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NH-52, Namsai, Arunachal Pradesh -792103

## MASTER OF SCIENCE (MATHEMATICS) - FIRST SEMESTER

First Semester			
S. No.	Name of Subject	Credits	Total Marks
1	Real Analysis	5	100
2	Algebra-I	4	100
3	Linear Algebra	5	100
4	Differential Equations	5	100
5	Complex Analysis	5	100
Total		24	

**Subject Name:** REAL ANALYSIS

### Unit 1: Revision

Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum and infimum. Sequences and series, convergence,  $\limsup$ ,  $\liminf$ , Continuity, uniform continuity.

### Unit 2: Sequences

Sequences and series of functions, Pointwise and uniform convergence, Monotonic functions, types of discontinuity, Absolute Convergence, functions of bounded variation, Continuous functions of bounded variation.

### Unit 3: Functions of Several Variables

Linear Transformations, Differentiations, The Contraction principle, Inverse Function Theorem, Implicit function theorem, Rank Theorem, Determinants, Derivatives of Higher order.

### Unit 4: Riemann-Stieltjes Integral

Riemann-Stieltjes integrals, The R-S integral as a limit of sum, Classes of R-S integrable functions, Algebra of R-S integrable functions, Relation between Riemann and Riemann-Stieltjes integral.

#### **Unit 5: Metric spaces**

Metric spaces, compactness, completeness, Bolzano Weierstrass theorem, Heine Borel theorem; connectedness and continuity, Spaces of continuous functions as examples.

#### **REFERENCE BOOKS:**

1. R.G. Bartle and D.R. Sherbert : Introduction to Real Analysis, Wiley India, 3rd Ed. 2005.
2. W. Rudin, Principles of Mathematical Analysis, Mc-Graw Hill, 2000 .
3. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, 2008 .
4. G.F. Simmons: Introduction to Topology and Modern Analysis, TMGH, 1963.

#### **Subject Name: ALGEBRA-I**

##### **Unit 1 :**

A brief review of groups, their properties and examples, subgroups, isomorphism theorems, homomorphism of groups, automorphisms of groups, symmetric, alternating and dihedral groups.

##### **Unit 2 :**

The class equation of finite groups, Sylow theorems, Direct products of groups, fundamental theorem of finite abelian groups and applications.

##### **Unit 3 :**

Nilpotent and Solvable Groups, Normal and Subnormal Series Jordan-Holder theorem.

##### **Unit 4 :**

Rings and Homomorphism, Ideals and Quotient Rings, Field of quotients of an Integral Domain.

#### **REFERENCE BOOKS:**

1. I.N.Herstein: *Topics in Algebra*, Wiley Eastern Ltd., New Delhi, 1975
2. Thomas W.Hungerford, *Algebra*, Springer-Verlag, New york, 1974
3. Gallian, J. A., *Contemporary Abstract Algebra*, 4th edition (Narosa Publishing house, New Delhi, 2009).

**Subject Name:** LINEAR ALGEBRA

**Unit 1 :**

Systems of linear equations, Vector Space, Linear Span, Bases and dimensions, change of bases, sums and direct sums.

**Unit 2 :**

Linear transformations, matrix representations of linear transformations, the rank and nullity theorem, Linear Operators and Eigenvectors, Diagonalization and triangulation.

**Unit 3 :**

Dual spaces, transposes of linear transformations, invariant subspaces, Annihilators, the minimal polynomial, Jordan canonical form.

**Unit 4 :**

Orthogonal Transformations, Unitary Transformations, The Principal Axis Theorem, Bilinear forms: bilinear, positive and quadratic forms.

**Unit 5 :**

Inner product spaces, orthonogonal bases, Gram-Schmidt process.

**REFERENCE BOOKS:**

1. Hoffman and R. Kunze, *Linear Algebra*, Prentice-Hall of India, 1996.
2. P.K. Saikia, *Linear Algebra*, Prentice Hall, 2006.
3. C.W. Curtis, *Linear Algebra An Introductory Approach*, Springer, 1984.
4. G. Schay, *Introduction to Linear Algebra*, Narosa, 1997.

**Subject Name:** DIFFERENTIAL EQUATIONS

**Unit 1: Partial Differential Equations of Second Order**

Linear partial differential equations of second order with constant co-efficient, Characteristic curves of second-order equations, Reduction to canonical forms, Separation of variables, Solutions of nonlinear equations of the second order by Monge's method.

**Unit 2: Laplace's Equation, Wave Equation, Diffusion Equation**

The occurrence of Laplace's equation in Physics, Boundary value problems, Solution of Laplace's equation by separation of variables,. The theory of Green's function for Laplace's equation, The occurrence of the Wave equation in Physics, Elementary solutions of the one-dimensional Wave equation, The occurrence of the Diffusion equation in Physics, Elementary solutions of the Diffusion equation, Solution of the Diffusion equation by separation of variables.

**Unit 3 : Ordinary Differential Equation**

Review of fundamentals of ODEs, Some basic mathematical models, direction fields, classification of differential equation, Solutions of some differential equation, 1st order

non-linear differential equation, Existence and Uniqueness problem, Gronwall's inequality, Peano existence theorem, Picard existence and uniqueness theorem.

#### REFERENCE BOOKS :

1. *Elements of Partial Differential Equations* by Ian. N. Sneddon, McGraw Hill Book Company.
2. Coddington, E. A. *An Introduction to Ordinary Differential Equations* (Prentice-Hall, 1974).
3. *Introduction to Partial Differential Equations* by K.S. Rao, PHI Pvt. Ltd, New Delhi, 2005.
4. Ross, S. L. *Differential Equations*, 3rd edition, Wiley 1984.

**Subject Name:** COMPLEX ANALYSIS

#### Unit 1 : Revisions

Functions of Complex variables, Mappings by exponential functions, limits, continuity, derivatives, Cauchy-Riemann equations, Analytic functions, Harmonic functions, Reflection principles, basic properties of Complex Integration, Cauchy's Theorem, Morera's Theorem, Cauchy Integral formula, Laurent's series, The Maximum modulus principle, Schewarz lemma, Liouville's theorem.

#### Unit 2 : Elementary functions

The exponential functions, logarithmic function, Branches and derivatives of logarithm, Complex exponents, Trigonometric functions, Hyperbolic functions, Inverse trigonometric functions.

#### Unit 3 : Series

Convergence of sequences, Convergence of series, Taylor series, Laurent Series, Absolute and uniform convergence of Power series, Integration and differentiation of power series, Uniqueness of series representation.

#### Unit 4 : Calculus of Residues

Residue at a finite point, Residue at the point at infinity, Residue Theorem, Number of zeros and poles, Argument principle, the winding number, Rouché's theorem, evaluation of Integrals.

#### Unit 5: Conformal Mapping

Linear Transformation, Linear fractional transformation, mappings of upper half plane, The transformation  $w = \sin z$ ; mappings by  $z^2$  and Branches of  $z^{1/2}$ , square roots of polynomials, preservation of angles, scale factor, local inverses, harmonic conjugates, transformation of harmonic functions, Applications.

#### REFERENCE BOOKS :

1. Mathews, J. H. and Howell, R. W., *Complex Analysis for Mathematics and Engineering*, 3<sup>rd</sup> Edition, Narosa, 1998.
2. S. Ponuswami, *Foundations of Complex Analysis*, Narosa Publication.
3. J.C. Brown and R.V. Churchill, *Complex Variables and Applications*, Mc- Graw Hill.
4. *Complex Analysis*, V.Karunakaran, Narosa Publication.