text book: Introduction to commutative algebra, By M.F. ATIYAH and I.G. MACDONALD, Addison-Wesley publishing Company, London.

STREAM – C
ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A/M.SC MATHEMATICS
III-SEMESTER
M304(2) SEMI GROUPS- I
(Revised w.e.f. 2018-19 admitted batch)

UNIT-I

Basic definition, monogenic semigroups, ordered sets, semilatttices 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).

Prescribed Text book : An introduction to semi group theory by J.M. Howie, 1976, Academic press, New York.

STREAM – C
ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A./M.Sc. MATHEMATICS
III-SEMESTER
M304(3) ADVANCED GRAPH THEORY
(Revised w.e.f. 2018-19 admitted batch)

UNIT-I

Matching and Augmenting paths; The marriage problem; The personnel assignment problem; The optimal Assignment problem. (Chapter 4 of the Text Book)

UNIT-II

Plane and planar graphs; Euler's formula, The platonic bodies, kurtowski's Theorem, Non-Hamiltonian plane graphs, The dual of a plane graph. (Chapter 5 of the Text Book)

UNIT-III

Vertex colouring; vertex colouring Algorithms; Critical graphs; cliques; Edge colouring; Map colouring. (Chapter 6 of the Text Book)

UNIT-IV

Definitions; Indegree and outdegree; Tournaments; Traffic flow.(Chapter 7 of the Text Book)

Prescribed Text book: A first look at GRAPH THEORY; John Clark & Derek Allan Holton, Allied Publishers Limited 1995.

ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M305: Calculus of Variations
III semester
(Revised w.e.f. 2018-19 admitted batch)

Unit 1
Variational Problems with Fixed Boundaries – The Concept of variation and its properties-Euler's equation-Variational problems for functionals-functionals dependent on higher order derivatives- functionals dependent on functions of several independent variables-Some applicatiosn tom problems of Mechanics
(Sections 1.1-1.5,1.7 of Chapter 1).

Unit 2
Variational Problems with Moving Boundaries – Functionals involving first order derivative-Variational problem with a moving boundary for a functional dependent on two functions-one sided variations-refletion and reflection of extremals
 (Sections 2.1-2.4 of Chapter 2).

Unit 3
 Sufficient conditions for an extremum – second variation-poisson bracket-The Hamilton-Jacobi equation-Clairaut's Theorem-Noether's Theorem
 (Sections 3.5,3.8,3.10-3.12 of Chapter 3).

Unit 4
Variational problems – Various constraints – Isoperimeric problems – Problems of Mayer and Bolza-Equilibrium problems for Elastic Bodies – problem of Electro statics
(Sections 4.1 – 4.5 of Chapter 4).

Prescribed Text book: A.S. Gupta, Calculus of Variations with Applications, PHI Learning Private Limited, 2009

ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A./M.Sc. MATHEMATICS
IV-SEMESTER
M401: MEASURE and INTEGRATION
(Revised w.e.f. 2018-19 admitted batch)

UNIT-I

Lebesgue measure: Introduction, Outer measure, measurable sets and Lebesgue measure, A nonmeasurable set, measurable functions, Littlewood's three principles. (Chapter 3 of the text book)

UNIT-II

The Lebesgue Integral: The Riemann integral, The Lebesgue integral of a bounded function over a set of finite measure, the integral of nonnegative function, the general Lebesgue integral, convergences in measure. (Chapter 4 of the text book)

UNIT-III

Differentiation and integration: Differentiation of monotone functions, Functions of bounded variation and differentiation of an integral, Absolute continuity, and convex functions. (Chapter 5 of the text book)

UNIT-IV

The classical Banach spaces: The L^p-spaces, The Minkoswki and Holder inequalities, convergence and completeness, approximation in L^p, Bounded linear functionals on the L^p spaces. (Chapter 6 of the text book).

TEXT BOOK: Real Analysis by H. L. Royden, Macmillan Publishing Co. Inc. 3rd Edition, New York, 1988.

STREAM – A
ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A./M.Sc. MATHEMATICS
IV-SEMESTER
M402(1): NUMBER THEORY- II
(PRE-REQUISITE NUMBER THEORY – I)
(Revised w.e.f. 2018-19 admitted batch)

UNIT-I

PERIODIC ARITHMETIAL FUNCTIONS AND GAUSS SUMS: Functions periodic modulo k-Existence of finite Fourier series for periodic arithmetical functions- Ramanujan's sum and generalizations- Multiplicative properties of the sums $s_k(n)$ - Gauss sums associated with Dirichlet characters-Dirichlet characters with nonvanishing Gauss sums.

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-Applications of the reciprocity law- The Jacobi symbol-Applications to Diophantine equations- Gauss sums and the quadratic reciprocity law. Chapter 8:- Articles 8.1 to 8.6 and Chapter 9:- Articles 9.1 to 9.9

UNIT-II

PRIMITIVE ROOTS: The exponent of a number mod m. Primitive roots- Primitive roots and reduced residue systems-The nonexistence of primitive roots mod 2^α for $\alpha \geq 3$ - The existence of primitive roots and p for odd primes p. Primitive roots and quadratic residues-The existence of primitive roots mod p^α - The existence of primitive roots mod 2 p^α - The non existence of primitive roots in the remaining cases- The number of primitive roots mod m. The index calculus- Primitive roots and Dirichlet characters-Real-valued Dirichlet characters mod p^α -Primitive Dirichlet characters mod p^α .

UNIT-III

DIRICHLET SERIES AND EULER PRODUCTS: Chapter- 11:- Articles 11.1 to 11.7. The half-plane of absolute convergence of a Dirichlet series, The function defined by Dirichlet series, Multiplication of Dirichlet series, Euler Products, The half-plane of convergence of a Dirichlet series, Analytic properties of Dirichlet series, Dirichlet series with non negative coefficients.

UNIT-IV

Chapter- 12:- Articles 12.1 to 12.8. Properties of the gamma function, Integral representation for the Hurwitz zeta function, A contour integral representation for the Hurwitz zeta function, The analytic continuation of the Hurwitz zeta function, Analytic continuation of ζ(s), L(s, ω) , Hurwitz's formula for ζ(s, a), The functional equation for Riemann zeta function.

TEXT BOOK: Introduction to Analytic Number Theory- By T.M.APOSTOL-
            Springer Verlag-New York, Heidalberg-Berlin-1976.

STREAM – A
ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A.M.Sc. MATHEMATICS
IV-SEMESTER
M402(2): UNIVERSAL ALGEBRA-II
(PRE-REQUISITE: UNIVERSAL ALGERBRA-I)
(Revised w.e.f. 2018-19 admitted batch)

UNIT-I:

Terms, Term Algebras and Free algebras- Identities , Free algebras and Birkhoff's theorem - Mal'cev conditions- The Centre of an algebra. (Sections 10, 11, 12, 13, of Chapter-II of the prescribed text book)

UNIT-II:

Boolean Algebras- Boolean rings – Filters and ideals- Stone identity. (Sections 1, 2, 3, 4, of Chapter-IV of the prescribed text book)

UNIT-III:

Boolean Powers- Ultra products and congruence- Distributive varieties- Primal algebras- Boolean Products.   (Sections 5, 6, 7, 8, of Chapter-IV of the prescribed text book)

UNIT-IV:

Discriminator varieties – Quasi primal algebras – Functionally complete algebras – skew-free algebras- Semi simple varieties – Directly represent able varieties. (Sections 9, 10, 11, 12, 13, of Chapter-IV of the prescribed text book

Prescribed Book: A course in Universal algebra- Stanley Burris, H.P. Sankappanavar, Springer-Verlag, New York- Heidelberg- Berlin.

STREAM – A
ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A./M.Sc. MATHEMATICS
IV-SEMESTER
M402(3): OPERATOR THEORY
(Revised w.e.f. from 2018-19 admitted batch)

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 Resovent 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.

STREAM B
ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A./M.Sc. MATHEMATICS
IV-SEMESTER
M403(1): LATTICE THEORY-II
(PRE-REQUISITE: LATTICE THEORY-I)
(Revised w.e.f. 2018-19 admitted batch)

UNIT-I

Boolean algebras, De Morgan formulae- Complete Boolean algebras- Boolean algebras and Boolean rings- The algebra of relations- The lattice of propositions- Valuations of Boolean algebras. (Sections 42 to 47 of chapters VI of the prescribed text book)

UNIT-II

Birkhoff lattices- Semimodular lattices- Equivalence lattices- Linear dependence- Complemented semimodular lattices. (Sections 48 to 52 of chapters VII of the prescribed text book)

UNIT-III

Ideals and dual ideals, Ideal chains- Ideal lattices- Distributive lattices and rings of sets. (Sections 53 to 55 of chapters VIII of the prescribed text book)

UNIT-IV

Congruence relation of an algebra- Permutable equivalence relations- The Schreier refinement theorem in arbitrary algebras- Congruence relations of lattices- Minimal congruence relations of some subsets of a distributive lattice- The connection between ideals and congruence relations of a lattice. (Sections 56 to 61 of chapters IX of the prescribed text book)

Prescribed text book: Introduction to Lattice Theory by Gabor Szasz, Academic Press, New York.

Books for reference: General Lattice Theory by G. Gratzer, Academic Press, New York.

ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A./M.Sc. MATHEMATICS
IV-SEMESTER
M403(2): Formal Languages and Automata Theory
(Revised w.e.f. 2018-19 admitted batch)

<u>UNIT-I:</u>

Sets, relations, strings, alphabets, languages, inductive proofs, finite state systems, nondeterministic finite automata, finite automata e-moves, regular expressions, 2 way finite automata, finite automata with output, applications of finite automata (Chaps. 1 and 2, pgs. 1-54.).

<u>UNIT-II:</u>

The pumping lemma for regular sets. Closure properties, decision algorithms, The Myhill-Nerode theorem, minimization of finite automata. (Chap. 3, pgs. 55-76.)

<u>UNIT-III:</u>

Context free grammars, derivation trees, simplification of CF grammars, Chomsky normal form, Greibach normal form, existence of inherently ambiguous CF languages. (Chaps 4, pgs. 77-106)

<u>UNIT-IIII:</u> Push down automata, the pumping lemma, closure properties, decision algorithms for CFL's. (Chaps. 5 and 6, pgs. 107-145.)

Content and scope as in Hopcroft and Ullman, Chaps. 1-6, Pages 1-145.

Prescribed text book: Hopcroft J. and Ullman J.D., Introduction to Automata Theory, Languages and Computation.

STREAM – B
ANDHRA UNIVERSITY
DEPARTMENT OF MATHEMATICS
M.A./M.Sc. MATHEMATICS
IV-SEMESTER
M403(3) BANACH ALGEBRA
(Revised w.e.f. 2018-19 admitted batch)

UNIT-I:

General preliminaries on Banach Algebras – The definition and examples – Regular and singular elements – Topological divisors of Zero – The spectrum – The formula for the spectral radius – The radical and the semi – simplicity.

UNIT-II:

The structure of commutative Banach Algebras - The Gelfand mapping - Applications of the formula $r(x) = \lim // x^n // 1/n$ – Involutions in Banach Algebras – The Gelfand – Neumark theorem.

UNIT-III:

Some special commutative Banach Algebras - Ideals in C(x) and the Banach – Stone theorem - The stone – Chech compactification – commutaticve C* - algebras.

UNIT-IV:

Fixed point theorems and some applications to analysis – Brouwer's and Schauder's fixed point theorems (without proofs) Picard's theorem – Continuous curves – The Hahn – Mazurkiewicz theorem (without proof). Boolean rings – The stone representation theorem.

Text Book: Introduction to Topology and Modern Analysis – By G.F. Simmons – International Student edition – McGraw – Hill Kogakusha Ltd.

M404(1) COMMUTATIVE ALGEBRA-II
(PRE-REQUISITE: COMMUTATIVE ALGERBRA-I)
(Revised w.e.f. 2018-19 admitted batch)

UNIT-I: Integral dependence, the going-up theorem-Integrally closed integral domains, the going-down theorem, valuation rings.

UNIT-II: Chain Conditions

UNIT-III: Noetherian rings- Primary decomposition of Noetherian rings, Artin rings

UNIT-IV: Discrete valuation rings, Dedekind domains, Fractional ideals.

Content and extent of Chapters 5 to 9 of the prescribed text book.

Prescribed Text Book : Introduction to commutative algebra by M.F.Atiya and I.G. Macdonald, Addison-Wesley Publishing Company, London.

M404(2) SEMI GROUPS-II
(PRE-REQUISITE SEMIGROUPS – I)
(Revised w.e.f. 2018-19 admitted batch)

UNIT-I: Union of Groups, Semi lattices of groups, bands, free bands, varieties of bands.

UNIT-II: Introduction to inverse semi groups, preliminaries, the natural partial order on an inverse semi group, fundamental inverse semi groups, anti-uniform semilattices.

UNIT-III: Bi-simple inverse semi groups, simple inverse semi-groups, representation of inverse semigroups.

UNIT-IV: Orthodox semigroups, basic properties, the analogue of the Munn semi-group, uniform and anti-uniform bands, the structure of orthodox semi groups.

Text Book: An introduction to semigroup theory by J.M.Howie, 1976, Academic press, New York.

M404(3) NONLINEAR FUNCTIONAL ANALYSIS
(Revised w.e.f. 2018-19 admitted batch)

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. Chapater 2 of the text book

UNIT-III:-
Banach's contraction principle and its genrerliation, Nonexpansive mappings, Fixed point theorems of Brouwer and Schauder. Secions 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.

Prescribed Book: _Some topics in Nonlinear functional analysis by Mohan C. Joshi and Ramendra k. Bose, Wiley Eastern limited- Hyderabad, 1985.

UNIT-I:

First Order P.D.E.: Curves and Surfaces – Genesis of First Order P.D.E. – Classification of Integrals – Linear equations of the First Order - Pfaffian Differential Equations – Compatible
Systems – Charpit's Method- Jacobi's Method (Chapter 1 – sections 1.1 – 1.8)

UNIT-II:

Second Order P.D.E.: Genesis of Second Order P.D.E. – Classification of Second Order P.D.E.
One Dimensional Wave equation: Vibrations of an Infinite String – Vibrations of Semi infinite
String Vibrations of String of Finite Length – Riemann's Method – Vibrations of a String of Finite Length (Method of Separation of Variables). (Chapter 2 – section 2.1 – 2.3)

UNIT-III:

Laplace's Equation: Boundary value Problems- Maximum and Minimum Principles- the CauchyProblem-The Dirichlet Problem for the upper Half Plane- The Neumann Problem for the upper Half Plane- The Dirchilet Problem for a Circle- The Dirchilet Exterior Problem for a Circle- The Neumann Problem for a Circle- The Dirchilet Problem for a Rectangle (Chapter 2 – section 2.4.1-2.4.9)

UNIT-IV:

Heat Conduction Problem: Heat Conduction – Infinite Rod Case - Heat Conduction –Finite Rod
Case- Duhamel's Principle: Wave Equation –Heat Conduction Equation.

Integral Surfaces through a Given Curve- Quasi Linear Equations.

(Chapter 2 – sections 2.5, 2.6 and Chapter 1 –sections 1.9, 1.10)

Text book: T. Amarnath, An Elementary Course in Partial differential equations, Second Edition,Narosa Publishing House.

Reference Book: Ian Sneddon, Elements of Partial Differential Equations, McGraw-Hill International Editions.

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EIGHT questions are to be given. Answer any Five questions. Each question carries 20 marks.
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Paper -I: Selected Topics in Mathematics (Compulsory).

Paper-II : The candidate has to choose any one of the following papers.

- Boolean Algebra
- Fuzzy Algebra
- Mathematical Modelling
- Number Theory and Cryptography
- Nonlinear Functional Analysis
- Numerical Analysis

Algebra

The Structure of Rings: Semi and Primitive Rings-The Jacobson Radical-Semi simple Rings -The Prime Radical-Prime and Semi prime Rings-Algebras-Division Algebras.
(Chapter IX of the Prescribed Text Book).

Prescribed Text Book: Thomas W. Hungerford,Algebra, Springer-Verlag, Second Indian Reprint 2005.

Real Analysis

Implicit functions and Extremum problems: Introduction-functions with non-zero Jacobian determinant-The inverse function theorem-The implicit function theorem-Extrema of real-valued functions of one variable-Extrema of real-valued functions of several variables-Extremum problems with side conditions.
(Chapter 13 of the Prescribed Text Book)

Prescribed Text Book: Tom M. Apostol, Mathematical Analysis, Addition-Wesley/Narosa, Indian student edition, Second edition, 1985

Topology

Convergence: Sequences of nets-Filterbases in spaces-Convergence properties of Filterbases-Closure in terms of Filterbases-Continuity, Convergence in Cartesian products-Adequacy of sequences-Maximal filterbases.
Homotopy: Homotopy-Homotopy classes-Homotopy and function spaces-Relative homotopy-Retracks and Extendability-DeformationRetraction and Homotopy-Homotopy and extendability-Applications.
(Chapter X and XV of the Prescribed Text Book.)

Prescribed Text Book: Topology, James Dugundji, Universal Book Stall, New Delhi.

DIFFERENTIAL EQUATIONS

Stability of Linear Systems – Introduction-Continuous dependence of solutions on initial conditions and parameters - stability properties of solutions- Linear systems-Two-dimensional systems
(Sections 3.1-3.3 and 3.5 of the text book).

Prescribed Text Book: Shair Ahmad, M. Rama Mohana Rao, Theory of Ordinary Differential Equations with applications in Biology and Engineering, Affiliated East-West Press Private Limited, 1999

Boolean rings – Boolean algebras – Fields of sets – Regular open Sets – Elementary relations – Order – Infinite operations – Subalgebras – Homomorphisms – Free Algebras – Ideals and filters – The Homomorphism theorem – Boolean σ-algebras – The countable chain condition – Measure algebras – Atoms – Boolean spaces – The representation theorem – Duality for ideals – Duality for homomorphisms.

Prescribed Text Book: Lectures on Boolean Algebras, by Paul R. Halmos, D. Van Nostrand Company, Inc. Princeton, New Jersey.

Department of Mathematics
Andhra University
Pre – Ph. D. / M. Phil. Examinations
Paper II – Fuzzy Algebra
(Revised w. e. f. the admitted batch 2018-2019)

Union of two fuzzy sub groups – fuzzy sub group generated by a fuzzy subset – fuzzy normal sub groups fuzzy conjugate subgroups and fuzzy characteristic subgroups – fuzzy syllow subgroups.
(Chapter 2 of prescribed book)

Some elementary properties of fuzzy ideals – union of fuzzy subrings (fuzzy ideals) fuzzy subring (fuzzy ideal) generated by a fuzzy subset – fuzzy ideals and homomorhisms – fuzzy cosets
(Chapter 2 of prescribed book)

Fuzzy prime ideals fuzzy maximal ideals – fuzzy semiprime ideals – characterization of regularity
(Chapter 4 of prescribed book)

Fuzzy primary ideals – fuzzy semiprimary ideals definition and some properties – fuzzy ideals and fuzzy irreducible ideals in Noetherian ring.
(Chapter 5 & 6 of prescribed book)

Prescribed Text Book: Fuzzy algebra by Rajesh Kumar,   University Press University of Delhi, Delhi – 110007.

Paper II - MATHEMATICAL MODELLING
(Revised w. e. f. the admitted batch 2018-2019)

Single species models:
    Exponential, logistic and Gompertz growth
    Harvest models: bifurcations and break points
Interacting populations:
    A classical predator – prey model, To cycle or not to cycle
    Global bifurcations in predator-prey models, Chemostat models
    Competition models, Mutualism models
    (A.1-2, B.7-10, B.12-13 (excluding discrete dynamic models) of the Text book)

Prescribed Text Book: Mark Kot, 2001, Elements of Mathematical Ecology, Cambridge University press.

References: Nisbet and Gurney, 1982, Modelling Fluctuating Populations, John Wiley & Sons.

Paper II : Nonlinear Functional Analysis
(Revised w. e. f. the admitted batch 2018-2019)

Results based on completeness: Banach Contraction Principle – Elementary domain Invariance - Continuation Methods for Contractive Maps – Nonlinear alternative for contractive Maps – Extensions of the Banach Theorem. Fixed point theorems in complete metric spaces. Extensions of the Banach theorem. **(Sections 1 to 5, 6A and 6B of I, § 1 of Text Book).**

Order- theoretic results: The Knaster-Tarski Theorem – Order and completeness, Theorem of Bishop – Phelps – Fixed Points for set-valued contractive maps – Applications to Geometry of Banach spaces – Applications to the theory of Critical Points. Fixed Points of Partially ordered sets. **(Sections 1 to 5 and 6A of I, § 2 of Text Book).**

Results based on convexity: KKM- Maps and the Geometric KKM- Principle – Theorem of Non Neumann and systems of inequalities – Fixed points of Affine Maps, Markoff – Kakutani theorem – Fixed points for Families of maps, Theorem of Kakutani. **(Sections 1 to 4 of I, § 3 of Text Book).**

Further results and applications of Fixed Point theorems : Nonexpansive Maps in Hilbert space – Applications of the Banach Principle to Integral and Differential equations – Applications of the Elementary Domain Invariance – Elementary KKM – Principle and its applications – Theorems of Mazur – Orlicz and Hahn – Banach. **(Sections 1 to 5 of I, § 4 of Text Book).**

Prescribed Text Book : Andrzej Granas and James Dugundji : Fixed point theory, Springer, 2003.

Polynomial Interpolation – Function approximation, Polynomial interpolation, Finite differences, Newton's interpolation formulae, Least square curve fitting, Spline interpolation.
(Chapter 3, Section 3.1 – 3.4 and Chapter 7 Section 7.2 – 7.4 of the textbook)

Numerical solution of ordinary differential equations: Initial value problem: an example – existence and uniqueness of solutions, single and multi step methods, stability study, first order systems, numerical solution of non-linear systems – the problem, Picard iteration, Newton's method.
(Chapter 5 Section 5.1 – 5.5 and Chapter 8.1 – 8.3 of the textbook)

Finite difference methods of Partial differential equations: Parabolic type – Introduction, Characteristic and types of second order equations, well posed problems, some basic properties of linear and quasi-linear equations, system of first order equations, finite difference discretization, parabolic type equations, Crank – Nicholson implicit scheme.
(Chapter 9 Section 9.1 – 9.9 of textbook)

Equation of hyperbolic and elliptic type – hyperbolic type equations, FTCS and other explicit scheme, Lax Wendorf scheme.
(Chapter 10 Section 10.1 – 10.3 of the textbook)

Prescribed Text Book: Numerical Analysis and Algorithms, Pradip Niyogi, Tata McGraw Hill Publishing Company Limited, 2003.

Some topics in elementary number theory: Time estimates for doing arithmetic –
Divisibility and
Euclidean algorithm – Congruence's – Some applications for factoring.
Chapter-I sections 1-4

Cryptography: Some simple Cryptosystems –Enciphering Matrices.
Chapter-III sections 1-2

Pubic Key: The idea of public key Cryptography – R.S.A. – Discrete logarithm Problem
Chapter -IV sections 1-3

Elliptic Curves: Basic facts – Elliptic Curve cryptosystems
Chapter- VI sections 1-2

Prescribed Text Book: A Course in Number Theory and Cryptography Author: Neal Koblitz.

Reference Book: Introduction to Cryptography Author: Johannes A. Buchmann