OUTLINES OF TESTS,
SYLLABI AND COURSES OF READING

for

M.Sc. Mathematics Part I
(Semester I & II)

Academic Sessions
2025–26 and 2026–27

NEP-TEMPLATE FOR MULTIDISCIPLINARY UG PROGRAMME

POST GRADUATE DEPARTMENT OF MATHEMATICS
GURU NANAK COLLEGE BUDHLADA
AN AUTONOMOUS COLLEGE
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Satish

SCHEME OF THE COURSE
M.Sc. I (MATHEMATICS) SEMESTER I & II

Semester I							
Type of Course	**Course Code**	**Course Title**	**Internal**	**External**	**Prac tical**	**Total**	**Credit**
Major	MATM1101T	Algebra-I	30	70	-	100	04
Major	MATM1102T	Mathematical Analysis	30	70	-	100	04
Major	MATM1103T	Topology-I	30	70	-	100	04
Major	MATM1104T	Differential Geometry	30	70	-	100	04
DISCIPLINE SPECIFIC ELECTIVE/OPEN ELECTIVE COURSES (Select Any One)							
Discipline Specific	MATM1105T	Introduction to Computer and Programming using C	15	35	-	50	03
Discipline Specific	MATM1105L	Software Laboratory-I (C-Programming)	15	-	35	50	02
Discipline Specific	MATM1106T	Mathematical Statistics	30	70	-	100	04
Discipline Specific	MATM1107T	Number Theory	30	70	-	100	04
Semester II							
Type of Course	**Course Code**	**Course Title**	**Internal**	**External**	**Prac tical**	**Total**	**Credit**
Major	MATM1201T	Algebra-II (Rings and Modules)	30	70	-	100	04
Major	MATM1202T	Topology-II	30	70	-	100	04
Major	MATM1203T	Functional Analysis	30	70	-	100	04
Major	MATM1204T	Complex Analysis	30	70	-	100	04
DISCIPLINE SPECIFIC ELECTIVE/OPEN ELECTIVE COURSES (Select Any One)							
Discipline Specific	MATM1205T	Programming Using Python	15	35	-	50	03
Discipline Specific	MATM1205L	Software Laboratory-II (Python Programming)	15	-	35	50	02
Discipline Specific	MATM1206T	Differential Equations-I	30	70	-	100	04
Discipline Specific	MATM1207T	Classical Mechanics	30	70	-	100	04

In addition to the above subjects, the student must pass the compulsory qualifying paper in Punjabi with code MATM1208T.

Rakesh Kumar

SEMESTER I
MATM1101T: ALEBRA I
(Major)

Credits: 04(L) External Exam Marks: 70
Time Allowed: 3 Hrs. Internal Assessment: 30
Pass percentage: 35% Total Marks: 100

COURSE OBJECTIVES: This course aims to build a solid foundation in abstract algebra, focusing on key concepts in group and ring theory. Students will explore group structures, including solvable and nilpotent groups, composition series, and group actions. They will study the structure of finitely generated abelian groups and learn to apply the Fundamental Theorem of Finitely Generated Abelian Groups. The course also covers essential topics in ring theory, such as homomorphisms, ideals, quotient rings, and fields of quotients, along with examples like matrix rings and endomorphism rings.

COURSE OUTCOMES:

1. **Demonstrate a deep understanding of group theory fundamentals**, including normal and subnormal series, solvable and nilpotent groups, and composition series, along with the Jordan-Hölder theorem.
2. **Apply group actions to analyze structures within groups**, including orbits, stabilizers, and the class equation, and utilize these concepts to study permutation groups and their conjugacy classes.
3. **Explore the structure of abelian groups**, particularly finitely generated ones, using the Fundamental Theorem of Finitely Generated Abelian Groups and compute their invariants.
4. **Gain foundational knowledge in ring theory**, including the structure and properties of rings, ring homomorphisms, ideals (prime, maximal), and algebra of ideals.
5. **Understand quotient rings and the field of quotients of integral domains**, and study examples such as matrix rings and rings of endomorphisms of abelian groups.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Section C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly. Each question in sections A and B will be of 10 marks each and section C will be of 30 marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each section A and B and compulsory question of section C.

SECTION-A

Normal and subnormal series, Solvable groups, Nilpotent groups, Composition Series, Jordan-Holder theorem for groups. Group action, Stabilizer, orbit, Class equation and its applications, permutation groups, cyclic decomposition, conjugacy classes in permutation groups. Alternating group A_n, Simplicity of A_n.

SECTION-B

Structure theory of groups, Fundamental theorem of finitely generated abelian groups (Statement only), Groups of Automorphisms of cyclic groups, homomorphism between two cyclic groups, Cauchy's Theorem for finite abelian groups, Sylow's theorems, Groups of order p^2, pq. Review of rings and homomorphism of rings, Ideals, Algebra of Ideals, Maximal and prime ideals, Ideal in Quotient rings, Field of Quotients of integral Domain, Matrix Rings and their ideals; Rings of Endomorphisms of Abelian Groups.

RECOMMENDED BOOKS :

1. Bhattacharya, Jain & Nagpaul : Basic Abstract Algebra, Second Edition (Ch. 6, 7, 8, 10)
2. Surjeet Singh, Qazi Zameeruddin : Modern Algebra
3. I.N. Herstein : Topics in Algebra, Second Edition
4. David S.Dummit, Richard M. Foote: Abstract Algebra, Wiley, Third Edition, 2003

SEMESTER I
MATM1102T: MATHEMATICAL ANALYSIS
(Major)

Credits: 04(L)
Time Allowed: 3 Hrs.
Pass percentage: 35%

External Exam Marks: 70
Internal Assessment: 30
Total Marks: 100

COURSE OBJECTIVES: This course introduces the fundamental concepts of measure theory, including algebras, σ-algebras, measurable spaces, and Lebesgue measure. It covers measurable functions, Borel and Lebesgue measurability, and the Lebesgue integral with key convergence theorems. The course also explores differentiation of integrals, absolute continuity, and properties of convex functions. Students gain a solid foundation in modern integration theory and its applications.

COURSE OUTCOMES:

1. Solve problems based on functional of several variables including Inverse function theorem, Implicit function theorem
2. Understand Measure spaces and Lebesgue measure
3. Identify measurable function, Riemann and lebesgue integrals.
4. Understand differentiation, functions of bounded variation, differentiation of an integral, absolute continuity, convex functions and Jensen’s inequality.
5. Describe the applications in probability theory, real analysis, and many other fields in mathematics as functional analysis, approximation theory and PDE.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Section C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly. Each question in sections A and B will be of 10 marks each and section C will be of 30 marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each section A and B and compulsory question of section C.

SECTION-A

Introduction to Metric spaces

Lebesgue Measure: - Lebesgue Outer Measure and its Properties, Algebras,σ - Algebra, their Properties, Measurable Sets and Properties, Outer and Inner approximation of Lebesgue measurable sets A Non-Measurable Set, Borel Sets, their Lebesgue Measurability. (Scope as in RB 1: Chapter 2)

Measurable Functions: Definition and Properties, Step Functions, Characteristic Functions, Simple Functions, Littlewood’s Three Principles, Egoroff’s theorem, Lusin theorem. The Lebesgue Integral of Bounded Function, Integration of Non- Negative Measurable Functions, Fatou’s Lemma, Monotone Convergence Theorem, Lebesgue Convergence Theorem. (Scope as in RB 1: Chapter 3 and Chapter 4 Section-4.1-4.5).

SECTION-B

Differentiation and Integration: Differentiation of Monotone Functions, Differentiation of an Integral, Lebesgue Differentiation Theorem, Vitalis Lemma, Four (Dini) Derivatives, Functions of Bounded Variation, Absolute Continuity, Convex Functions, Jensens Inequality (Scope as in RB 1: Chapter 6)

The Spaces: Definition and Properties, Holder and Minkowski's Inequalities, Bounded Linear Functionals on the L_p Spaces, Completeness and Approximation of L_p Space, The Riesz Fischer Theorem, The Riesz Representation Theorem. (Scope as in RB 1: Chapter 7)

RECOMMENDED BOOKS :

1. H.L. Royden: Real analysis, Macmillan Pub. co. Inc. 4th Edition, New York, 1993. Chapters 3, 4, 5 and Sections 1 to 4 of Chapter 11.
2. I. K. Rana, An Introduction to Measure and Integration (2nd ed.), Narosa Publishing House, New Delhi, 2004.
3. G.de Bara, Measure Theory and Integration, Ellis Horwood Limited, England, Edition 2003. 4. P.K. Jain and V.P. Gupta, Lebesgue Measure and Integration, New Age International Ltd.,2000.

SEMESTER I
MATM1103T: TOPOLOGY-I
(Major)

Credits: 04(L) External Exam Marks: 70
Time Allowed: 3 Hrs. Internal Assessment: 30
Pass percentage: 35% Total Marks: 100

COURSE OBJECTIVES: This course aims to develop a strong foundation in set theory and general topology. It introduces cardinality, topological spaces, continuity, and fundamental topological properties such as connectedness and compactness. Students will explore separation axioms, countability conditions, and their implications in metric spaces. The course emphasizes rigorous reasoning and topological structures relevant to advanced mathematical analysis.

COURSE OUTCOMES:

1. Understand the concepts of equipotent sets, cardinality, countable and uncountable sets, perform operations with cardinal numbers, and analyze results like Bernstein's Theorem and the Continuum Hypothesis.
2. Define and construct topological spaces using bases and sub-bases; understand Euclidean spaces as topological spaces and generate topologies through various elementary operations.
3. Explain and apply fundamental topological concepts such as closure, interior, frontier, dense sets, subspaces, and relativization of topologies.
4. Analyze continuous functions, homeomorphisms, open and closed maps, and understand their behavior through restriction, composition, and neighborhood-based definitions.
5. Explore the concept of connectedness and path-connectedness, including their characterizations, and understand their behavior under continuous mappings with applications to Euclidean spaces.
6. Understand and distinguish between different forms of compactness (compact, countably compact, locally compact), and study one-point compactification, its relation with Hausdorff spaces, and countability axioms.
7. Investigate the second countability axiom, separability, and Lindelöf property in metric spaces; prove the equivalence of compactness and countable compactness in metric spaces.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Section C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly. Each question in sections A and B will be of 10 marks each and section C will be of 30 marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each section A and B and compulsory question of section C.

SECTION-A

Cardinals: Equipotent sets, Countable and Uncountable sets, Cardinal Numbers and their Arithmetic, Bernstein's Theorem and the Continuum Hypothesis.

Topological Spaces: Definition and examples, Euclidean spaces as topological spaces, Basis for a given topology, Topologizing of Sets; Sub-basis, Equivalent Basis.

Elementary Concepts: Closure, Interior, Frontier and Dense Sets, Topologizing with pre-assigned elementary operations. Relativization, Subspaces.

Maps: Continuous Maps, Restriction of Domain and Range, Characterization of Continuity, Continuity at a point, Piecewise definition of Maps and Neighborhood finite families. Open Maps and Closed Maps, Homeomorphisms and Embeddings.

SECTION-B

Connectedness: Connectedness and its characterizations, Continuous image of connected sets, Applications to Euclidean spaces. Components, Path Connectedness.

Compactness and Countability: Compactness and Countable Compactness, Local Compactness, One-point Compactification, T_0, T_1, and T_2 spaces, T_2 spaces and Sequences and Hausdorfness of One-Point Compactification.

Axioms of Countability and Separability, Equivalence of Second axiom, Separable and Lindelof in Metric Spaces. Equivalence of Compact and Countably Compact Sets in Metric Spaces.

RECOMMENDED BOOKS :

1. W.J. Pervin Foundations of General Topology, New York, Academic Press, Ch. 2 (Sections 2.1, 2.2), Section 4.2, and Ch 5 (Sec 5.1 to 5.3).
2. James Dugundji : TOPOLOGY. Allyn and Bacon. Relevant Portions from Ch.III (excluding Sec 6 and Sec 10) , Ch IV; (Sections 1-3) and ChV
3. James Munkres: Topology,2nd Edition Pearson.
4. Steen and Seebach : Counterexamples in Topology, Dover Books.
5. Stephen Willard: General Topology Addison Wesley.
6. Kelley: Topology. Graduate Texts in Mathematics 27. Springer.

SEMESTER I
MATM1104T: DIFFERENTIAL GEOMETRY
(Major)

Credits: 04(L) External Exam Marks: 70
Time Allowed: 3 Hrs. Internal Assessment: 30
Pass percentage: 35% Total Marks: 100

COURSE OBJECTIVES: The main objective is to provide fundamental concepts of differential geometry with an emphasis on curves and surfaces. Students will understand and apply the differential geometry of curves and surfaces.

COURSE OUTCOMES:

1. Analyze curves in space through arc length, curvature, torsion, and Serret–Frenet formulae.
2. Examine smooth surfaces using tangent spaces, surface patches, maps, and orientability.
3. Apply first and second fundamental forms to study lengths, curvatures, and surface properties.
4. Understand geodesics, their equations, and fundamental results like Gauss' Theorema Egregium.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Section C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly. Each question in sections A and B will be of 10 marks each and section C will be of 30 marks.

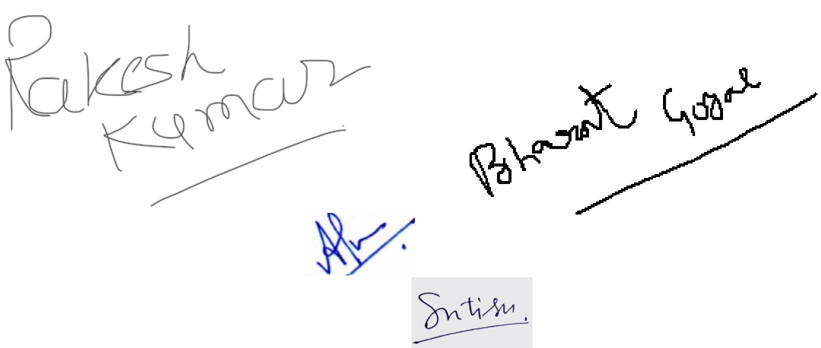
INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each section A and B and compulsory question of section C.

SECTION-A

Curves in space: arc length, unit speed curves, reparametrization, regular curves, closed curves. Curvature: plane curves, space curves, Fundamental theorem of space curves (Statement only), torsion, Serret-Frenet formulae.

Surfaces in three dimensions: smooth surfaces, regular and allowable surface patches, transition maps, smooth maps, tangent space, derivatives of smooth maps, normals and orientability. The first fundamental form: Lengths of curves on surfaces, Isometries of surfaces in relation to symmetric bilinear forms. The second fundamental form, The Gauss and Weingarten maps.



SECTION-B

Normal and geodesic curvatures,Gauss equation. The Gaussian and mean curvature, principal curvature of a surface, Euler's theorem. Flat surfaces, parallel surfaces.
Geodesics: Definition and basic properties, geodesic equations, The Gauss and Codazzi-Mainardi equations, Gauss' Theorema Egregium.

RECOMMENDED BOOKS :

1. Andrew Pressley, Elementary Differential Geometry, Springer, Fourth Indian Reprint 2009.
2. T.J.Willmore,An Introduction toDifferential Geometry, Dover Publications, 2012.
3. B. O'Neill, ElementaryDifferential Geometry, 2ndEd., Academic Press, 2006.
4. C.E.Weatherburn,DifferentialGeometryofThreeDimensions,CambridgeUniversityPress 2003.
5. D.J. Struik, Lectures on Classical Differential Geometry, Dover Publications, 1988.
6. S. Lang, Fundamentals of Differential Geometry, Springer, 1999.

SEMESTER I
MATM1105T: Introduction to Computer and Programming using C
(Discipline Specific)

Credits: 03(L) External Exam Marks: 35
Time Allowed: 3 Hrs. Internal Assessment: 15
Pass percentage: 35% Total Marks: 50

COURSE OBJECTIVES: This course aims to provide foundational knowledge of computer systems, their architecture, software, and networking concepts. It introduces problem-solving techniques and programming fundamentals using the C language, including control structures, functions, arrays, pointers, and structures. The course also focuses on algorithm development, flowcharts, and coding practices for efficient software development. Students will develop logical thinking and gain hands-on experience in structured programming.

COURSE OUTCOMES:

1. Have basic knowledge of computer hardware and software
2. Write, compile and debug programs in C language
3. Use different data types, operators and I/O functions in computer program
4. Design programs involving decision control statements, loop control statements and case control statements
5. Understand the implementation of arrays, pointers and functions
6. Use the file operations, character I/O, strings and pre-processor directives

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Section C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly. Each question in sections A and B will be of 10 marks each and section C will be of 30 marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each section A and B and compulsory question of section C.

SECTION-A

Characterization of Computers, types of Computers, the Computer generations. Basic Anatomy of Computers: memory unit, input-output unit, arithmetic logic unit, control unit, central processing unit, RAM, ROM, PROM, EPROM. Input-Output Devices

Computer Software: Introduction, types of software: application and systems software. Networking: Basics, types of networks (LAN, WAN, MAN), topologies, communication media, Operating System, Definition, functions and types of operating system.

Computer Languages: Machine Language, assembly language, high level language, 4GL, assembler, compiler and interpreter

Problem Identification, Analysis, Flowcharts, Decision tables, Pseudo codes and algorithms, Program coding, Program Testing and execution,

C Programming: character set, Identifiers and keywords, Data types, Declarations, Statement and symbolic constants, Input-output statements, Preprocessor commands,

Operators and Expressions: Arithmetic, relational, logical, unary operators, others operators, Bitwise operators: AND, OR, complement precedence and Associating bitwise shift operators, Input-Output: standard, console and string function

SECTION-B

Control statements: Branching, looping using for, while and do-while Statements, Nested control structures, switch, break, continue statements.
Functions: Declaration, Definition, Call, passing arguments, call by value, call by reference, Recursion, Use of library functions; Storage classes: automatic, external and static variables.
Arrays: Defining and processing arrays, Passing arrays to a function, Using multidimensional arrays, Solving matrix problems using arrays.
Strings: Declaration, Operations on strings.
Pointers: Pointer data type, pointers and arrays, pointers and functions.
Structures: Using structures, arrays of structures and union

RECOMMENDED BOOKS :

1. Norton Peter, Introduction to Computers, Tata McGraw Hill (2005).
2. Computers Today: Suresh K. Basandra, Galgotia, 1998.
3. Kerninghan B.W. and Ritchie D.M., The C programming language, PHI (1989)
4. Kanetkar Yashawant, Let us C, BPB (2007).
5. Rajaraman V., Fundamentals of Computers, PHI (2004).
6. Shelly G.B., Cashman T.J., Vermaat M.E., Introduction to computers, Cengage India Pvt Ltd (2008).

SEMESTER I
MATM1105L: SOFTWARE LABORATORY-I (C-Programming)
(Discipline Specific)

Credits: 02(P)
Time Allowed: 3 Hrs.
Pass percentage: 35%

External Exam Marks: 35
Internal Assessment: 15
Total Marks: 50

This laboratory course will mainly consist of exercises on what is learnt under the paper," Computer Programming using C".

SEMESTER I
MATM1106T: MATHEMATICAL STATISTICS
(Discipline Specific)

Credits: 04(L) External Exam Marks: 70
Time Allowed: 3 Hrs. Internal Assessment: 30
Pass percentage: 35% Total Marks: 100

COURSE OBJECTIVES: This course provides a rigorous foundation in probability theory, random variables, and common discrete and continuous probability distributions. It introduces key concepts in estimation theory, hypothesis testing, and sampling distributions. Students will gain practical skills in statistical inference, including estimation techniques, confidence intervals, and various parametric and non-parametric tests. The course prepares students for data-driven decision-making using statistical reasoning.

COURSE OUTCOMES:

1. Knowledge of the theory of statistics through mathematical techniques
2. To understand the axiomatic approach to probability with reference to the conceptual details of the set theory
3. Demonstration of the uses of specific parametric families of univariate density functions in day to day life
4. To obtain various generating functions for different discrete and continuous distributions and derive their properties
5. To understand the concept of sampling and some important sampling distributions to make inferences about the population
6. To apply the knowledge of two important aspects of statistical inference- estimation and test of hypothesis in various feasible statistical and mathematical spheres

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Section C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly. Each question in sections A and B will be of 10 marks each and section C will be of 30 marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each section A and B and compulsory question of section C.

SECTION-A

Algebra of sets, fields, limits of sequences of subsets, sigma-fields generated by a class of subsets. Probability measure on a sigma-field, probability space. Axiomatic approach to probability.
Real random variables, distribution functions, discrete and continuous random variables, decomposition of a distribution function, Independence of events. Expectation of a real random variable. Linear properties of expectations, Characteristic functions, their simple properties
Discrete probability distributions: Binomial distribution, Poisson distribution, negative binomial distribution, geometric distribution.
Continuous probability distributions: Normal distribution, rectangular distribution, gamma distribution, beta distribution of first and second kind, exponential distribution.

SECTION-B

Theory of Estimation: Population, sample, parameter and statistic, sampling distribution of a statistic, standard error. Interval estimation, Methods of estimation, properties of estimators, confidence intervals.

Exact Sampling Distributions: Chi-square distribution, Student's t distribution, Snedecor's F-distribution, Fisher's – Z distribution .

Hypothesis Testing: Tests of significance for small samples, Null and Alternative hypothesis , Critical region and level of significance. Tests of hypotheses, Tests of significance based on t, Z and F distributions, Chi square test of goodness of fit. Large Sample tests, Sampling of attributes, Tests of significance for single proportion and for difference of proportions, Sampling of variables, tests of significance for single mean and for difference of means and for difference of standard deviations.

RECOMMENDED BOOKS :

1. Goon, A. M., Gupta, M. K., & Dasgupta, B. (2003). *An outline of statistical theory(Vol 1 & 2)*. World Press Pvt Limited.
2. Lehmann, E. L., & Casella, G. (1998). *Theory of point estimation* (Vol. 31). Springer
3. Science & Business Media.
4. Lehmann, E. L., & Romano, J. P. (2006). *Testing statistical hypotheses*. Springer Science & Business Media.
5. Rohatgi, V. K., & Saleh, A. M. E. (2011). *An introduction to probability and statistics*. John Wiley & Sons.

SEMESTER I
MATM1107T: LINEAR PROGRAMMING
(Discipline Specific)

Credits: 04(L) External Exam Marks: 70
Time Allowed: 3 Hrs. Internal Assessment: 30
Pass percentage: 35% Total Marks: 100

COURSE OBJECTIVES: The objective of this course is to develop a deep understanding of fundamental concepts in number theory, including arithmetic and multiplicative functions, Diophantine equations, quadratic forms, and rational approximations. It aims to equip students with tools such as Möbius inversion, Farey sequences, continued fractions, and Pell's equation to solve classical and modern number-theoretic problems. The course also fosters analytical thinking by connecting algebraic methods with geometric principles like Minkowski's theorem and applications such as Pythagorean triples and four-square representations.

COURSE OUTCOMES:

1. Apply arithmetic, multiplicative, and inversion functions to solve number-theoretic problems.
2. Solve linear Diophantine equations, quadratic forms, and analyze rational points on curves.
3. Employ Farey sequences, approximation theorems, and geometry of numbers in problem solving.
4. Use Euclidean algorithm, continued fractions, and Pell's equation for rational approximations.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short answers covering the entire syllabus uniformly. The weightage of section A and B will be 30% and that of section C will be 40%. Use of scientific calculators is allowed.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all, selecting two questions from each section A and B and compulsory question of section C. Use of a scientific calculator is allowed.

SECTION-A

Greatest integer function, Arithmetic function, multiplicative function, completely multiplicative function, mobius- inversion formula, recurrence function, combinational number theory.

Solution of the equation ax+by =c, simultaneous linear equations, Unimodular matrices, Pythagorean triangles, some assorted examples, ternary quadratic forms, rational points on curves.

SECTION-B

Farey sequences, rational approximations, Hurwitz theorem, irrational numbers, Blichfeldt’s principle, Minkowski’s Convex body theorem, Lagrange's four square theorem.
Euclidean algorithm, finite and infinite continued fractions, approximations to irrational numbers, Best possible approximations, Hurwitz theorem, Periodic continued fractions, Pell’s equation.

RECOMMENDED BOOKS

1. Burton, David. Ebook: Elementary number theory. McGraw Hill, 2010.
2. Koshy, Thomas. Elementary number theory with applications. Academic press, 2002.
3. Rosen, Kenneth H. Elementary number theory. London: Pearson Education, 2011.

SEMESTER II
MATM1201T: ALGEBRA-II (RINGS AND MODULES)
(Major)

Credits: 04(L) External Exam Marks: 70
Time Allowed: 3 Hrs. Internal Assessment: 30
Pass percentage: 35% Total Marks: 100

COURSE OBJECTIVES: This course explores advanced algebraic structures, focusing on rings, domains, and modules. It introduces key concepts like Unique Factorization Domains, Principal Ideal Domains, and polynomial rings, and extends to module theory, including submodules, homomorphisms, and chain conditions. Students will understand foundational theorems and structural properties essential for abstract algebra and its applications in modern mathematics.

COURSE OUTCOMES:

1. Understand and distinguish various types of rings, including Unique Factorization Domains (UFDs), Principal Ideal Domains (PIDs), and Euclidean Domains, and analyze polynomial rings over UFDs.
2. Develop a foundational understanding of modules, including unital modules, submodules, quotient modules, and module homomorphisms.
3. Analyze structural aspects of modules such as direct sums, direct summands, and identify simple modules using isomorphism theorems.
4. Comprehend the concept of free modules and clearly distinguish between modules and vector spaces in algebraic structures.
5. Explore the theory of modules over a PID, and understand the implications of chain conditions such as Noetherian and Artinian properties for both modules and rings.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Section C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly. Each question in sections A and B will be of 10 marks each and section C will be of 30 marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each section A and B and compulsory question of section C.

SECTION-A

Division in Rings, Unique Factorization Domains, Principal Ideal Domains, Euclidean Domains, Polynomial Rings over UFD.

Modules, Unital Modules, Submodules, Direct sum and Direct Summand, Quotient modules Homomorphism, Simple modules, Isomorphic Theorems.

SECTION-B

Free modules, Difference between modules and vector spaces, Modules over PID.
Modules with chain conditions: Artinian Modules, Noetherian Modules, Artinian Rings, Noetherian Rings, Composition series of a module, Length of a module, Hilbert Basis Theorem, Cohen Theorem.

RECOMMENDED BOOKS

1. Bhattacharya, Jain and Nagpaul: Basic Abstract Algebra, Second Edition.
2. Musili C., Introduction to Rings and Modules, Second Revised Edition.

SEMESTER II
MATH1202T: TOPOLOGY II
(Major)

Credits: 04(L) External Exam Marks: 70
Time Allowed: 3 Hrs. Internal Assessment: 30
Pass percentage: 35% Total Marks: 100

COURSE OBJECTIVES: To explore advanced topological structures and categorical concepts, emphasizing separation axioms, product and quotient topologies, filters, and the foundational role of categories and functors in modern topology.

COURSE OUTCOMES:

1. Understand and distinguish between higher separation axioms (Regular, Completely Regular, Normal, Completely Normal) and demonstrate their significance in topological and metric spaces.
2. Apply key theorems such as Urysohn's Lemma and the Tietze Extension Theorem to study extensions of continuous functions in topological spaces.
3. Analyze the behavior of product spaces, particularly the invariance of topological properties such as first countability, regularity, and normality, and understand the Stone-Čech compactification and embedding of Tychonoff spaces.
4. Develop a deep understanding of filters, filter bases, and ultrafilters, including their role in defining convergence, continuity, compactness, and the Tychonoff Theorem.
5. Comprehend the construction and properties of identification topologies and quotient spaces, and examine the interplay between identification maps, subspaces, and equivalence relations.
6. Understand the basics of category theory and functors, particularly in the context of topology (Top and hTop), and explore concepts such as homotopy, nullhomotopy, contractibility, and path component functors, with a focus on their invariance under homotopy equivalence.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Section C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly. Each question in sections A and B will be of 10 marks each and section C will be of 30 marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each section A and B and compulsory question of section C.

SECTION-A

Higher Separation Axioms : Regular, Completely Regular, Normal and Completely Normal Spaces. Metric Spaces as Completely Normal T_2 Spaces. Urysohn's Lemma and The Tietze Extension Theorem.

Products : Elementary Concepts in Product Space, Products of first countable, Regular, T_2 and Completely Regular Spaces. Non invariance of normality under products. Embedding of Tichonov spaces into parallelotope and the Stone Cech Compactification.

Filters : Filter and filterbase, convergence and clustering, filter characterization of closure, continuity and filter convergence, ultrafilters, filter characterization of compactness and the Tychonoff Theorem.

SECTION –B

Identification Topology: Identification Topology, Identification Map, Subspaces, General Theorem, Transgression, Transitivity, Spaces with Equivalance Relation, Quotient Spaces.

Categories and Functors: Categories: Definition and Examples, The Arrow Category, Congruence in a Category, Quotient Category, Functors, Duality, Contravariance and Duality, Homotopy as Congruence in Top, The Category hTop, homotopy equivalence, nullhomotopy.

RECOMMENDED BOOKS

1. W.J. Pervin : Foundations of General Topology, (Sections 2.3 to 2.5), Section 5.5 to 5.6
2. Stephen Willard : GENERAL TOPOLOGY Ch 4 (excluding section 10), Ch 6 (Theorems 17.4 and 17.8 only)
3. James Dugundji : TOPOLOGY. Chapter VI,VII (1.3(3), 2.3(2), 3.3(3), 7.2 to 7.4 only and theorem 8.2 of Chapter XI)
4. 4. Joseph J. Rotman: An Introduction to Algebraic Topology. Relevant Portions from Chapter 0 and Chapter 1.

References:

1. James Munkres: Topology,2nd Edition Pearson.
2. Steen and Seebach : Counterexamples in Topology, Dover Books.
3. Stephen Willard: General Topology Addison Wesley.
5. 4. J. Kelley: Topology. Graduate Texts in Mathematics 27. Springer.

SEMESTER II
MATH1203T: FUNCTIONAL ANALYSIS
(Major)

Credits: 04(L)	External Exam Marks: 70
Time Allowed: 3 Hrs.	Internal Assessment: 30
Pass percentage: 35%	Total Marks: 100

COURSE OBJECTIVES: This course aims to provide an in-depth understanding of normed linear spaces, Banach and Hilbert spaces, and fundamental results like the Hahn-Banach, Open Mapping, and Closed Graph Theorems. It explores bounded linear functionals, dual spaces, and orthonormal systems. Students will also study operator theory, including adjoint, self-adjoint, and unitary operators, along with the spectral theorem and Banach fixed point theorem, forming a foundation for functional analysis and its applications.

COURSE OUTCOMES:

1. To learn to recognize the fundamental properties of normed linear spaces.
2. To understand the concepts of Banach spaces, Inner product and Hilbert spaces and to learn to classify the examples.
3. To study the main properties of bounded linear transformations over Banach and Hilbert spaces.
4. To be acquainted with the statements and proofs of Hahn-Banach theorem, Open mapping, Closed graph, Uniform boundedness, Riesz representation theorem, spectral and Banach fixed point theorems.
5. Identify complete orthonormal sets, orthogonal complement, adjoint, self-adjoint, normal and unitary, projection operators.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Section C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly. Each question in sections A and B will be of 10 marks each and section C will be of 30 marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each section A and B and compulsory question of section C.

SECTION-A

Normed Linear Spaces: Banach spaces, Examples of Banach spaces and subspaces, Quotient Spaces, Completeness in the Quotient spaces, Holder's, Minkowski and Schwarz inequality, Continuous linear transformation, Norm linear spaces of bounded linear maps. Bounded Linear functional,

equivalent norms, Conjugate space N^*, Natural imbedding of N into N^{**}, Projections on Banach spaces, Hahn Banach Theorem in normed linear spaces, Inner Product Space: Definition and examples, Hilbert Spaces, Statement of Baire's Category Theorem, Open mapping theorem, Closed graph theorem.

[Scope as in Text Book 1 and Text Book 2]

SECTION-B

Uniform boundedness theorem, Complete Orthonormal set: Complete orthonormal sets, Orthogonal Complements, Bessel's inequality Cauchy Schwarz inequality

Dual or Conjugate spaces: First and second dual spaces, second conjugate space of l_p and C[a,b], The Riesz representation theorem for linear functional on Hilbert spaces. The conjugate of an operator, Adjoint operators, Self-adjoint operators, Normal and unitary operators, Projection operators, Eigenvalues, Eigen vectors, Eigen spaces, invariant spaces, Spectrum of an operator, Spectral Theorem.

[Scope as in the Text Book 1 and Text Book 2]

RECOMMENDED BOOKS

1. G.F.Simmons : Introduction to Topology and Modern Analysis, Mcgraw Hill.
2. S. Kumaresan and D. Sukumar: Functional Analysis, Narosa Publications, 1st Ed., 2020
3. B.V. Limaye: Functional Analysis, New Age International Publishers, 3rd Ed., 2014.

SEMESTER II
MATH1204T: COMPLEX ANALYSIS
(Major)

Credits: 04(L) External Exam Marks: 70
Time Allowed: 3 Hrs. Internal Assessment: 30
Pass percentage: 35% Total Marks: 100

COURSE OBJECTIVES: This course aims to develop a strong foundation in complex analysis, focusing on analytic functions, complex integration, and key theorems like Cauchy's and Liouville's. It introduces conformal mappings, harmonic functions, and the theory of residues with applications to definite integrals. Students will also explore power series, Laurent expansions, singularities, and techniques of analytic continuation.

COURSE OUTCOMES:

1. Study the theory of complex variable with reference to theory real variables
2. Analyse the behaviour of derivative of a function of a complex variable
3. To deal effectively with the numerical concepts related to analytic functions and harmonic functions
4. Construction of various methods to deal with complex integration
5. To investigate the behaviour of a function at the singularities through various series expansions
6. To deal with the concept of analytic continuation by extending the domain of analyticity

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Section C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly. Each question in sections A and B will be of 10 marks each and section C will be of 30 marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each section A and B and compulsory question of section C.

SECTION-A

Function of complex variable, Analytic function, Cauchy-Riemann equations, Harmonic function and Harmonic conjugates, Conformal Mapping, Bilinear Transformations. Complex Integration, Cauchy's theorem, Cauchy Goursat theorem, Cauchy integral formula, Morera's theorem, Liouville's theorem, Fundamental theorem of Algebra, Maximum Modulus Principle, Schwarz lemma.

SECTION-B

Taylor's theorem. Laurent series in an annulus. Singularities, Meromorphic function. Cauchy's theorem on residues. Application to evaluation of definite integrals. Principle of analytic continuation, General definition of an analytic function. Analytic continuation by power series method, Natural boundary.

RECOMMENDED BOOKS

1. L.V.Ahlfors, Complex Analysis, 3rd edition.
2. E.T.Copson, An introduction to Theory of Functions of a Complex Variable
3 H.S. Kasana, Complex Variables, Prentice Hall of India
4. Herb Silverman, Complex Variables, Houghton Mifflin Company Boston

SEMESTER II
MATM1205T: PROGRAMMING USING PYTHON
(Discipline Specific)

Credits: 03(L)	External Exam Marks: 35
Time Allowed: 3 Hrs.	Internal Assessment: 15
Pass percentage: 35%	Total Marks: 50

COURSE OBJECTIVES: This course is designed to introduce students to Python programming, covering its syntax, data types, control structures, and functions. It explores essential programming concepts such as recursion, file handling, modules, and exception handling. Students will also gain a foundational understanding of object-oriented programming in Python, including classes, inheritance, and operator overloading, preparing them for real-world problem-solving using Python.

COURSE OUTCOMES:

1. To learn and understand Python programming basics and paradigm
2. To learn and understand Python looping, control statements and string manipulations
3. To acquire Object Oriented Skills in Python.
4. To learn and know the concepts of file handling and exception handling in Python

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Section C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly. Each question in sections A and B will be of 10 marks each and section C will be of 30 marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each section A and B and compulsory question of section C.

SECTION-A

Introduction to Python: History of python, strength and weakness, different versions, installing python, python identifiers and reserved key words.

Python syntax: Variables and variables type, data types, data types conversion, operators (arithmetic, comparison, assignment, bitwise, logical, membership, identity), operators precedence, python decision making (if, else if, else, nested if), python loops (while, for, nested loops), break and continue statements.

Python Functions and Data Structures: Function Specifications, Global Variables, Modules, Passing parameters to Functions, scope of variables (global and local), Recursive functions, Lambda function in python, Python String and string operations, List, Tuple, Set, And Dictionary Manipulations

SECTION-B

Python Modules: Modules, standard modules (sys, math, time), import statement, from statement.
Python File handling: Opening a file, Understanding read functions: read(), readline() and readlines(), Understanding write functions: write() and writelines(), writing data to a file, closing files.
Python Exception handling: What is exception, Handling an exception, try…except…else, try-finally clause, Argument of an exception, Raising an exception, User-defined exceptions.

Python Object Oriented Programming: OOPs Concept of class, object and instances, Constructor, class attributes and destructors, Method overloading in python, Operator overloading, Inheritance.

RECOMMENDED BOOKS

1. Wesley J Chun: *Core Python Applications Programming*, Third Edition. Pearson Publication
2. P.Gries, Jennifer Campbell, Jason Montojo: *Practical Programming- An Introduction to Computer Science Using Python 3.6*, Shroff Publications and Distributors.
3. James Payne : *Beginning Python: Using Python 2.6 and Python 3.1,* Wrox Publication
4. Wesley J Chun: *Core Python Programming*, Prentice Hall
5. Ashok Namdev Kamthane, Amit Ashok Kamthane: *Programming and Problem Solving with Python,* Mcgraw Hill Education
6. R. Sedgewick, Kevin Wayne, Robert Dondero, *Introduction to Programming in Python: An Inter-disciplinary Approach*, Pearson India Education Services Pvt. Ltd., 2016.
7. T. A. Budd: *Exploring Python*, Mc-Graw Hill Education (India) Private Ltd., 2015.
8. Campbell: *Practical Programming: An Introduction to Computer Science Using Python*, Shroff Publications and Distributors.

SEMESTER I
MATM1205L: SOFTWARE LABORATORY-II (PYTHON PROGRAMMING)
(Discipline Specific)

Credits: 02(P)	External Exam Marks: 35
Time Allowed: 3 Hrs.	Internal Assessment: 15
Pass percentage: 35%	Total Marks: 50

This laboratory course will mainly consist of exercises on what is learnt under the paper," PROGRAMMING USING PYTHON ".

SEMESTER II
MATM1206T: DIFFERENTIAL EQUATIONS-I
(Discipline Specific)

Credits: 04(L) External Exam Marks: 70
Time Allowed: 3 Hrs. Internal Assessment: 30
Pass percentage: 35% Total Marks: 100

COURSE OBJECTIVES: The main objective is to provide mathematics majors with an introduction to the theory of Differential Equations through applications and methods of solution. Students will become knowledgeable about systems of Differential Equations and how they can serve as models for physical processes. The course will also develop an understanding of the elements of analysis of Differential Equations.

COURSE OUTCOMES:

1. Check the existence and uniqueness of the solution of initial value problems.
2. Check stability analysis for linear systems.
3. Solve boundary value problems and Sturm-Liouville problems.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Section C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly. Each question in sections A and B will be of 10 marks each and section C will be of 30 marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each section A and B and compulsory question of section C.

SECTION-A

Existence of solution of ODE of first order, initial value problem, Ascoli's Lemma, Gronwall's inequality, Cauchy Peano Existence Theorem, Uniqueness of Solutions. Method of successive approximations, Existence and Uniqueness Theorem. System of differential equations, nth order differential equation, Existence and Uniqueness of solutions, dependence of solutions on initial conditions and parameters.

SECTION-B

Linear system of equations (homogeneous & non homogeneous). Superposition principle, Fundamental set of solutions, Fundamental Matrix, Wronskian, Abel Liouville formula, Reduction of order, Adjoint systems and self adjoint systems of second order, Floquet Theory. Linear 2nd order equations, preliminaries, Sturm's separation theorem, Sturm's fundamental comparison theorem, Sturm Liouville boundary value problem, Characteristic values & Characteristic functions, Orthogonality of Characteristic functions, Expansion of a function in a series of orthonormal functions.

RECOMMENDED BOOKS :

1. William E. Boyce, Richard C. DiPrima, and Douglas B. Meade, Elementary Differential Equations and Boundary Value Problems, 11th edition, Wiley, 2017.
2. E. A. Coddington and N. Levinson, Theory of Ordinary Differential Equations, McGraw Hill Education, 2017.
3. George F. Simmons and Steven G. Krantz, Differential Equations: Theory, Technique, and Practice, McGraw Hill Education, 2006.
4. L. Perko, Differential Equations and Dynamical Systems, 3rd Edition, Springer, 2008.
5. S.L. Ross, Differential Equations, Wiley, 2004.

SEMESTER II
MATM1207T: CLASSICAL MECHANICS
(Discipline Specific)

Credits: 04(L) External Exam Marks: 70
Time Allowed: 3 Hrs. Internal Assessment: 30
Pass percentage: 35% Total Marks: 100

COURSE OBJECTIVES: This course introduces the foundational principles of classical mechanics using advanced formulations like Lagrangian and Hamiltonian dynamics. It emphasizes variational principles, conservation laws, and symmetry properties. Students will explore central force problems, orbital dynamics, and scattering theory, including the Kepler problem and Rutherford scattering, developing a deeper theoretical understanding of motion and interactions in physical systems.

COURSE OUTCOMES:

1. Determine the Lagrangian and Hamiltonian functions for a physical systems
2. Derive and solve the equations of motion from these functions
3. Determine the moments of inertia of a rigid body.
4. Identify symmetries and to derive the corresponding conservation laws
5. Perform calculations using relativistic kinematics and conservation laws

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Section C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly. Each question in sections A and B will be of 10 marks each and section C will be of 30 marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each section A and B and compulsory question of section C.

SECTION-A

Basic Principles: Mechanics of a Particle and a System of Particles, Constraints , Generalized Coordinates, Holonomic and Non-Holonomic Constraints. D'Alembert's Principle and Lagrange's Equations, Velocity Dependent Potentials and the Dissipation Function, Simple Applications of the Lagrangian Formulation.

Variational Principles and Lagrange's Equations: Hamilton's Principle, Derivation of Lagrange's Equations from Hamilton's Principle, Extension of Hamilton's Principle to Non-Holonomic Systems.

Conservation Theorems and Symmetry Properties: Cyclic Coordinates, Canonical Momentum and its Conservation, The Generalized Force, and Angular Momentum Conservation Theorem.

SECTION - B

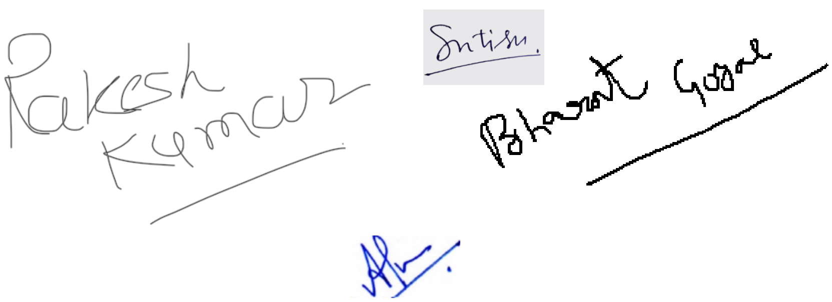
The Two-Body Central Force Problem: Reduction to the Equivalent One-Body Problem, The Equation of Motion, The Equivalent One Dimensional Problem and the Classification of Orbits, The Virial Theorem, Conditions for Closed Orbits, Bertrand’s Theorem.

The Kepler Problem: Inverse Square Law of Force, The Motion in Time in the Kepler Problem, Kepler’s Laws, Kepler’s Equation, The Laplace-Runge-Lenz Vector.

Scattering in a Central Force Field: Cross Section of Scattering, Rutherford Scattering Cross Section, Total Scattering Cross Section, Transformation of the Scattering Problem to Laboratory Coordinates.

RECOMMENDED BOOKS

1. Herbert Goldstein: Classical Mechanics
2. T. M. Helliwell and V. V. Sahakian ; Modern Classical Mechanics
3. John Dirk Walecka ; Introduction To Classical Mechanics: Solutions To Problems



SEMESTER I
MATH1208T: ਮੁਢਲਾ ਗਣਿਤ (ਡਿਗਰੀ ਲਈ ਜਰੂਰੀ ਪਾਸ ਕਰਨ ਵਾਲਾ ਕੁਆਲੀਫਾਈਂਗ ਵਿਸ਼ਾ)
(Qualifying Paper)

Credits: 02(L) External Exam Marks: 35
Time Allowed: 1.5 Hrs. Internal Assessment: 15
Pass percentage: 35% Total Marks: 50

COURSE OBJECTIVES: This course provides a foundational understanding of differential and integral calculus. It covers limits, continuity, derivatives, and their applications in analyzing function behavior, including maxima, minima, and rates of change. Students will also explore definite integrals, the Fundamental Theorem of Calculus, and applications such as area, arc length, and exponential growth and decay.

Course Learning Outcomes: By the end of the course, students will understand key concepts in group theory, including composition series, solvable and nilpotent groups, and group actions. They will analyze permutation groups, conjugacy classes, and finitely generated abelian groups using fundamental theorems. The course also covers core topics in ring theory, such as ring homomorphisms, ideals, quotient rings, and applications to matrix rings and endomorphism rings.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Section C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly. Each question in sections A and B will be of 10 marks each and section C will be of 30 marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each section A and B and compulsory question of section C.

SECTION-A

ਅੰਗਰੇਜੀ ਤੋਂ ਪੰਜਾਬੀ ਤੱਕ ਬੁਨਿਆਦੀ ਗਣਿਤਿਕ ਨਾਮਕਰਨ। ਸੈੱਟ ਥਿਊਰੀ ਦੀਆਂ ਬੁਨਿਆਦੀ ਧਾਰਨਾਵਾਂ, ਬੇਸਿਕ ਸੈੱਟ, ਫੰਕਸ਼ਨਜ ਅਤੇ ਰਿਲੇਸ਼ਨਜ, ਟੇਅਲਰ ਥਿਊਰਮ, ਬਾਈਨੋਮੀਅਲ ਥੀਊਰਮ।

SECTION-B

ਅਸਲ ਜੀਵਨ ਵਿੱਚ ਗਣਿਤ ਅਤੇ ਇਸਦੇ ਉਪਯੋਗ, ਗਣਿਤਿਕ ਮਾਡਲ ਦੀ ਪਰਿਭਾਸ਼ਾ। ਸਧਾਰਨ ਡਿਫਰੈਨਸ਼ੀਅਲ ਸਮੀਕਰਨਾਂ ਰਾਹੀਂ ਗਣਿਤਿਕ ਮਾਡਲਿੰਗ।

RECOMMENDED BOOKS

1. ਵੀ. ਸਿੰਘ, ਆਰ. ਐੱਮ ਗੋਇਲ, ਬੀ.ਐੱਸ. ਮਾਂਗਟ ਅਤੇ ਰਾਮ ਸਿੰਘ, ਐਲੀਮੈਂਟਰੀ ਗਣਿਤ, ਪਬਲੀਕੇਸ਼ਨ ਬਿਊਰੋ, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ, ਪੰਜਾਬ, ਭਾਰਤ।
2. ਜੇ. ਐਨ. ਕਪੂਰ, ਮੈਥਮੈਟਿਕਲ ਮਾਡਲਿੰਗ, ਨਿਊ ਏਜ ਪਬਲੀਸ਼ਰਜ, ਭਾਰਤ।