MSC MATHEMATICS

SYLLABUS

WITH EFFECT FROM THE

ACADEMIC YEAR

2023-2024

DEPARTMENT OF MATHEMATICS

UNIVERSITY COLLEGE OF SCIENCE

MAHATMA GANDHI UNIVERSITY, NALGONDA

Minutes of the BOS Meeting

The BOS Meeting is convened on 06-09-2023 at 11.30am in the Dept of Mathematics Osmania university, Hyderabad to approve the PG (MSC Mathematics) syllabus w.e.f. the Academic year 2023-2024 and the following members were present in the meeting.

1. Dr.P.Maddileti, MGU, Chairman, BOS in Mathematics
2. Prof. M.A. Srinivas, JNTU, Member, BOS in Mathematics
3. Prof. N.Kishan, OU, Member, BOS in Mathematics
4. Prof.P.Malla Reddy, KU, Member, BOS in Mathematics
5. Dr.D.Hymavathi, MGU, Member, BOS in Mathematics
6. Dr.G.Upender Reddy, MGU, Member, BOS in Mathematics
7. Prof.B.Surender Reddy, Professor of Mathematics, OU, Ex-Officio Member
8. Prof.B.KrishnaReddy, Professor of Mathematics, OU, Ex-Officio Member
9. Prof.S.Harising Naik, Professor of Mathematics, OU, Ex-Officio Member

Resolutions:

1. It is resolved to approve the proposed Syllabus for M.Sc Mathematics w.e.f the Acadamic year 2023-2024.
2. It is also resolved to approve the MSC Mathematics examination model paper.

The above resolutions are approved by the BOS Committee members.

1. Dr.P.Maddileti, MGU
   Chairman, BOS in Mathematics
2. Prof. M.A. Srinivas, JNTU
   Member, BOS in Mathematics
3. Prof.P.Malla reddy, KU
   Member, BOS in Mathematics
4. Prof. N.Kishan, OU
   Member, BOS in Mathematics
5. Dr.D.Hymavathi, MGU
   Member, BOS in Mathematics

6. Dr.G.Upender Reddy, MGU
   Member, BOS in Mathematics
7. Prof.B.Surender Reddy,
   Professor of Mathematics, OU, Ex-Officio Member
8. Prof.B.KrishnaReddy,
   Professor of Mathematics, OU, Ex-Officio Member
9. Prof.S.Harising Naik,
   Professor of Mathematics, OU, Ex-Officio Member

Department of Mathematics, Mahatma Gandhi University
(Choice based Credit System)
M.Sc Mathematics
Scheme of Instructions and Examinations (W.e.f the Academic Year 2023-24)

Semester	Theory Paper	Paper Title	Hrs/ week	Credits	Marks
Sem-I	101-Paper-I	Abstract Algebra	4	4	100
	102-Paper-II	Real Analysis	4	4	100
	103-Paper-III	Discrete Mathematics	4	4	100
	104-Paper-IV	Elementary Number Theory	4	4	100
	105-Paper-V	Theory Ordinary Differential Equations	4	4	100
		Seminar			
Total			**20**	**20**	**500**
Sem-II	201-Paper-I	Galois theory	4	4	100
	202-Paper-II	Measure and Integration	4	4	100
	202-Paper-III	Functional Analysis	4	4	100
	203-Paper-IV	Mathematical Methods	4	4	100
	205-Paper-V	Topology	4	4	100
	Paper- VI	Add on paper	2	2	50
		Seminar			
			22	**22**	**550**
Sem-III	301-Paper-I	Complex Analysis	4	4	100
	302-Paper-II	Elementary Operatory Theory	4	4	100
	303-Paper III	Operations Research	4	4	100
	304-Paper-IV	(a) Numerical Analysis	4	4	100
		(b)Analytical Number Theory	4		
	305-Paper-V	(a)Integral Transforms	4		
		(b)Mechanics	4	4	100
	Paper-VI	Basic Mathematics (Open Elective-ID Paper)	2	2	50
		Seminar			
		Total	**30**	**22**	**550**
Sem-IV	401-Paper-I	Advanced Complex Analysis	4	4	100
	402-Paper-II	Integral Equations & Calculus of Variations	4	4	100
	403-Paper-III	Linear Algebra	4	4	100
	404-Paper-IV	(a)Finite Difference Methods	4	4	100
		(b)Cryptography	4		
	405-Paper-V	(a)Applications of Functional Analysis	4	4	100
		(b)Fluid Mechanics	4		
	Paper-VI	Project Work	4	4	100
		Seminars			
		Total	**32**	**24**	**600**
		Grand Total	**104**	**88**	**2200**

6/9/2023

DEPARTMENT OF MATHEMATICS
MAHATMA GANDHI UNIVERSITY
M.Sc. Mathematics
Semester I

MM –101

Paper-I

Abstract Algebra

Unit I

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

Unit II

Structure theorems of groups: Direct product- Finitly 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 homomsphism- 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.

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 (3rd Edition) (Chapters 2, 4, 6).

By W. Tuddin Mc Graw-Hill Internation Edition.

DEPARTMENT OF MATHEMATICS
MAHATMA GANDHI UNIVERSITY
M.Sc. Mathematics
Semester I

MM –103

Discrete Mathematics

Paper-III

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 – Bolean 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).

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 Arithemtic, 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

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

MM-105 **Paper-V**

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 strum separation theorem the strum comparision theorem- the strum 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 WalterLeighton.

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

MM –201 **Paper-I**

Galois Theory

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 Galoes 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:

Topics in Algrbra By I. N. Herstein.

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

MM –202 **Paper-II**

Measure and Integration

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^{rd} Edition) (Chapters 3, 4, 5) - by H. L. Royden

Pearson Education (Low Price Edition).

M 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 4.3,4.5,4.6,4.7,4.12,4.13).

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

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References Books:-

1).B.V.Limaye, "Functional Analysis", 2nd Edition.

2).Brown and Page, "Elements of Functional Analysis"

3).P.K.Jain, O.P.Ahuja and Khalil Ahmed, "Functional Analysis"

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

MM – 204 **Paper-IV**

Mathematical Methods

Unit-I

Fourier Series and Orthogonal Functions: The Fourier Coefficients-The problem of Convergence- Even and Odd Functions- Cosine and Sine Series-Extension Arbitrary Intervals-Orthogonal Functions.

Unit-II

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

Unit III

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-IV

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.

Text Books:

[1] Differential Equations with Applications and Historical Notes by George F.Simmons, Second Edition, Mc Graw-Hill

[2] Ordinary and Partial Differential Equations, by M.D. Raisingania, S. Chand Company Ltd., New Delhi.

[3] Elements of Partial Differential Equations, By Ian Sneddon, Mc.Graw-Hill.

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 - Ascolli's theorem.

Unit III

Seperation-T1 spaces and Hausdorff spaces – complete regular spaces and Normal space-Urysohn's lemma – 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, McGraw Hill.

DEPARTMENT OF MATHEMATICS
MAHATMA GANDHI UNIVERSITY
M.Sc. Mathematics
Semester III

MM –301 T

Paper-I

Unit I **Complex Analysis**

Regions in the complex plane- Functions of a complex variable- Mappings by exponential functions- Limits- Continuity- Derivatives- Cauchy-Riemans equations- Sufficient conditions for differentiation- Polar coordinates.

Unit II

Analytic functions- Uniquely determined analytic functions- Reflection principle- The exponential function- The logarithmic function- Complex exponents- Trigonometric functions- Hyperbolic functions- Inverse trigonometric- Hyperbolic functions.

Unit III

Derivatives of functions w(t)- Definite integrals of functions w(t)- Contours- Contour integrals- Upper bounds for moduli of contour integrals- Anti derivatives.

Unit-IV

Cauchy-Goursat theorem and its proof- Simply and multiply connected domains- Cauchy's integral formula- Derivatives of analytic functions- Liouville's theorem and fundamental theorem of algebra- Maximum modulus principle.

Text Books:

[1] Complex Variable and Application (8th Edition) by James Ward Brown, Ruel V-churchill.

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

MM – 302 **Paper-II**

Elementary Operator Theory

Unit I

Spectral theory in finite dimensional normed spaces - Basic concepts of spectrum - Resolvent sets - Spectral properties of bounded linear operators - Further properties of resolvent and spectrum. (Sections 7.1, 74)

Unit II

Compact linear operators on normed spaces - Properties of compact linear operators - Spectral properties of compact linear operators on normed spaces - Operator equations involving compact linear operators. (Sections 8.1, 8.2, 8.3 and 8.5 of [1])

Unit III

Spectral properties of bounded self adjoint linear operators - Further spectral properties of bounded linear operators - Positive operators - Square root of a positive operator. (Sections 9.1, 9.2, 9.3 and 9.4 of [1])

Unit IV

Projection operators - Properties of projection operators - Spectral family - Spectral family of a bounded self adjoint linear operator.
(Sections 9.5, 9.6, 9.7 and 9.8 of [1])

Text Book :

[1] E. Kreyszig : Introductory Functional Analysis, John Wiley and Sons, New York, 1978.

Reference Books:

[1] Brown and Page: Elements of Functional Analysis, D.V.N. Comp.
[2] B.V. Limaye : Functional Analysis, Wiley Eastern Limited, (2nd Edition)
[3] P.R.Halmos :AHilbert Space Problem Book, D.Van Nostrand Company, Inc. 1967.

DEPARTMENT OF MATHEMATICS
MAHATMA GANDHI UNIVERSITY
M.Sc. Mathematics
Semester III

MM – 303

Paper III

Operations Research

Unit I

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

Unit II

Mathematical formulation of Assignment problem, Reduction theorem, Hungarian Assignment Method, Travelling salesman problem, Formulation of Travelling Salesman problem as an Assignment problem, Solution procedure. Mathematical formulation of Transportation problem, Tabular representation, Methods to find initial basic feasible solution, North West corner rule, Lowest cost entry method, Vogel's approximation methods, Optimality test, Method of finding optimal solution, Degeneracy in transportation problem, Method to resolve degeneracy, Unbalanced transportation problem.

Unit III

Concept of Dynamic programming, Bellman's principle of optimality, characteristics of Dynamic programming problem, Backward and Forward recursive approach, Minimum path problem, Single Additive constraint and Multiplicatively separable return, Single Additive constraint and Additively separable return, Single Multiplicatively constraint and Additively separable return.

Unit-IV

Historical development of CPM/PERT Techniques - Basic steps - Network diagram representation - Rules for drawing networks - Forward pass and Backward pass computations - Determination of floats - Determination of critical path - Project evaluation and review techniques updating.

Text Books:

[1] S. D. Sharma, Operations Research.
[2] Kanti Swarup, P. K. Gupta and Manmohan, Operations Research.
[3] H. A. Taha, Operations Research – An Introduction.

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

MM – 304 A

Paper IV(A)

Numerical Analysis

Unit I

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

Unit II

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

Unit III

Interpolation and Approximation: Introduction, Lagrange and Newton's divided difference interpolation, Finite difference operators, stirling and Bessel interpolation, Hermite interpolation, piecewise and Spline Interpolation, least square approximation. (Algorithms on Lagrange and Newton divided difference Interpolation).

Unit IV

Numerical Differentiation: methods based on Interpolation, methods based on Finite difference operators Numerical Integration: methods based on Interpolation, Newton's cotes methods, methods based on Undertermined coefficients, Guass legendre Integration method, Numerical methods ODE: Singlestep methods: Eulers method, Taylor series method, Rungekutte second and forth order methods, Multistep methods: Adam Bash forth method, Adam Moulton methods, Milne-Simpson method. (Algorithms on Trapezoidal, Simpson, Eulers & Runggekutte. methods only)

Text Book:

(1) Numerical Methods for Scientific and Engineering computation by M.K. Jain, S.R.K. Iyengar, R.K. Jain, New Age Int. Ltd., New Delhi.
(2) Computer Oriented Numerical Methods by V. Rajaraman.

Reference:

(1) Introduction to Numerical Analysis, by S.S. SastryPrentice Hall Flied.

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

MM – 304 B

Paper-IV(B)

Analytic Number Theory

Unit I

Averages of arithmetical function: The big oh notation- Asymptotic equality of functions- Euler summation formula- Some asymptotic formulas- The average order of d(n)- The average order of the divisor functions $\sigma\alpha(n)$- The average order of $\emptyset(n)$- An application to the distribution of lattice points visible trona the origin- The average order of $\mu(n)$ and $\Lambda(n)$- The partial sums of dirichlet product- Applications to $\mu(n)$ and $\Lambda(n)$- Another identity for the partial sums of a dirichlet product. (Sections3.1 to 3.12)

Unit II

Some elementary theorems on the distribution of prime numbers- Introduction chebyshev's functions- $\psi(x)$ and $\theta(x)$- Relation connecting $\theta(n)$and $\pi(n)$-Some equivalent forms of the prime number theorem- Inequalities for $\pi(n)$ and p_n. (Sections4.1 to 4.5)

Unit III

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 mobins function- Selberg Asymptotic formula.

Unit-IV

Finite Abelian groups and their character: Construction of sub groups- Characters of finite abelian group- The character group- The orthogonality relations for characters Dirichlet characters- Sums involving dirichelt characters the non vanishing of $L(1, \chi)$ for real non principal χ.

Text Books:

[1] Tom M. Apostol- Introduction to Analytic Number Theory.

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

MM – 305 A **Paper V(A)**

Integral Transforms

Unit-I

Fourier Transform: Introduction - Classess of Function-Fourier Series and Fourier Integral Formula-Fourier sine and cosine Transforms-Linear Property-Change of Scale property- Modulation Theorem- Evalution of Integrals by means of Inversion theorem- Fourier Transform of some particular functions- Convolution of Integral functions- Parsevals relations- Fourier Transform of Derivatives-Fourier Transform of some more useful functions- Other important examples concerning derivative of Fourier Transform.

Unit-II

The Laplace Transform: Introduction- Definitions- Sufficient conditions- Linear Property- Laplace Transform of some elementary functions - First and Second shifting theorems-Change of Scale property- Examples- Laplace Transform of derivatives, Integral of a function-Laplace Transform of a function by Multiplication and Division by t- Periodic functions- Initial and final value theorems of Laplace Transforms, Examples, Convulution two functions.

Unit-III

Applications of Laplace Transforms: Inverse Laplace Transforms- Introduction-Calculation of Laplace Inversion of some Elementary functions- Method of Expansion into partial fractions of the ratio of two poloynomials- Applications of Laplace Transforms to ODE with constant coefficients, simultaneous ODE with constant coefficients- ODE with Variable coefficients.

Unit-IV

Z-Transforms: Introduction-Definitions- Some operational properties of Z-Transforms- Applications of Z-Transforms.

Text Book:

An Introduction to Integral Transforms by Baidyanath Patra, Levent Books, Kolkata India

DEPARTMENT OF MATHEMATICS
MAHATMA GANDHI UNIVERSITY
M.Sc. Mathematics
Semester III

MM –305 B **Paper-V(B)**

Mechanics

Unit I

Dynamics of systems of Particles:- Introduction - Centre of Mass and Linear Momentum of a system- Angular momentum and Kinetic Energy of a system, Mechanics of Rigid bodies- Planar motion:- Centre of mass of Rigid body- some theorem of Static equilibrium of a Rigid body- Equilibrium in a uniform gravitational field- Rotation of a Rigid body about a fixed axis.

Unit II

Moment of Inertia:- calculation of moment of Inertia Perpendicular and Parallel axis theorem- Physical pendulum-A general theorem concerning Angular momentum-Laminar Motion of a Rigid body-Body rolling down an inclined plane (with and without slipping).

Unit III

Motion of Rigid bodies in three dimension-Angular momentum of Rigid body products of Inertia, Principles axes-Determination of principles axes-Rotational Kinetic Energy of Rigid body- Momentum of Inertia of a Rigid body about an arbitrary axis- The momental ellipsoid - Euler's equation of motion of a Rigid body.

Unit IV

Lagrange Mechanics:-Generalized Coordinates-Generalized forces-Lagrange's Equations and their applications-Generalized momentum-Ignorable coordinates-Hamilton's variational principle-Hamilton function-Hamilton's Equations- Problems-Theorems.

Text Book:

[1] G.R.Fowles, Analytical Mechanics, CBS Publishing, 1986.

DEPARTMENT OF MATHEMATICS
MAHATMA GANDHI UNIVERSITY
M.Sc. Mathematics
Semester IV

MM – 401 **Paper- I**

Advanced Complex Analysis

Unit I

Convergence of sequences and of series- Taylors series- Laurent's series- Absolute and uniform convergence of power series- Continuity of sums of power series- Uniqueness of series representation.

Unit II

Residues- Cauchy's residue theorem- Using a single residues the three types of isolated singular points- Residues at poles- Zeroes of analytic functions- Zeroes and poles- Behavior of f near isolated singular points.

Unit III

Evaluation of improper integrals- Improper integrals from Fourier analysis- Jordan's lemma- Indented paths- Definite integrals involving sines and cosines- Argument principle- Rouche's theorem.

Unit-IV

Linear transformations- The transformation $w = \frac{1}{z}$ mappings by $w = \frac{1}{z}$,

Linear fractional transformations- An implicit form- Mapping of the upper half plane- The transformation $w = \sin z$, Mapping by z^2.

Text Books:

[1] Complex Variable and Application (8th Edition)
By James Ward Brown, RuelV.churchill
Mc Graw Hall Int. Edition.

Reference: Complex Analysis by Serge Lang Springer- Varlag

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

MM – 402

Paper- II

Integral Equations and Calculus of Variations

Unit I

Volterra Integral Equations: Basic concepts - Relationship between Linear differential equations and Volterra Integral equations - Resolvent Kernel of Volterra Integral equation. Differentiation of some resolvent kernels - Solution of Integral equation by resolvent kernel - The method of successive approximations - Convolution type equations-Solution of Integro-differential equations with the aid of the Laplace Transformation – Volterra integral equation of the first kind - Euler integrals - - Abel's problem - Abel's integral equation and its generalizations. .

Unit II

Fredholm integral equations: Fredholm integral equations of the second kind - Fundamentals - Method of Fredholm Determinants-Iterated kernels constructing the resolvent kernel with the aid of iterated kernels - Integral equations with degenerated kernels - Hammerstein type equation - Characteristic numbers and Eigen functions and its properties.

Calculus of Variations

Unit III

Definitions of Functionals - Strong and Weak Variations - Derivations of Euler's' equation - Other forms of Euler's equation - Special cases – Examples - Fundamental Lemma of Calculus of Variation-The problem of minimum surface of revolution - Minimum Energy Problem Brachistochrone Problem - Variational notation - Variational problems involving Several functions.

Unit IV

Isoperimetric problem - Examples - Eulers's equations in two dependent variables variational problems in parametric form - Functional dependent on higher order derivatives. Euler Poisson equation-Application of Calculus of Variation - Hamilton's principle - Lagrange's Equation, Hamilton's equations.

Text Books:

[1] M. Krasnov, A. Kiselev, G. Makarenko, Problems and Exercises in Integral Equations (1971)

[2] L. Elsgolts, Differential Equation and Calculus of Variations.

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

MM – 403

Paper- III

Linear Algebra

Unit-I

Elementary Canonical forms-Introduction, Characteristic values, Annihilating Polynomials, Invarant Sub- Spaces, Simultaneous Triangulation and Simultaneous Diagonalization (Ch6,Sec6.1-605).

Unit-II

Direct sum Decomposition, Invariant Direct sums, the Primary Decomposition Theorem (Ch6,Sec 6.6-6.8). The Rational and Jordan Forms: Cyclic Subspaces and Annihilators (Ch7,Sec7.1)

Unit –III

Cyclic Decomposition and the Rational form,The Jordan form, Computation of invariant factors,Semi Simple Operators (Ch10,Sec 7.2-7.5)

Unit- IV

Bilinear Forms: Bilinear forms, Symmetric BilinearForms,Skew- Symmetric Bilinear Forms,Groups Preserving Bilinear Forms(Ch10,Sec 10.1 -10.4)

Text Books:

Linear Algebra by Kenneth Hoffman and Ray Kunze,(2e),PHI.

References:

1. **Advanced Linear algebra** by Steven Roman(3e)
2. **Linear algebra** by David C Lay.
3. **Linear Algebra** by Kuldeep Singh.

DEPARTMENT OF MATHEMATICS
MAHATMA GANDHI UNIVERSITY
M.Sc. Mathematics
Semester IV

MM – 404 A

Paper IV(A)

Finite Difference Methods

Unit I

Partial differential equations – Introduction- Difference method- Routh Hurwitz criterion- Domain of Dependence of Hyperbolic Equations.(1.1 to 1.4)

Uint II

Difference methods for Parabolic partial differential equations- Introduction – One space dimension- Two space Dimensions- spherical and Cylindrical coordinate system. (2.1 to 2.3, 2.5)

Uint III

Difference methods for Hyperbolic partial differential equations- Introduction- One space dimensions- two space dimensions –first order equations. (3.1 to 3.4)

Unit IV

Numerical methods for elliptic partial differential equations- Introduction- Difference methods for linear boundary value problems- general second order linear equations – Equations in polar coordinates(4.1 to 4.4)

Text Books:

[1] M. K. Jain , S. R. K. Iyengar and R. K. Jain Computational methods for partial differential Equations, Wiley eastern limited, New Age International Limited, New Delhi.

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

MM – 404 (B)

Paper- IV(B)

Cryptography

Unit-I

Simple substitution ciphers; Divisibility and greatest common divisors Modular arithmetic ;Prime numbers unique factorization, and finite fields; Powers and primitive roots in fields; Cryptography before the computer age; Symmetric and asymmetric ciphers.

Unit-II

The birth of public key cryptography, The discrete logarithm problem Diffie—Hell mankey exchange, The ELGamal public key crypto system, An over view of the theory of groups, How hard is the discrete logarithm problem? A collision algorithm for the DLP.

Unit-III

The Chinese remainder theorem, The Pohlig-Hellman algorithm, Rings, Quotients, polynomials, and finite fields ,Euler's formula and roots modulo pq, Primality testing.

Unit-IV

Elliptic curves, Elliptic curves over finite fields, The elliptic curve discrete logarithm problem, Elliptic curve cryptography.

Text Books:

*__Mathematical Principles and Applications__ by Everyday Cryptography,Keith Martin.

References:

1.__Fundamental Principles and Applications__ by Every day Cryptography, Keith Martin.

2.__Cryptography: An Introduction__ by N.P.Smart

DEPARTMENT OF MATHEMATICS
MAHATMA GANDHI UNIVERSITY
M.Sc. Mathematics
Semester IV

MM – 405(a)

Paper V(a)

Applications of Functional analysis

Unit I

Concepts of metric spaces and vector spaces (Questions should not be framed from this part)- Concepts of normed and Banach spaces – inner product and Hilbert spaces- Uniform boundedness theorem- space of polynomial- fourier series – strong and week convergence- examples- convergence of sequences of operators and functionals- applications to summability of sequences(see 2.2, 3.1, 4.7, 4.8, 4.9, 4.10 of [1])

Unit II

Banach fixed point theorem- application of Banach theorem to linear equations application of Banach theorem to differential equations- applications of Banach theorem to Integral equations. (see 5.1, 5.2, 5.3 and 5.4 of [1])

Unit III

Approximations in Normed spaces – Examples- Uniqueness – strict convexity- Uniform Approximations. (See 6.1, 6.2, 6.3 of [1])

Unit IV

Legendre, Hermite and Lagurre's polynomials- Chebyshev polynomials- approximation in Hilbert spaces- splines (See 3.7, 6.4, 6.5 and 6.6 of [1])

Text Book:

[1] Krayszig, Introductory functional analysis with applications, John Wiley and sons- 1989.

Reference Book:

[1] Brown and Page, Introductory functional analysis.

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

MM – 405 B

Paper- V(B)

Fluid Mechanics

Unit I

General orthogonal curvilinear coordinates - Kinematics - Lagrangian and Eulerian methods - Equation of continuity - Boundary surface - Stream lines, Path lines and Streak lines - Velocity potential - Irrotational and rotational motions - Vortex lines

Unit II

Equation of motion - Lagrange's and Euler's equation of motion - Bernoulli's theorem - Stream functions - Irrotational motion in two-dimensions - Complex velocity potential sources – Sinks, doublets and their images - Milne-Thompson Circle theorem

Unit III

Two dimensional irrotational motion produced by motion of Circular, Co-axial and elliptic cylinders in an infinite mass of liquid - Theorem of Blasius motion of a sphere through a liquid at rest at infinity - Liquid streaming past a fixed sphere.

Unit IV

Stress components in a real fluid - Relation between rectangular components of stress - Connection between stresses and gradient of velocity - Navier-Stoke's equations of motion - Plane Poiseulle and couette flows between two parallel plates.

Text Books:

[1] W.H. Besaint and A.S.Ramsay, A Treatise on Hydromechanics, Part-II. CBS Publishers, Delhi, 1988.
[2] F.Chorlton, Text book of Fluid Dynamics, CBS Publishers, Delhi, 1985.

DEPARTMENT OF MATHEMATICS

MAHATMA GANDHI UNIVERSITY

M.Sc. (Mathematics)

Semester III

Open Elective ID Paper

BASIC MATHEMATICS

Unit-I

Simplifications by BODMAS Rule - Numbers - Averages - Percentages - Profit and Loss - Ratio and Proportion.

Unit-II

Time and Work - Speed-Time-Distance - Simple Interest - Compound Interest - Analytical and Critical Reasoning.

Text Book:

[1] Quantitative Aptitude by R.S.AGGARAVAL.