GOVERNMENT AUTONOMOUS COLLEGE, RAJAMAHENDRAVARAM M.Sc MATHEMATICS

SEMESTER: I

SYLLABUS {w.e.f 2021-2022 Admitted Batch}

PAPER-M 101 - ALGEBRA

UNIT I

Automorphisms - Conjugacy and G-sets- Normal series solvable groups- Nilpotent groups.

[1] (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.

[1] .(Sections 1 to 5 of Chapter 8)

UNIT III

Ideals and homomsphisms - Sum and direct sum of ideals, Maximal and prime ideals-

Nilpotent and nil ideals- Zorn's lemma

[1] (Sections 1 to 6 of Chapter 10)

UNIT IV

Unique factorization domains - Principal ideal domains- Euclidean domains-

Polynomial rings over UFD- Rings of fractions.

[1] (Sections 1 to 4 of Chapter 11, Sections 1 of Chapter 12)

Additional Module: (No question is given from this module)

Integers – Peano's axioms – Modules and vector spaces – Submodules and direct sums – R-homomorphisms and quotient modules.

REFERENCE BOOKS:

[1] Basic Abstract Algebra, Secound Edition by P.B. Bhattacharya,

- S.K. Jain and S.R. Nagpaul.
- [2] Topics in Algebra by I.N. Herstein

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SEMESTER: I

SYLLABUS {w.e.f 2021-2022 Admitted Batch}

PAPER-M 102 - REAL ANALYSIS - 1

UNIT-I

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

[1] (Chapter 2)

UNIT-II

Numerical Sequences and Series: Convergent sequences, Sub sequences, 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.

[1] (Chapter 3)

UNIT-III

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

[1] (Chapter 4)

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.

[1] (Chapter 5)

Additional Module: (No question is given from this module)

Some special functions – Power series – The exponential and logarithmic functions – The trigonometric series – Fourier series.

Reference books:

[1] Principles of Mathematical Analysis by Walter Rudin, International Student Edition,

3rd Edition, 1985.

[2] Mathematical Analysis by Tom M. Apostal, Narosa Publishing House,

2nd Edition, 1985.

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Semester: I

SYLLABUS {w.e.f 2021-2022 Admitted Batch}

PAPER-M 103 - DIFFERENTIAL EQUATIONS

UNIT-I

Second order Linear Differential equations: Introduction - General solution of the homogeneous equation – Use of a known solution to find another solution – Homogeneous equation with Constant coefficients – Method of undetermined coefficients –Method of variation of parameters.

[1] 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.

[1] 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.

[1] 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 theorem some examples.

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

Additional Module: (No question is given from this module)

Vibrations in mechanical system – Newton's law of gravitation and the motion of the planets – Gauss hyper geometric equation.

Reference books:

[1] George F. Simmons, Differential Equations, Tata McGraw-Hill Publishing Company

Limited, New Delhi.

[2] Theory of ordinary Differential equations by Earl A. Coddington.

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Semester: I

SYLLABUS {w.e.f 2021-2022 Admitted Batch}

Paper-M 104: TOPOLOGY

UNIT-I

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).

[1] (Chapter 3: 16 to 20)

UNIT-II

Compactness: Compact spaces – Product of Spaces – Tychonoff's theorem and locally

Compact spaces - Compactness for metric spaces - Ascoli theorem.

[1] (Chapter 4: Sections 21 to 25)

UNIT - III

Separation: T_1 -space and Hausdorff space, Completely regular space and normal space, Uryshon lemma and Tietz extension theorem-the Uryshon imbedding theorem – the Stone cetch compactification.

[1] (Chapter 5: Sections 26 to 30)

UNIT- IV

Connectedness: Connect space, the components of a space , Totally disconnected space, Locally connected space.

[1] (Chapter 6: Sections 31 to 34)

Additional Module: (No question is given from this module)

 T_1 Spaces and Hausdorff spaces- Completely regular spaces and normal spaces – Urysohn's lemma and Tietze Extention theorem.

Reference Books:

[1] Introduction to Topology by G.F.Simmons, Tata Mc.Graw-Hill book company.

[2] Topology a first course by James R Munkres.

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Semester: I

SYLLABUS {w.e.f 2021-2022 Admitted Batch}

Paper-M 105: DISCRETE MATHEMATICS

UNIT-I

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

[1] (Chapters 1, 2 and 3)

UNIT-II

Eulerian graphs, Hamiltonian graphs, spanning trees, Fundamental cycles, Minimal spanning trees. Kruskal algorithm, Primes algorithm.

[2] (Chapter 4)

UNIT-III

Definitions of Lattices, Modular Lattices and distributive lattices

[3] (Chapter I)

UNIT-IV

Basic properties, Boolean polynomials, Ideals, Minimal forms of Boolean polynomials.

[3] (Chapter 2)

Additional Module: (No question is given from this module)

Konigsberg Bridge Problem – Representation and maximisation of Boolean functions.

Reference Books:

- [1] Graph theory applications by L.R.Foulds, Narosa publishing house, New Delhi.
- [2] Discrete Mathematical structures by Kolman and Busby and Sharon Ross Prentice Hall of India-2000 (Third Edition)
- [3] Applied Abstract Algebra by Rudolf Lidl and Gunter pilz, published by Springer verlag.

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SEMESTER: III

SYLLABUS {w.e.f 2021-2022 Admitted Batch}

PAPER- M 301 – 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.

[1] (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.

[1] (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.

[1] (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.

[1] (Sections 60 - 63 of chapter - 11)

Reference Books:

[1] Introduction to Topology and Modern Analysis by G.F.Simmons, McGraw Hill Book Company, Inc-International student ed.

[2] Functional Analysis by Gofman and Fedrich.

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SEMESTER: III

<u>SYLLABUS {w.e.f 2021-2022 Admitted Batch}</u> Paper: M 302 – 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.

[1] (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.

[1] (Chapter 4)

UNIT-III

Differentiation of monotonic functions, functions of bounded variation, differentiation of an integral, absolute continuity.

[1] (Chapter 5)

UNIT-IV

Lp- Spaces the Holder's and Minkowski inequalities, convergence and completeness

[1] (Chapter 6)

Reference Books:

[1] H.L.Royden, Real Analysis, Macmillan Publishing Company, New York,

Third Edition, 1988.

[2] Lebesgue Measure and integration Third Edition by P K Jain, V k Guptha, & Pankaj Jain.

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SEMESTER: III

SYLLABUS {w.e.f 2021-2022 Admitted Batch}

Paper: M 303 – ANALYTICAL NUMBER THRORY

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.

[1] (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.

[1] (Sections 3.1 - 3.12 of chapter 3)

UNIT-III

SOME ELEMENTARY THEOREMS ON THE DISTRIBUTION OF PRIME NUMEBRS:-

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 pn – Shapiro's Tauberian theorem – Applications of Shapiro's theorem – An asymptotic formula for the partial sums $\sum (1/n)$ - The partial sums of the Mobius function.

[1] (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.

[1] (Sections 5.1 – 5.9 of chapter 5)

Reference Books:

[1] Introduction to Analytic Number Theory – By T.M.APOSTOL – Springer Verlag, New York, Heidelberg – Berlin – 1976.

[2] Analytical Number Theory by Henryk Iwaniec and Emmanuel kowalski.

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SEMESTER: III

SYLLABUS {w.e.f 2021-2022 Admitted Batch}

Paper: M 304 - 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.

[1] (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, nonlinear 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.

[1] (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.

[1] (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.

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

Reference Books:

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

[2] Fritz John, Partial Differential Equations, Narosa Publishing House, New Delhi, 1979

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SEMESTER: III

SYLLABUS {w.e.f 2021-2022 Admitted Batch}

Elective Paper: M 305.1 – 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.

[1] (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.

[1] (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.

[1] (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 sub lattices 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.

[1] (Sections 30 – 40 of Chapter 4)

Reference Books:

[1] Introduction to Lattice Theory by Gabor Szasz, Academic Press, New York

[2] General Lattice theory by G.Gratzer, Academic Press, New York.

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SEMESTER: III

SYLLABUS {w.e.f 2021-2022 Admitted Batch}

Elective Paper:: M 305.2 - 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.

[1] (Chapter 1)

UNIT-II

Modules and module homomorphism's, Sub modules and quotient modules, operations on sub modules, 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.

[1] (Chapter 2)

UNIT-III

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

[1] (Chapter 3)

UNIT-IV

Primary decompositions.

[1] (Chapter 4)

Reference Books:

[1] Introduction to commutative algebra, M.F.ATIYAH and I.G.MACDONALD, Addition – Wesley publishing Company, London.

[2] An Introduction by William Hoffman and Xiaohong jia.

M.Sc MATHEMATICS

SEMESTER: III

SYLLABUS {w.e.f 2021-2022Admitted Batch}

Elective Paper:: M 305.3 - 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] (Sections 1,2,3,4 of chapter-6)

UNIT-II

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

[1] (Sections 1,2,3,4,5,6 of chapter-7)

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] (Sections 1,2,3 of chapter-8 and Sections 1,2,3 of chapter 9)

UNIT-IV

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

[1] (Sections 1,2 of chapter-10 and Sections 1,2,3 of chapter 11)

Reference Books:

[1] Functions of one complex variables by J.B.Conway : Second edition, Springer International student Edition, Narosa Publishing House, New Delhi.

[2] Complex Variables and applications by James Ward Brown, Ruel V. Churchill.