Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

Autonomous

Course Structure for M.Sc. I Mathematics

Semester	Paper Code	Title of Paper	No. of Credits
I	MAT4101	Real Analysis	4
	MAT4102	Advanced Calculus	4
	MAT4103	Group theory	4
	MAT4104	Numerical Analysis	4
	MAT4105	Ordinary Differential Equations	4
	MAT4106	Practical: Programming in C	4
II	MAT4201	Complex Analysis	4
	MAT4202	Topology	4
	MAT4203	Rings and Modules	4
	MAT4204	Linear Algebra	4
	MAT4205	Partial Differential Equations	4
	MAT4206	Practical: Programming in C++	4

Course Structure for M.Sc. II Mathematics

III	MAT5301	Combinatorics	4
	MAT5302	Field Theory	4
	MAT5303	Functional Analysis	4
	MAT5304	Graph Theory	4
	MAT5305	Applied Mathematics I	4
	MAT5306	Practical: Python	4
IV	MAT5401	Number Theory	4
	MAT5402	Differential Geometry	4
	MAT5403	Fourier Analysis	4
	MAT5404	Lattice Theory	4
	MAT5405	Applied Mathematics II	4
	MAT5406	Project	4

SYLLABUS (CBCS) FOR M.Sc. I MATHEMATICS
(w.e.f. June, 2020)

Academic Year 2020-2021

Class : M.Sc. II (Semester- IV)
Paper Code : MAT5401
Paper : I Title of Paper: Number Theory
Credit : 4 No. of lectures: 60

Course Objectives:

1. To solve problems numerically by various approximation methods.
2. To find the approximate area of some complex regions using Numerical Integration.
3. Demonstrate understanding of common Numerical Methods andhow they are used to obtain approximate solutions.
4. Perform an error analysis for various numerical methods.
5. Derive appropriate numerical methods to calculate a definite integral.
6. Analyze the error incumbent in any such numerical approximation.
7. Study different techniques of interpolation.

Course Outcomes:

By the end of the course, students will be able to:

CO1. Student will be able to handle Machine Learning algorithms using Numerical Analysis.

CO2. Student will be able to construct a function which closely fits given n- points in the plane by using interpolation method.

CO3. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.

CO4. Implement numerical methods in Scilab and other mathematical software.

CO5. Solve a linear system of equations using an appropriate numerical method.

CO6. Student will be able solve an algebraic or transcendental equation using an appropriate numerical method.

CO7. Student will be able to approximate a function using an appropriate numerical

TOPICS/CONTENTS:

Unit 1- Revision :- Divisibility in integers, Division algorithm, G.C.D., L.C.M. Fundamental theorem of arithmetic, The number of primes, Mersene numbers and Fermat's numbers.

Unit 2- Congruences :- Properties of congruence relation, Residue classes their properties Fermat's and Euler's theorems, Wilson's Theorem, Linear congruence of degree one, Chinese remainder theorem.

Unit 3- Arithmetic functions : Euler function, Greatest integer function, Divisor function $\delta(n)$,

Mobius function μ(n), Properties and their inter relation.
Unit 4- Quadratic Reciprocity: - Quadratic residue, Legendre's symbol its properties, Quadratic Reciprocity law, Jacobi symbol its properties, Sums of Two Squares.
Unit 5- Some Diophantine Equations: The equation ax + by = c , simultaneous linear equations.
Unit 6- Algebraic Numbers :- Algebraic Numbers, Algebraic number fields, Algebraic integers, Quadratic fields, Units in Quadratic fields, Primes in Quadratic fields, Unique factorization Primes in quadratic fields having the unique factorization property.

Text Book :- Ivan Niven & H. S. Zuckerman, An introduction to number theory (Wiley Eastern Limited) Sections: 2.1 to 2.4, 3.1 to 3.3, 3.6, 4.1 to 4.4, 5.1, 5.2, and 9.1 to 9.9

Reference Books :-

1. T.M. Apostol, An Introduction to Analytical Number Theory (Springer International Student's Edition)
2. David M Burton, Elementary Number Theory (Universal Book Stall, New Delhi)
3. S. G. Telang, Number Theory (Tata Mc-graw Hill)
4. G. H. Hardy and E. M. Wright, Introduction to Number Theory (Oxford university press)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc-II (Sem IV) **Subject:** Mathematics
Course: Number Theory **Course Code:** -MAT5401
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	2				1				
CO 2	2	2							
CO 3	2	2			2				
CO 4	3	3		2					3
CO 5	1	3							
CO 6	3	3			1				
CO 7	2	3							2

Justification for the mapping

PO1: Disciplinary Knowledge
CO1: Finding quotients and remainders from integer division is a fundamental operation in arithmetic and computer science, essential for tasks like modular arithmetic, algorithm design, and data structure implementation.
CO2: Understanding the definitions of congruence, residue classes, and least residues is essential for foundational comprehension in number theory and modular arithmetic.
CO3: Identifying arithmetic functions and Dirichlet multiplications is crucial in number theory to analyze the behavior of prime numbers and investigate their properties within the framework of multiplicative number theory.

CO4: The Mobius inversion formula is a powerful tool in number theory and combinatorics that allows us to recover existing identities and relationships by reversing the summation or convolution process, providing a systematic and efficient method for studying number-theoretic functions and relationships.
CO5: Determine multiplicative inverses modulo n to solve linear congruences, as these inverses allow for division in modular arithmetic, enabling the solution of equations of the form ax ≡ b (mod n).
CO6: Applying Wilson's theorem helps identify the existence of primitive roots in modular arithmetic by revealing that if (p-1) is prime, then primitive roots exist modulo p.
CO7: Understanding legendary symbols is essential for identifying quadratic or non-quadratic residues modulo p in number theory and modular arithmetic, a key component of disciplinary knowledge.

PO2: Critical Thinking and Problem solving

CO2: Understanding the definitions of congruence, residue classes, and least residues is essential for critical thinking and problem-solving in number theory, modular arithmetic, and cryptography, enabling the manipulation and analysis of modular equations and their applications in diverse mathematical and real-world scenarios.

CO3 Identifying arithmetic functions and Dirichlet multiplications is essential for critical thinking and problem-solving in number theory, enabling the analysis and manipulation of number sequences and their properties to tackle complex mathematical problems..
CO4 The Mobius inversion formula is a powerful tool for unraveling existing identities by providing a systematic method to transform and solve problems involving arithmetic functions, fostering critical thinking and problem-solving skills in number theory and combinatorics.
CO5: Determine multiplicative inverses modulo n to solve linear congruences is critical for problem-solving in number theory and cryptography, as it enables efficient solutions to equations in modular arithmetic, a fundamental concept with various real-world applications.
CO6: Applying Wilson's theorem is a fundamental step in determining the existence of primitive roots, demonstrating a key aspect of critical thinking and problem-solving in number theory.
CO7: Understanding legendary symbols is essential for distinguishing between quadratic and non-quadratic residues modulo p, a key component of critical thinking and problem-solving in number theory and cryptography.

PO4: Research-related skills and Scientific temper
CO4: The Mobius inversion formula is a powerful tool for revealing underlying patterns in existing identities, demonstrating critical research-related skills and a strong scientific temper in unravelling complex mathematical relationships.

PO5: Trans-disciplinary knowledge
CO1: "Find the quotients and remainders from integer division transcends disciplinary boundaries, applying to various fields of study."

CO3: Arithmetic functions are elementary number theory functions used in various mathematical disciplines, while Dirichlet multiplications are a tool in analytic number theory that combines functions to study number-theoretic properties in a trans-disciplinary approach.

CO6: Applying Wilson's theorem to calculate primitive roots enables us to bridge number theory with computational algebra, showcasing the power of trans-disciplinary knowledge.

PO7: Effective Citizenship and Ethics

CO7: Understanding polynomial rings and their properties can enhance mathematical reasoning skills, fostering a foundation for informed decision-making in various ethical and societal contexts.

PO9: Self-directed and Life-long learning:

CO4: The Mobius inversion formula enables the identification of underlying patterns and relationships, fostering self-directed and lifelong learning by revealing the interconnected nature of mathematical structures.

CO7 : Self-directed and lifelong learning is essential for individuals to continually expand their knowledge and adapt to evolving challenges in an increasingly complex and dynamic world.

Class : M.Sc. II (Semester- IV)
Paper Code : MAT5402
Paper : II Title of Paper: Differential Geometry
Credit : 4 No. of lectures: 60

Course Objectives:

1. To introduce equivalence of two curve, definition and parameterization of surface.
2. To introduce tangent space of surfaces.
3. To introduce integrate differential forms on surfaces.
4. To get introduced to the notion of Serret-Frenet frame for space curves.
5. To understand the idea of orientable and non-orientable surfaces.
6. To get introduced to the concepts of a regular parameterized curve.
7. To understand the isometry between two surfaces and characterization of local isometry between them.

Course Outcomes:

CO1 Student will be able to understand the treatment of Level sets, Geodesics,
CO2 Weingarten map, smooth curve, and line integral.
CO3 Student will be able to find differential maps between surfaces.
CO4 Students will develop understanding of basics of differential geometry.
CO5 Student will be able to understand and solve problems which require the use of differential geometry.
CO6 Students will know how to use formal mathematical reasoning and write mathematical proofs when necessary.
CO7 Students will demonstrate ability to cover a topic independently and tp present their results in a written report.
CO8 Student will be able to perform calculations of curvature and related quantities for curves and surfaces in 3-dimensional spaces.

TOPICS/CONTENTS:

Unit 1-Graphs and Level Sets: Level Set, Graphs of Level Sets.
Unit 2-Vector Field: Dot product, Cross product, length of vector, Vector Field Smooth vector Field, Gradient, Parametrized Curve, Divergence, Integral Curve, Complete Vector Field.
Unit 3-The Tangent Space: Tangent to Level Sets, Properties.
Unit 4-Surface: Surface of Revolution.
Unit 5-Vector Field On Surface: Vector Field, Tangent Vector Field, Smooth Vector Field, Normal Vector Field, Connectedness.
Unit 6-The Gauss Map: Gauss Map, Spherical Image of Oriented n-Surfaces.
Unit 7-Geodesics: Speed of α, Geodesics Property.
Unit 8- The Parallel Transport: Vector Field, Covarient Derivatives , Euclidean Parallel , Levi –civita ,Use of parallelism.
Unit 9-The Weingarten Map: Properties of directional derivative, Covarient Derivative of Tangent vector field.
Unit 10-Curvature Of Plane Curve: Significance of sign of k(p) , Global Parametrization.
Unit 11-Arc Length And Line Integral: Arc Length, Fundamental Domain, Differentiable 1-form.

Text Book:
Elementary Topics In Differential Geometry,J.A.Thorpe
(Springer Verlag)

Reference Book:
1) B Oneill: Elementary Differential Geometry (Acedamic New-York).
2) Do CarmoM. :Differential Geometry of Curves and Surfaces.(Englewood Cliffs,N.J.Prentice Hall,1977).

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc-II (Sem IV) **Subject:** Mathematics
Course: Differential Geometry **Course Code:** -MAT5402
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1		2							
CO 2	2				2				3
CO 3	2								
CO 4		3			3				
CO 5	1								
CO 6									
CO 7	2	3			1				

Justification for the mapping

PO1: Disciplinary Knowledge
CO2: Studying Level sets, Geodesics, Weingarten map, smooth curves, and line integrals enhances a student's comprehension of fundamental concepts in differential geometry and contributes to their disciplinary knowledge.
CO3: Justification: Understanding differential maps between surfaces is essential for grasping the mathematical foundation of geometry and topology within the discipline of mathematics.
CO5: Justification: Developing proficiency in formal mathematical reasoning and proof writing equips students with essential skills for solving complex problems and advancing in their disciplinary knowledge.
CO7: Justification: Developing proficiency in formal mathematical reasoning and proof writing equips students with essential skills for solving complex problems and advancing in their disciplinary knowledge.

PO2: Critical Thinking and Problem solving

CO1: Studying the treatment of level sets, geodesics, Weingarten maps, smooth curves, and line integrals enhances critical thinking and problem-solving skills by enabling students to navigate complex geometric and analytical challenges in various mathematical and scientific contexts.
CO4: Studying differential geometry equips students with the critical thinking and problem-solving skills needed to tackle complex mathematical challenges and real-world problems.
CO7: Studying differential geometry equips students with the critical thinking and problem-solving skills necessary to tackle complex mathematical problems in a geometric context.

PO5: Trans-disciplinary knowledge

CO2: Justification: The ability to find differential maps between surfaces fosters trans-disciplinary knowledge by bridging mathematical concepts with real-world applications, enabling students to navigate complex problems across various fields.

CO4: Studying differential geometry fosters trans-disciplinary knowledge by equipping students with the skills to comprehend and tackle complex problems across diverse fields through geometric insights and techniques.

CO7: Studying curvature and related calculations in 3-dimensional spaces fosters trans-disciplinary knowledge by enabling students to analyze and apply geometric concepts across various fields, from physics and engineering to computer graphics and biology.

PO9: Self-directed and Life-long learning

CO2: Justification: Teaching students to find differential maps between surfaces promotes self-directed and lifelong learning by fostering problem-solving skills and encouraging exploration beyond the classroom.

Class : M.Sc II (Semester- IV)
Paper Code: MAT5403
Paper : III
Credit : 4
Title of Paper: Fourier analysis
No. of lectures: 60

Course Objectives:

1. To understand theory in Fourier analysis.
2. To enable the students to study finite Fourier sine and cosine series.
3. To introduce theory of differentiation and integration of Fourier series.
4. Use Fourier series to solve boundary value problems.
5. Understand the convergence of Fourier series of continuous periodic functions.
6. To introduce Strum-Liouville problems.
7. To understand the convergence of Fourier series of piecewise continuous functions.

Course Outcomes:

1. Student will be able to calculate Fourier series of a function.
2. Student will Classify and solve partial differential equations.
3. Student will be able to evaluate the Fourier series expansion for different periodic functions.
4. Student will discuss the nature of the partial differential equations.
5. Student will be able to analyze the properties of a Fourier Transforms.
6. Student will be able to calculate the Fourier sine and cosine series and apply it in solving boundary value problems.
7. Student will be able to calculate the infinite Fourier series of elementary functions from the definition.

TOPICS/CONTENTS:

Unit 1- Fourier Series

Piecewise Continuous Functions, Fourier Cosine Series, Examples, Fourier Sine Series, Examples, Fourier Series, Examples, Adaptations to other Intervals.

Unit 2- Convergence of Fourier Series

One Sided Derivatives, A Property of Fourier Coefficients, Two Lemmas, A Fourier Theorem, Discussion of the theorem and its Corollary, Convergence on other interval, A Lemma, Absolute and Uniform Convergence of Fourier Series, Differentiation of Fourier Series, Integration of Fourier Series.

Unit 3- Fourier Method:

Linear Operators, Principle of Superposition, Temperature, A Vibrating String Problem

Unit 4- Boundary Value Problems:

A slab with faces at prescribed temperatures, Related Problems, A Slab with Internally Generated Heat, Steady Temperatures in a Rectangular Plate, Cylindrical Coordinates.

Unit 5- Orthonormal Sets:

Inner Products and Orthonormal Sets, Examples, Generalized Fourier Series, Examples, Best Approximation in the Mean, Bessel's Inequality and Paeseval's Equation, Applications to Fourier Series.

Unit 6- Sturm-Liouville Problems and Applications:

Regular Strum-Liouvilles Problems, Modifications, Orthogonality of Eigenfunctions, Real valued Eigenfunctions and Nonnegative Eigenvalues, Methods of Solution, Examples of Eigenfunction Expansions, A temperature Problem in Rectangular Coordinates.

Unit 7- Bessel Functions and Applications:

Bessel Functions $J_n(x)$, General Solutions of Bessel's Equation, Recurrence Relations, Bessel's Integral Form, Some Consequences of the Integral Forms, The Zeros of$J_n(x)$, Zeros of Related Functions.

Text Book

Churchill and Brown.: Fourier Seriesand Boundary Value Problems (7th edition) McGraw-Hill

Reference Book:

E. Stein and R. Shakharchi, Fourier Seriesand Boundary Value Problems, New age International

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc-II (Sem IV) **Subject:** Mathematics

Course: Fourier Analysis **Course Code:** -MAT5403

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3= strong or direct relation.

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	2	1		1					
CO 2	2	2							1
CO 3	1	2							
CO 4	2	2			1				
CO 5	3	3		2	1				
CO 6	3	2							
CO 7	2	2		1					

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: Studying the theory of Fourier analysis in disciplinary knowledge is essential as it forms the foundation for advanced mathematical techniques used in diverse fields, enabling precise analysis and modelling of complex phenomena, and facilitating in-depth understanding and problem-solving within those disciplines.

CO2: Studying finite Fourier sine and cosine series in disciplinary knowledge is crucial as it equips students with the mathematical tools necessary to represent and analyze a wide range of real-world phenomena, promoting a deeper understanding of complex systems and facilitating problem-solving within their specific disciplines.

CO3: Introducing the theory of differentiation and integration of Fourier series in disciplinary knowledge is vital as it enables a deeper understanding of the mathematical properties and applications of Fourier analysis, which is widely used in various scientific and engineering disciplines, enhancing the ability to solve complex problems and make precise predictions.

CO4: Using Fourier series to solve boundary value problems in disciplinary knowledge is essential as it provides a powerful mathematical technique for analyzing and solving complex problems related to heat transfer, wave propagation, and other phenomena, enhancing the ability to model and address real-world challenges within specific fields.

CO5: Understanding the convergence of Fourier series of continuous periodic functions in disciplinary knowledge is crucial as it ensures the accuracy and reliability of Fourier analysis techniques, enabling precise modelling and analysis of various phenomena within specific disciplines, thus enhancing problem-solving and research capabilities.
CO6: Introducing Sturm-Liouville problems in disciplinary knowledge is important as it provides a powerful mathematical framework for solving a wide range of differential equations, making it an essential tool for understanding and addressing complex phenomena and problems within specific disciplines, thereby enhancing problem-solving and research capabilities.
CO7: Understanding the convergence of Fourier series of piecewise continuous functions in disciplinary knowledge is crucial as it allows for accurate representation and analysis of a broader range of real-world phenomena, providing a foundational mathematical tool for addressing complex problems within specific fields, enhancing problem-solving and research capabilities.

PO2: Critical Thinking and Problem solving
CO1: Understanding the theory in Fourier analysis is vital for critical thinking and problem-solving as it equips individuals with a powerful mathematical framework for analyzing complex phenomena, enabling precise modelling and insightful problem-solving in various disciplines, fostering a deeper understanding of critical issues and their solutions.
CO2: Classifying and solving partial differential equations is a critical thinking and problem-solving skill that empowers students to tackle a wide array of complex real-world problems across various disciplines, fostering analytical thinking, and enhancing their ability to address intricate and multifaceted challenges.
CO3: Evaluating Fourier series expansions for various periodic functions enhances critical thinking and problem-solving skills by providing a systematic approach to analyze and model complex phenomena, enabling effective problem-solving in diverse disciplines.
CO4: Discussing the nature of partial differential equations fosters critical thinking and problem-solving skills by promoting a deep understanding of the fundamental properties and behaviours of these equations, enabling effective problem analysis and solutions in various disciplines.
CO5: Analyzing the properties of Fourier Transforms enhances critical thinking and problem-solving skills by providing a versatile mathematical tool for understanding and solving complex problems in diverse fields, facilitating precise analysis and modelling of phenomena.

CO6: Calculating Fourier sine and cosine series and applying them to solve boundary value problems is essential for critical thinking and problem-solving, as it equips students with a powerful mathematical technique to address real-world challenges, fostering analytical skills and effective solutions in various disciplines.
CO7: Calculating the infinite Fourier series from the definition in critical thinking and problem-solving enhances mathematical reasoning and analytical skills, enabling students to accurately represent and analyze complex functions and phenomena, facilitating effective problem-solving in diverse disciplines.

PO4: Research-related skills and Scientific temper
CO1: Calculating Fourier series of a function in research-related skills and scientific temper enhances one's ability to analyze and model complex phenomena, fostering precise data interpretation and mathematical skills that are vital for conducting rigorous research and making informed scientific conclusions.
CO5 Analyzing the properties of Fourier Transforms in research-related skills and scientific temper enhances the capacity for in-depth data analysis and modeling, contributing to more rigorous research practices and fostering a commitment to evidence-based scientific inquiry.

CO7: Calculating infinite Fourier series from the definition in research-related skills and scientific temper enhances mathematical proficiency and analytical capabilities, vital for conducting thorough research and promoting a rigorous, evidence-based scientific approach.

PO5: Trans-disciplinary knowledge

CO4: Discussing the nature of partial differential equations in trans-disciplinary knowledge fosters a foundational understanding of these equations, promoting a holistic approach to problem-solving and enabling their application in diverse fields of study and collaboration.

CO5: Analyzing the properties of Fourier Transforms in trans-disciplinary knowledge provides a versatile mathematical tool for understanding and addressing complex phenomena, facilitating interdisciplinary problem-solving and enhancing collaboration across diverse fields of study.

PO9: Self-directed and Life-long learning:

CO2: Classifying and solving partial differential equations in self-directed and life-long learning fosters independent problem-solving skills and equips individuals to continually adapt and apply mathematical techniques across various disciplines, promoting lifelong intellectual growth.

Class : M.Sc II (Semester- IV)
Paper Code: MAT5404
Paper : IV Title of Paper: Lattice Theory
Credit : 4 No. of lectures: 60

A) Course Objectives:

1. To study the concept of Lattice as an algebra and Lattice as a poset.
2. To familiarize the concepts of Distributivity and Modularity.
3. Generalization of lattice concept by dropping one or more of the lattice identities.
4. To know the concept and applications of Lattice Theory.
5. To study relation between Graph Theory and Lattice Theory
6. To know Lattice-ordered Groups and related concepts.
7. To study complements, relative complements, and semi-complements of elements of a bounded lattice.

A) **Course Outcomes:**

By the end of the course, students will be able to:

CO1: Student will be able to understand how lattices as an algebra and as a poset are used as tools and mathematical models in the study of networks.

CO2: Students will be able to classify Distributive and Modular Lattices.

CO3: Student will be able to learn the equivalent conditions for a lattice to become modular and distributive.

CO4: Understand the concepts of maximal chain condition, Duality, and atoms in lattices.

CO5: Student will be able to learn the property of homomorphism of lattices.

CO6: To recognize the significance of ideal lattices.

CO7: Students will be able to explain the relation between Graph Theory and Lattice Theory.

TOPICS/CONTENTS:

Unit 1- Lattice First Concepts:

- Two definitions of lattices
- Hasse diagrams
- Homomorphism
- Isotone maps
- Ideals and congruence relations
- Congruence lattices
- Product of lattices
- Complete lattice, Ideal lattice, Distributive –Modular inequalities and identifies, complements, pseudo complements
- Boolean lattice of pseudo complements, join and meet-irreducible elements.

Unit 2- Characterization theorems and representation theorems:

- Birkhoff`s distributivity criterion
- Hereditary subsets, rings of sets
- Stone theorems
- Nachbin theorem, statements of Hashimoto’s theorem.

Unit 3- Modular and Semimodular lattices:

- Isomorphism theorem

- Upper and lower covering conditions, Kuros-Ore theorem
- Independent sets (Drops results involving projectivity and sublattice generated by sets / elements)
- Jordan-Holder chain condition.

Text Book: General Lattice Theory , G. Gratzer (Birkhauser, IInd Edition 1998) Chap. 1 Section 1,2,3,4,6, Cha. 2 Section-1, Chap.3. Section –1,2.

Reference Books: 1) Lattice Theory: First Concepts and Distributive Lattices, George Gratzer.
3) Lattice Theory **:** Special Topics and applications ,GA Gratzer,FWehrung Springer.

Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc-II (Sem IV) **Subject:** Mathematics
Course: Lattice Theory **Course Code:** -MAT5404

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3= strong or direct relation.

	Programme Outcomes(POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	3		1	3				
CO 2	3	3		3		2			2
CO 3	3	3		1					1
CO 4	3	2		1					
CO 5	3	3		1					
CO 6	3	3		2	2				2
CO 7	3	2		3	3	2			2

Justification for the mapping

PO 1: Disciplinary Knowledge:

CO1, CO3, CO4 and CO5 are building blocks of Lattice theory that helps students to acquire the knowledge and skills required for the advanced lattice theory concepts. CO 2, CO 6 and CO 7 require students to develop deep understanding of types of Lattices and apply the concepts in the Graph Theory.

PO 2: Critical Thinking and Problem Solving:

All the Course outcomes also contribute to the development of students' critical thinking and problem-solving skills. For example, CO1, CO3, CO4, and CO5 require students to think critically about how to apply Lattice, Boolean Lattice, Modular Lattice to solve different Lattice Identities. CO2, CO6 and CO7 require students to think critically and apply the knowledge to classified types of Lattices.

PO 4: Research-related skills and Scientific temper:

CO1, CO3, CO4 and CO5 require students to apply their knowledge of atoms, Modular Lattice, Boolean algebra and ideal Lattice to solve problems in networks in computer science and Graph theory. CO2, CO6 and CO7 enhance the educational experience and prepare students for the advanced studies and research in the related lattice theory fields.

PO5: Trans-disciplinary knowledge:

CO1, CO6, and CO7 contribute to the development of student's trans-disciplinary knowledge. For example, CO1 requires students to learn how to apply Boolean algebra as a tool in network models. CO6 and CO7 requires students to develop an understanding of the connections between Lattice diagram and graphical diagram in graph theory and other subjects.

PO6: Personal and professional competence:

CO2, and CO7 contribute to the development of students personal and professional competence. For example, CO2 reflect the practical application of various types of Lattices. CO2 and CO7 require students to develop their ability to work independently and as part of a team**.** This integrated approach prepares students for the challenges and demands of their chosen careers and equips them with the skills and mindset required for continuous growth and adaptability.

PO9: Self-directed and Life-long learning:

CO2, CO3, CO6 and C07 empower students to view challenges as opportunities for growth and learning. For example, all of the mentioned COs requires students to develop their ability to learn graph theoretical concepts in terms lattices.

Class : M.Sc II (Semester- IV)
Paper Code: MAT5405
Paper : V
Credit : 4

Title of Paper: Applied Mathematics II
No. of lectures: 60

Course Objectives:

1. Enable students to visualize and understand spherical triangles and their properties on a three-dimensional spherical surface.
2. Introduce spherical coordinate systems and their significance in representing points on the sphere, aiding in problem-solving and visualization.
3. Ensure proficiency in spherical trigonometric functions (sine, cosine, tangent, etc.) and their properties on a sphere.
4. Enhance students' problem-solving abilities by presenting complex problems that require the application of spherical trigonometry principles.
5. Familiarize students with the laws governing spherical triangles, such as the law of sines, law of cosines, and the law of tangents, and their applications in solving problems on the sphere.
6. Explore the differences and similarities between spherical trigonometry and planar trigonometry, emphasizing how curvature affects trigonometric relationships.
7. Teach students how to measure angles on a sphere, understanding concepts like radian measure and steradian measure.

Course Outcome:

1. Students will develop a solid understanding of trigonometric functions on a sphere, including the laws of spherical trigonometry and their applications.
2. Students will develop problem-solving skills through the application of spherical geometry concepts to various real-world problems.
3. Students will be familiar with spherical coordinate systems, their conversion, and transformations between spherical and Cartesian coordinate systems.
4. Students will develop visualization skills to understand and represent three-dimensional spherical shapes and angles.
5. Students will be understand the fundamental concepts of spherical geometry, including great circles, small circles, spherical triangles, and spherical polygons.
6. Students will develop skills to solve problems involving spherical triangles, applying various trigonometric formulas and laws specifically designed for spherical surfaces.
7. Students will explore geodesics (shortest paths on a curved surface) and their significance in navigation, cartography, and astronomy.

TOPICS/CONTENTS:

Unit 1-Keplar's Law of Palnetery Motion: Planets, Inferior and Superior Planets Astroids, Satellites, Keplars 3 law Of planetary motion, Perihelion, Aphelion, Eccentric And True Anamoly, Mean Distance , Heliocentric Distance, Polar Equation Of Ellipse , Kepler's Equation

Unit 2- Time: Sideral Time , Sideral Day, Mean Equinox, Uniform Sideral Day, Sideral Year, Mean Solar Day, Equation Of Time, Causes and length of seasons.

Unit3- Planetary Motion and Phenomenon: Heliocentric longitude and latitude, Conjunction, Heliocentric, geocentric, superior and Inferior Conjunction, Orbital Period, Relation Between Synodic and Orbital Period, Direct Retrograde Motion, GeocentricMotion, Elongation of Planet, Phases of Moon.

Text Book: Spherical Astronomy ByM.L.Khanna- Published by Jai Prakash Nath and Company Meerut(U.P)

Reference Book: Spherical Astronomy By karr.

Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc-II (Sem IV) **Subject:** Mathematics
Course: Applied Mathematics II **Course Code:** -MAT5405

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3= strong or direct relation.

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	1	1							
CO 2	2	2			1				
CO 3	2	1		2					
CO 4	1			1					1
CO 5	1				2				
CO 6		1		1	1				
CO 7		2			1				1

Justification for the mapping

PO1: Disciplinary Knowledge
CO1: Students will comprehensively grasp spherical trigonometry, encompassing the laws of trigonometric functions on a sphere and their applied significance within disciplinary knowledge.
CO2: Students will adeptly refine problem-solving abilities by applying spherical geometry concepts to diverse real-world problems within their disciplinary knowledge.
CO3: Students will proficiently navigate spherical coordinate systems, mastering conversions and transformations between spherical and Cartesian coordinates within their disciplinary knowledge.
CO4: Students will cultivate visualization skills to comprehend and depict three-dimensional spherical shapes and angles proficiently within their disciplinary knowledge.
CO5: Students will adeptly master visualization techniques to understand and represent three-dimensional spherical shapes and angles within their disciplinary domain.
PO2: Critical Thinking and Problem solving
CO1: Students will critically engage in comprehending trigonometric functions on a sphere, exploring the laws of spherical trigonometry and their diverse applications.
CO2: Students will actively apply critical thinking to grasp trigonometric functions on a sphere, analyzing the laws of spherical trigonometry and their multifaceted applications

CO3:Students will rigorously apply critical thinking to comprehend trigonometric functions on a sphere, dissecting the laws of spherical trigonometry and their versatile applications

CO6: Students will rigorously employ critical thinking to comprehend spherical trigonometry, dissecting its laws and versatile applications.

CO7: Students will rigorously apply critical thinking to comprehend spherical trigonometry's principles and versatile applications, fostering analytical depth in critical thinking.

PO4: Research-related skills and Scientific temper

CO3: Students will adeptly engage in researching spherical coordinate systems, mastering their conversions, and exploring transformations between spherical and Cartesian coordinates with advanced research skills.

Co4: Students will expertly navigate research involving spherical coordinate systems, demonstrating mastery in conversions and transformations between spherical and Cartesian coordinates with advanced research proficiency.

CO6: Students will adeptly tackle problems with spherical triangles, utilizing specialized trigonometric formulas and laws tailored for spherical surfaces, showcasing advanced research skills.

PO5: Trans-disciplinary knowledge

CO2: Students will adeptly enhance problem-solving skills by applying spherical geometry concepts to diverse real-world challenges across interdisciplinary domains.

CO5: Students will comprehensively grasp fundamental spherical geometry concepts encompassing great circles, small circles, spherical triangles, and spherical polygons across diverse interdisciplinary fields.

CO6: Students will adeptly comprehend fundamental spherical geometry concepts, such as great circles, small circles, spherical triangles, and spherical polygons, within diverse interdisciplinary contexts.

CO7: Students will proficiently grasp essential spherical geometry concepts—like great circles, small circles, spherical triangles, and polygons—within diverse transdisciplinary contexts, showcasing adept comprehension.

PO9: Self-directed and Life-long learning:

CO4: Students will continuously master essential spherical geometry concepts—great circles, small circles, spherical triangles, and polygons—across diverse transdisciplinary fields, demonstrating adept comprehension in lifelong learning.

CO7: Students will persistently excel in understanding crucial spherical geometry concepts—great circles, small circles, spherical triangles, and polygons—across diverse transdisciplinary fields, exemplifying adept comprehension in lifelong learning endeavors.