

**Department of Mathematics  
Mahatma Gandhi University  
(Choice Based Credit System)**

**M,Sc Mathematics**

**Scheme of Instruction And Examinations  
(W.e.f The Academic year 2015-16)**

**Semester - I**

S.No	Sub Code	Subject	Hrs/Week	Duration of Exam	Internal Assessment	External Marks	Total Marks	Credits
1	MM101	Algebra	6	3	20	80	100	6
2	MM102	Real Analysis	6	3	20	80	100	6
3	MM103	Discrete Mathematics	6	3	20	80	100	6
4	MM104	Elementary Number theory	6	3	20	80	100	6
5	MM105	Mathematical Methods	6	3	20	80	100	6
6	MM 199	Seminar and Tutorials	2(extra)				25	1
7	ADDON Paper	Communicative English & Soft Skills	2	2	10	40	50	2
<b>Total</b>			<b>34</b>				<b>575</b>	<b>33</b>

**Semester- II**

S.No	Sub Code	Subject	Hrs/Week	Duration of Exam	Internal Assessment	External Marks	Total Marks	Credits
1	MM201	Advanced Algebra	6	3	20	80	100	6
2	MM202	Advanced Real Analysis	6	3	20	80	100	6
3	MM203	Functional Analysis	6	3	20	80	100	6
4	MM204	Theory of Ordinary Differential Equations	6	3	20	80	100	6
5	MM205	Topology	6	3	20	80	100	6
6	MM 299	Seminar and Tutorial	2(extra)				25	1
7	ADDON Paper	Human values and Ethics	2	2	10	40	50	2
<b>Total</b>			<b>34</b>				<b>575</b>	<b>33</b>

*Handwritten signature*

*Handwritten signature*

*Handwritten signature*

DEPARTMENT OF MATHEMATICS  
MAHATMA GANDHI UNIVERSITY

M.Sc. Mathematics  
Semester I

MM -101

Paper-I

Algebra

Unit I

Automorphisms- Conjugacy and G-sets- Normal series solvable groups- Nilpotent groups. (Pages 104 to 128 of [1] )

Unit II

Structure theorems of groups: Direct product- Finitely generated abelian groups- Invariants of a finite abelian group- Sylow's theorems- Groups of orders  $p^2, pq$ . (Pages 138 to 155)

Unit III

Ideals and homomorphism- Sum and direct sum of ideals, Maximal and prime ideals- Nilpotent and nil ideals- Zorn's lemma (Pages 179 to 211).

Unit-IV

Unique factorization domains - Principal ideal domains- Euclidean domains- Polynomial rings over UFD- Rings of traction. (Pages 212 to 228)

**Text Books:**

[1] Basic Abstract Algebra by P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul.

**Reference:**

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



*Algebra*  
02/09

*any*  
*Crash*

*2/9/15*

DEPARTMENT OF MATHEMATICS  
MAHATMA GANDHI UNIVERSITY

M.Sc. Mathematics  
Semester I

MM - 102

Paper-II

Real Analysis

Unit I

Metric spaces- Compact sets- Perfect sets- Connected sets

Unit II

Limits of functions- Continuous functions- Continuity and compactness  
Continuity and connectedness- Discontinuities – Monotone functions.

Unit III

Rieman- Steiltjes integral- Definition and Existence of the Integral- Properties of  
the integral- Integration of vector valued functions- Rectifiable waves.

Unit-IV

Sequences and series of functions: Uniform convergence- Uniform convergence  
and continuity- Uniform convergence and integration- Uniform convergence and  
differentiation- Approximation of a continuous function by a sequence of  
polynomials.

**Text Books:**

[1] Principles of Mathematical Analysis (3<sup>rd</sup> Edition) (Chapters 2, 4, 6 )

by W. Tuddin Mc Graw-Hill International Edition

*[Handwritten signature]*

*[Handwritten signature]*  
02/09/2015

*[Handwritten signature]*

*[Handwritten signature]*  
2/9/15

**DEPARTMENT OF MATHEMATICS  
MAHATMA GANDHI UNIVERSITY**

M.Sc. Mathematics  
Semester I

MM-103

Paper-III

Discrete Mathematics

**UNIT- I**

**LATTICES:** Partial Ordering – Lattices as Posets – some properties of Lattices – Lattices as Algebraic Systems – Sublattices, Direct products and Homomorphisms – some special Lattices – Complete, complemented and distributive lattices. (Pages 183-192, 378-397 of [1])

**UNIT- II**

**BOOLEAN ALGEBRA:** Boolean Algebras as Lattices – Boolean Identities – the switching Algebra – sub algebra, Direct product and homomorphism – Join irreducible elements – Atoms (minterms) – Boolean forms and their equivalence – minterm Boolean forms – Sum of products canonical forms – values of Boolean expressions and Boolean functions – Minimization of Boolean functions – the Karnaugh map method. (Pages 397 – 436 of [1])

**UNIT- III**

**GRAPHS AND PLANAR GRAPHS :** Directed and undirected graphs – Isomorphism of graphs – subgraph – complete graph – multigraphs and weighted graphs – paths – simple and elementary paths – circuits – connectedness – shortest paths in weighted graphs – Eulerian paths and circuits – Incoming degree and outgoing degree of a vertex – Hamiltonian paths and circuits – Planar graphs – Euler's formula for planar graphs. (Pages 137-159, 168-186 of [2])

**UNIT- IV**

**TREES AND CUT-SETS:** Properties of trees – Equivalent definitions of trees – Rooted trees – Binary trees – path lengths in rooted trees – Prefix codes – Binary search trees – Spanning trees and Cut-sets – Minimum spanning trees (Pages 187-213 of [2])

**Text Books:-**

- [1] J P Tremblay and R. Manohar: Discrete Mathematical Structures with applications to Computer Science, McGraw Hill Book Company
- [2] C L Liu : Elements of Discrete Mathematics, Tata McGraw Hill Publishing Company Ltd. New Delhi. (Second Edition).

*[Handwritten signatures and dates in blue ink: "M... 02/09", "C... 2/9/15", and other illegible marks]*

**DEPARTMENT OF MATHEMATICS  
MAHATMA GANDHI UNIVERSITY**

M.Sc. Mathematics  
Semester I

MM 104

**Paper-IV**

Elementary Number Theory

**UNIT-I**

The Fundamental Theorem of arithmetic: Divisibility, GCD, Prime Numbers, Fundamental theorem of Arithmetic, the series of reciprocal of the Primes, The Euclidean Algorithm.

**UNIT-II**

Arithmetic function and Dirichlet Multiplication, The functions  $\phi(n)$ ,  $\mu(n)$  and a relation connecting them, Product formulae for  $\phi(n)$ , Dirichlet Product, Dirichlet inverse and Mobius inversion formula and Mangoldt function  $\Lambda(n)$ , multiplication function, multiplication function and Dirichlet multiplication, Inverse of a completely multiplication function, Liouville's function  $\lambda(n)$ , the divisor function is  $\sigma_\alpha(n)$

**UNIT-III**

Congruences, Properties of congruences, Residue Classes and complete residue system, linear congruences conversion, reduced residue system and Euler Fermat theorem, polynomial congruence modulo P, Lagrange's theorem, Application of Lagrange's theorem, Chinese remainder theorem and its application, polynomial congruences with prime power moduli

**UNIT-IV**

Quadratic residue and quadratic reciprocity law, Quadratic residues, Legendre's symbol and its properties, evaluation of  $(-1/p)$  and  $(2/p)$ , Gauss Lemma, the quadratic reciprocity law and its applications.

**Text Book:-** Introduction to analytic Number Theory by Tom N. Apostol.  
Chapters 1,2,5,9



 02/09





 2/9/15

**DEPARTMENT OF MATHEMATICS**  
**MAHATMA GANDHI UNIVERSITY**

M.Sc. (Mathematics)  
Semester I

MM - 105

Paper- V

Mathematical Methods

**Unit I** Existence and Uniqueness of solution of  $\frac{dy}{dx} = f(x,y)$ . The method of successive approximation- Picard's theorem- Sturm-Liouville's boundary value problem. Partial Differential Equations: Origins of first-order PDES-Linear equation of first-order- Lagrange's method of solving PDE of  $Pp+Qq = R$  - Non-Linear PDE of order one- Charpit method- Linear PDEs with constant coefficients.

**Unit II** Partial Differential Equations of order two with variable coefficients- Canonical form Classification of second order PDE- separation of variable method solving the one-dimensional Heat equation and Wave equation- Laplace equation.

**Unit III**

Power Series solution of O.D.E. - Ordinary and Singular points- Series solution about an ordinary point -Series solution about Singular point-Frobenius Method. Lagrange Polynomials: Legendre's equation and its solution- Legendre Polynomial and its properties- Generating function-Orthogonal properties- Recurrence relations- Laplace's definite integrals for  $P_n(x)$ - Rodrigue's formula.

**Unit-IV**

Bessels Functions: Bessel's equation and its solution- Bessel function of the first kind and its properties- Recurrence Relations- Generating function- Orthogonality properties. Hermite Polynomials: Hermite's equation and its solution- Hermite polynomial and its properties- Generating function- Alternative expressions (Rodrigue's formula)- Orthogonality properties- Recurrence Relations.

**Text Books:**

- [1] "Elements of Partial Differential Equations", By Ian Sneddon, Mc.Graw-Hill International Edition.
- [2] "Text book of Ordinary Differential Equation", By S.G.Deo, V. Lakshmi Kantham, V. Raghavendra, Tata Mc.Graw Hill Pub. Company Ltd.
- [3] "Ordinary and Partial Differential Equations", By M.D. Raisingania, S. Chand Company Ltd., New Delhi.

*Marty 02/09*      *over*      *Erin*      *H. P. S. 2/11/15*

**DEPARTMENT OF MATHEMATICS**  
**MAHATMA GANDHI UNIVERSITY**  
M.Sc. (Mathematics)  
Semester II

MM-201

**Paper-I**

Advanced Algebra

**Unit I**

Algebraic extensions of fields: Irreducible polynomials and Eisenstein criterion-  
Adjunction of roots- Algebraic extensions-Algebraically closed fields (Pages 281  
to 299)

**Unit II**

Normal and separable extensions: Splitting fields- Normal extensions- Multiple  
roots- Finite fields- Separable extensions (Pages 300 to 321)

**Unit III**

Galois theory: Automorphism groups and fixed fields- Fundamental theorem of  
Galois theory- Fundamental theorem of Algebra (Pages 322 to 339)

**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. (Pages 340-364)

**Text Books:**

[1] Basic Abstract Algebra- S.K. Jain, P.B. Bhattacharya, S.R. Nagpaul.

**Reference Book:**

1. Topics in Algebra By I. N. Herstein

*[Handwritten signatures and marks]*

**DEPARTMENT OF MATHEMATICS  
MAHATMA GANDHI UNIVERSITY**

M.Sc. Mathematics  
Semester II

MM -202

**Paper-II**

Advanced Real Analysis

**Unit I**

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

**Unit II**

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

**Unit III**

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

**Unit-IV**

Differentiation of an integral- Absolute continuity- The  $L^p$ -spaces- The Minkowski and Holder's inequalities- Convergence and completeness.

**Text Books:**

- [1] Real Analysis (3<sup>rd</sup> Edition) (Chapters 3, 4, 5) by H. L. Royden  
Pearson Education (Low Price Edition)

Musty  
02/09

may

Praveen

Praveen  
2/9/15

**DEPARTMENT OF MATHEMATICS  
MAHATMA GANDHI UNIVERSITY**

M.Sc. Mathematics  
Semester II

MM - 203

Paper-III

Functional Analysis

**UNIT-I**

Normed Space, Banach Space, further properties of normed spaces, Finite dimensional normed spaces and subspaces, compactness and finite dimension linear operators, Bounded and continuous linear operators, linear functionals, linear operators and functionals on finite dimensional spaces, normed spaces of operators, Dual spaces.

(See Sections 2.2 to 2.10)

**UNIT-II** Inner product space, Hilbert space, further properties of inner product spaces, orthogonal complements and direct sums, orthonormal sets and sequences, series related to orthonormal sequences and sets. (Sections 3.1 to 3.5)

**UNIT-III** Total Orthonormal sets and sequences, Representation of functionals on Hilbert Spaces, Hilbert-adjoint operator, self-adjoint, unitary and normal operators. (See Sections 3.6, 3.8, 3.9 and 3.10)

**UNIT-IV**

Hahn-Banach theorems for Complex vector spaces and normed spaces, adjoint operator, Reflexive spaces, uniform boundedness theorem, convergence of sequences of operators and Functionals. Open mapping theorem, closed graph theorem.

(See Sections 4.3, 4.5, 4.6, 4.7, 4.12 and 4.13).

---

**Text Book:-** Introductory Functional Analysis by E. Kreyszig, John-wiley and Sons, New York,

**References Books:-**

- 1). B.V. Limaye, "Functional Analysis", 2<sup>nd</sup> Edition
- 2). Brown and Page, "Elements of Functional Analysis"
- 3). P.K. Jain, O.P. Ahuja and Khalil Ahmed, "Functional Analysis".



Munty  
02/09

copy  
Esa

HANU  
2/9/15

**DEPARTMENT OF MATHEMATICS**  
**MAHATMA GANDHI UNIVERSITY**  
M.Sc. Mathematics  
Semester II

MM - 204

Paper-IV

Theory of Ordinary Differential Equations

**UNIT-I**

Linear differential equations of higher order: Introduction-Higher order equations A Modelling problem -Linear Independence- Equations with constant coefficients- Equations with variable coefficients- Wronskian- Variation of parameters- Some standard methods.

**UNIT-II** Existence and Uniqueness of solutions: Introduction – preliminaries – successive approximations – Picard’s theorem – continuation and dependence on initial conditions – existence of solutions on the large – existence and uniqueness of solutions of systems – fixed point method

**UNIT-III** Analysis and methods of non-linear differential equations:-Introduction – Existence theorem- Extremal solutions – Upper and Lower solutions- Monotone iterative method, method of quasi linearization- Bihari’s inequality.

**Unit - IV** Oscillation theory for linear Differential equation of Second Order :- The adjoint equation- self adjoint differential equation of second order- Abel’s formula - the number of zeros in a finite interval – the Sturm separation theorem- the Sturm comparison theorem- the Sturm Picone theorem- the Bocher Osgood theorem- A special pair of solution – Oscillation on half axis.

**Text Book :**

- 1) Ordinary Differential Equations and Stability theory by S.G. Deo, V. Lakshmikantham, V. Raghavendra

**Reference Books:**

1. An Introduction to Ordinary Differential Equations by E.A.Coddington
2. Ordinary Differential Equations and stability theory by David Sanchez
3. An Introduction to the Theory of Ordinary Differential Equations by Walter Leighton

*BB*

*2*

*Murthy  
02/09*

*copy  
-  
Gray*

*#D...  
2/9/10*

DEPARTMENT OF MATHEMATICS  
MAHATMA GANDHI UNIVERSITY  
M.Sc. Mathematics  
Semester-II

MM - 205

Paper- V

Topology

Unit I

Topological spaces: Definition and some examples- Elementary concepts Open bases and open subbases – weak topologies.

Unit II

Compactness : Compact spaces – products of spaces- Tychonoff's theorem and locally compact spaces – Compactness for metric spaces – Ascoli's theorem.

Unit III

Separation :  $T_1$  -spaces and Hausdorff spaces – completely regular spaces and normal spaces – Uryson's lemma and the Tietze extension theorem- the Urysohn imbedding theorem.

Unit IV

Connectedness: Connected spaces – The components of a spaces – Totally disconnected spaces – Locally connected spaces.

Text Book:

[1] G. F. Simmons, Topology and Modern Analysis, (Chapters 3,4,5,6) McGraw Hill.

 



