FACULTY OF SCIENCES
SYLLABUS FOR THE BATCH FROM THE YEAR 2024 TO YEAR 2026

Programme Code: MMAT

Programme Name:M.Sc. Mathematics

(Semester I-II)

Examinations: 2024-2026

Department of Mathematics

Khalsa College, Amritsar

Chairperson, BoS in Mathematics

S.No.	PROGRAMME OBJECTIVES
1.	To enhance problem solving skills and develop logical thinking.
2.	To exhibit proficiency in application of mathematics to solve daily life problems

S.No.	PROGRAMME SPECIFIC OUTCOMES (PSOS)
PSO-1	Understand the nature of abstract mathematics and explore the concepts in various fields.
PSO-2	Inculcate mathematical reasoning and assimilate complex mathematical ideas and arguments
PSO-3	Communicate mathematical ideas with clarity and coherence, both written and verbally
PSO-4	Undertaking original research on a particular topic.
PSO-5	To impart computer knowledge to enable them to calculate various mathematical concepts.

COURSE SCHEME

SEMESTER - I

Course Code	Course Name	Hours/Week	Credits			Total Credits	Max Marks				Page No.
			L	T	P		Th	P	IA	Total	
Major Courses											
MHM-411	Real Analysis-I	6	5	1	0	6	75	-	25	100	4-5
MHM-412	Algebra-I	6	5	1	0	6	75	-	25	100	6-7
MHM-413	Classical Mechanics and Calculus of variations	6	5	1	0	6	75	-	25	100	8-9
MHM-414	Complex Analysis	6	5	1	0	6	75	-	25	100	10-11
MHM-415	Differential Equations	6	5	1	0	6	75	-	25	100	12-13
Total		30	25	5	0	30	-	-	-	500	

SEMESTER - II

Course Code	Course Name	Hours/Week	Credits			Total Credits	Max Marks				Page No.
			L	T	P		Th	P	IA	Total	
Major Courses											
MHM-421	Real Analysis-II	6	5	1	0	6	75	-	25	100	14-15
MHM-422	Algebra-II	6	5	1	0	6	75	-	25	100	16-17
MHM-423	Number Theory	6	5	1	0	6	75	-	25	100	18-19
MHM-424	Differential Geometry	6	5	1	0	6	75	-	25	100	20-21
MHM-425	Partial Differential Equations and Integral Equations	6	5	1	0	6	75	-	25	100	22-23
Total		30	25	5	0	30	-	-	-	500	

Khalsa College, Amritsar

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Syllabus for

PROGRAMME: M.Sc.-Mathematics (Semester-I)

COURSE CODE-MHM- 411

COURSE TITLE: REAL ANALYSIS-I

L	T	P	Credits
5	1	0	6

COURSE CREDIT(PER WEEK): 6

TOTAL HOURS: 90 hrs.

Medium: English **MAXIMUM MARKS: 100**

TIME: 3HRS. **(Theory Marks: 75**

Internal Assessment: 25)

INSTRUCTIONS FOR PAPER SETTERS:

1. The question paper will consists of five sections namely Section-A, which will be from entire syllabus (equally distributed from each unit), Section–B, C, D and E from Unit-I, II, III and IV, respectively.
2. Section–A will consists of eight short answer type questions, each of 2.5 marks. Students are to attempt any six.
3. Sections–B, C, D & E will consist of two questions each**(each question should be sudivided into two parts)**. Students are to attempt any four questions in total by selecting one question from each section. Each question carries 15marks.
4. Question paper should cover at least 40% article work from the recommended books.
5. Teaching time for this paper would be eight periods per week.

COURSE OBJECTIVES:

- This course introduce students to the fundamentals of mathematical analysis
- The objective of this course is to enable students to understand the concept of cardinality of a set, open sets, closed sets, compact sets and connected sets.
- Students wil realize how these notions are generalized from real line to metric spaces.

COURSE CONTENT:

Unit-I

Set Theory: Finite, countable and uncountable sets. Metric spaces: Definition and examples, open sets, closed sets, compact sets, elementary properties of compact sets, k- cells, compactness of k- cells, Compact subsets of Euclidean space R^k, Perfect sets, The Cantor set.

Unit-II

Separated sets, connected sets in a metric space, Connected subsets of real line, Components, Functions of Bounded Variation, Sequences in Metric Spaces: Convergent sequences (in Metric Spaces), subsequences, Cauchy sequences, Complete metric spaces, Cantor's Intersection Theorem

Unit-III

Baire's theorem, Banach contraction principle, Continuity: Limits of functions (in metric spaces) Continuous functions, Continuity and Compactness, Continuity and Connectedness, Discontinuities, Monotonic functions, Uniform Continuity.

Unit-IV

The Riemann Stieltje's Integral: Definition and existence of Riemann Stieltje's integral, Properties of integral. Integration and Differentiation. Fundamental Theorem of Calculus, Ist and 2nd Mean Value Theorems of Riemann Stieltje's integral.

Books Recommended:

1. Walter Rudin : Principles of Mathematical Analysis (3rd Edition) McGraw-Hill Ltd Ch.2, Ch.3, (3.1-3.12), Ch.4, Ch.6, (6.1-6.22)
2. Simmons, G.F. : Introduction to Topology and Modern Analysis, McGraw- Hill Ltd(App.1) pp337-338, Ch.2(9-13)
3. Shanti Narayan : A course of Mathematical Analysis.
4. Apostol, T.M. : Mathematical Analysis 2nd Edition 7.18(Th.7.30&7.31)
5. Malik, S.C and Savita Arora. : Mathematical Analysis, Wiley Eastern Ltd.

COURSE OUTCOMES : On completing the course, the students will be able to:

- introduces students to the fundamentals of mathematical analysis and reading and writing mathematical proofs.
- correlate Calculus with real analysis by finding infinite sums and evaluating limits to understanding the concept of continuity and uniform continuity one is doing real analysis.
- understand the abstract language of Mathematics.
- generalize mathematical concepts to higher dimensions.

Khalsa College, Amritsar

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Syllabus for
PROGRAMME:M.Sc.-Mathematics (Semester-I)
COURSE CODE-MHM- 412

COURSE TITLE: ALGEBRA – I

L	T	P	Credits
5	1	0	6

CREDIT HOURS(PER WEEK):6
TOTAL HOURS: 90 hrs.

Time: 3Hrs **MAXIMUM MARKS: 100**
Medium: English **(Theory : 75**
Internal Assessment: 25)

INSTRUCTIONS FOR PAPER SETTERS

1. The question paper will consists of five sections namely Section-A, which will be from entire syllabus (equally distributed from each unit), Section–B, C, D and E from Unit-I, II, III and IV, respectively.
2. Section–A will consists of eight short answer type questions, each of 2.5 marks. Students are to attempt any six.
3. Sections–B, C, D & E will consist of two questions each**(each question should be sudivided into two parts)**. Students are to attempt any four questions in total by selecting one question from each section. Each question carries 15marks.
4. Question paper should cover at least 40% article work from the recommended books.
5. Teaching time for this paper would be eight periods per week.

COURSE OBJECTIVES:

- To get familiar with the concept of group.
- To study various properties of group, subgroup, normal group, cyclic group etc.

COURSE CONTENT:

Unit -I

Groups: Definition & examples, Subgroups, Normal subgroups and Quotient Groups, Lagrange's Theorem, Generating sets, Cyclic Groups.

Unit -II

The Commutator subgroups, Homomorphism, Isomorphism Theorems, Automorphisms, , inner Automorphisms, Permutation groups, the alternating groups, Simplicity of A_n, $n \geq 5$, Cayley's theorem.

Unit -III

Structure of finite Abelian groups. Conjugate elements, class equation with applications, Cauchy's Theorem, Sylow's Theorems and their simple applications, Composition Series, and Jordan Holder Theorem, Solvable Groups.

Unit -IV

Direct Products: External and Internal. Fundamental theorem of finite Abelian groups and its applications; Semidirect Products, Recognition Theorems on semidirect products.

BOOKS RECOMMENDED:

1. Herstein, I.N. : Topics in Algebra, Willey Eastern 1975.
2. Fraleigh, J. B : An Introduction to Abstract Algebra.
3. Surjit Singh and Quazi Zameeruddin: Modern Algebra.

COURSE OUTCOMES: On completing the course, the students will be able to:

- recognize the foundation required for more advanced studies in Algebra.
- Investigate symmetry using group theory.
- Understand the concept of various algebraic structures.
- Understand the importance of algebraic properties relative to working within various number systems.

Khalsa College, Amritsar

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Syllabus for

PROGRAMME:M.Sc.-Mathematics (Semester-I)

COURSE CODE-MHM- 413

COURSE TITLE: CLASSICAL MECHANICS AND CALCULUS OF VARIATIONS

L	T	P	Credits
5	1	0	6

CREDIT HOURS(PER WEEK): 6
TOTAL HOURS: 90 hrs.
MAXIMUM MARKS: 100

Time: 3Hrs **(Theory : 75**
Medium -English **Internal Assessment: 25)**

INSTRUCTIONS FOR PAPER SETTERS

1. The question paper will consists of five sections namely Section-A, which will be from entire syllabus (equally distributed from each unit), Section–B, C, D and E from Unit-I, II, III and IV, respectively.
2. Section–A will consists of eight short answer type questions, each of 2.5 marks. Students are to attempt any six.
3. Sections–B, C, D & E will consist of two questions each**(each question should be sudivided into two parts)**. Students are to attempt any four questions in total by selecting one question from each section. Each question carries 15marks.
4. Question paper should cover at least 40% article work from the recommended books.
5. Teaching time for this paper would be eight periods per week.

COURSE OBJECTIVES:

- The course will introduce the concepts of Lagrange's equation for holomonic and non holomonic constraints.
- The course is designed to introduce the applications of Lagrange's formulation and generalized coordinates.
- The course gives introduction of fundamental problems of calculus of variations and variational problems with moving boundaries.
- The course explains the concepts of variation of a functional and its properties.

COURSE CONTENT:

Unit-I

Generalized co-ordinates and generalized velocities, virtual work, generalized forces, Lagrange's equations for a holonomic dynamical system, conservative system, holonomic dynamical system for impulsive forces and their applications.

Unit-II

Kinetic energy as a quadratic function of velocities, theory of small oscillations, Functional, variation of functional and its properties, fundamental lemma of calculus of variation, Euler's equations, necessary and sufficient conditions for extremum, The Brachistochrone problem, Functionals dependent on higher order derivatives and several dependent variables.

Unit-III

Variational problems with fixed boundaries, Transversality conditions, Orthogonality conditions, Sturm-Liouville's theorem on extremals, one sided variations, Hamilton's principle, The principle of least action, Langrange's equations from Hamilton's principle.

Unit-IV

Variational Methods: The Ritz method, Kantorovich Method for Boundary value problems in ODE's & PDE's, Isoperimetric Problems.

BOOKS PRESCRIBED:

1. Chorlton, F.: Text Book of Dynamics.
2. Elsgolts, L: Differential Equations and the Calculus of Variations.
3. Gelfand,I.M. and Fomin, S.V.: Calculus of Variations.

COURSE OUTCOMES: On completing the course, the students will be able to:

- apply the classical mechanics approach to solve a mechanical problem.
- understand the concept of functional and determine stationary paths of a functional to deduce the differential equation for stationary paths.
- describe and understand the motion of a mechanical system using Lagrange Hamilton formalism.
- recognize the degrees of freedom and understand the concept of generalized coordinates.

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Syllabus for

PROGRAMME:M.Sc.-Mathematics (Semester-I)

COURSE CODE: MHM- 414

COURSE TITLE:COMPLEX ANALYSIS

L	T	P	Credits
5	1	0	6

CREDIT HOURS(PER WEEK): 6

TOTAL HOURS: 90 hrs.

Time: 3Hrs **MAXIMUM MARKS: 100**

Medium: English **(Theory : 75**

Internal Assessment: 25)

INSTRUCTIONS FOR PAPER SETTERS

1. The question paper will consists of five sections namely Section-A, which will be from entire syllabus (equally distributed from each unit), Section–B, C, D and E from Unit-I, II, III and IV, respectively.
2. Section–A will consists of eight short answer type questions, each of 2.5 marks. Students are to attempt any six.
3. Sections–B, C, D & E will consist of two questions each**(each question should be sudivided into two parts)**. Students are to attempt any four questions in total by selecting one question from each section. Each question carries 15marks.
4. Question paper should cover at least 40% article work from the recommended books.
5. Teaching time for this paper would be eight periods per week.

COURSE OBJECTIVES:

- The content of this course is designed to make the students understand the properties of analytic functions, concept of poles, singularities, residues, contour integration and conformal mappings and their applications.

COURSE CONTENT:

Unit–I

Functions of complex variables, continuity and differentiability. Analytic functions, Conjugate function, Harmonic function. Cauchy Riemann equations (Cartesian and Polar form). Construction of analytic functions, Complex line integral, Cauchy's theorem, Cauchy's integral formula and its generalized form.

Unit–II

Cauchy's inequality. Poisson's integral formula, Morera's theorem. Liouville's theorem, Power Series, Taylor's theorem, Laurent's theorem. Maximum Modulus Principle. Schwarz's lemma. Theorem on poles and zeros of meromorphic functions.

Unit–III

Zeros, Singularities, Residue at a pole and at infinity. Cauchy's Residue theorem, Jordan's lemma. Integration round Unit circle. Evaluation of integrals of the type of $\int_{-\infty}^{\infty} f(x)dx$ and integration involving many valued functions.

Unit–IV

Fundamental theorem of Algebra and Rouche's theorem. Argument principle. Conformal transformations. Bilinear transformations. Critical points, fixed points, cross-ratio. Problems on cross-ratio and bilinear transformation.

BOOKS RECOMMENDED:

1. Copson, E.T.: Theory of functions of complex variables.
2. Ahlfors, D. V.: Complex analysis.
3. Kasana, H.S. : Complex variables theory and applications.
4. Conway, J.B.: Functions of one complex variable
5. Shanti Narayan : Functions of Complex Variables.

COURSE OUTCOMES: On completing the course, the students will be able to:

- understand the properties of analytic functions.
- to understand the concept of poles, singularities, residues, contour integration and conformal mappings and their applications.

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Syllabus for

PROGRAMME:M.Sc.-Mathematics (Semester-I)

COURSE CODE-MHM- 415

COURSE TITLE: DIFFERENTIAL EQUATIONS

L	T	P	Credits
5	1	0	6

CREDIT HOURS(PER WEEK): 6

TOTAL HOURS: 90 hrs.

MAXIMUM MARKS: 100

Time: 3Hrs **(Theory : 75**

Medium -English **Internal Assessment: 25)**

INSTRUCTIONS FOR PAPER SETTERS

1. The question paper will consists of five sections namely Section-A which will be from entire syllabus (equally distributed from each unit), Section–B, C, D and E from Unit-I, II, III and IV, respectively.
2. Section–A will consists of eight short answer type questions, each of 2.5 marks. Students are to attempt any six.
3. Sections–B, C, D & E will consist of two questions each**(each question should be sudivided into two parts)**. Students are to attempt any four questions in total by selecting one question from each section. Each question carries 15marks.
4. Question paper should cover at least 40% article work from the recommended books.
5. Teaching time for this paper would be eight periods per week.

COURSE OBJECTIVES:

- Studemts will be able to know how to model the world in terms of differential equations, and how to solve those equations and interpret the solutions.
- Students will understand properties of solutions of differential equations is fundamental to much of contemporary science and engineering.
- Ordinary differential equations (ODE's) will help the students to deal with functions of one variable, which can often be thought of as time.

COURSE CONTENT:

Unit-I

Existence and uniqueness theorem for solution of the equation dy/dx = f(x,y), The method of successive approximation, general properties of solution of linear differential equation of order n, adjoint and self-adjoint equations, Total differential equations. Simultaneous differential equations, orthogonal trajectories, Sturm Liouville's boundary value problems. Sturm comparison and Separation theorems, Orthogonality solution.

Unit-II

Laplace Transform: Definition, existence, and basic properties of the Laplace transform, Inverse Laplace transform, Convolution theorem, Laplace transform solution of linear differential equations and simultaneous linear differential equations with constant coefficients.

Unit-III

Fourier Transform: Definition, existence, and basic properties, Convolution theorem, Fourier transform of derivatives and Integrals, Inverse Fourier transform, solution of linear ordinary differential equations, Complex Inversion formula.

Unit-IV

Special Functions: Solution, Generating function, recurrence relations and othogonality of Legendre polynomial, Bessel functions, Hermite and Laguerre polynomials.

BOOKS RECOMMENDED:

1. Piaggio, H.T.H.: Differential equations.
2. Ross, S.L.: Differential equations.
3. Sneddon, I. N. : Elements of partial differential equations.

COURSE OUTCOMES: On completing the course, the students will be able to:

- learn to express laws of nature with the help of differential equations.
- know how to model the world in terms of differential equations, and how to solve those equations and interpret the solutions.
- to focus on the equations and techniques most useful in science and engineering.
- understand properties of solutions of differential equations is fundamental to much of contemporary science and engineering.
  - learn to formulate, classify and transform first order partial differential equation into canonical forms.

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Syllabus for

PROGRAMME:M.Sc.-Mathematics (Semester-II)

COURSE CODE-MHM- 421

COURSE TITLE:REAL ANALYSIS –II

L	T	P	Credits
5	1	0	6

CREDIT HOURS(PER WEEK): 6

TOTAL HOURS: 90 hrs.

MAXIMUM MARKS: 100

Time: 3Hrs **(Theory : 75**

Medium -English **Internal Assessment: 25)**

INSTRUCTIONS FOR PAPER SETTERS

1. The question paper will consists of five sections namely Section-A which will be from entire syllabus (equally distributed from each unit), Section–B, C, D and E from Unit-I, II, III and IV, respectively.
2. Section–A will consists of eight short answer type questions, each of 2.5 marks. Students are to attempt any six.
3. Sections–B, C, D & E will consist of two questions each **(each question should be sudivided into two parts)**. Students are to attempt any four questions in total by selecting one question from each section. Each question carries 15marks.
4. Question paper should cover at least 40% article work from the recommended books.
5. Teaching time for this paper would be eight periods per week.

COURSE OBJECTIVES:

- The course objective is to enable students to understand Riemann Stieltjes integrability of a bounded function and prove a selection of theorems concerning integration.
- Students will recognize the difference between pointwise and uniform convergence of sequence and series of functions.
- Students will be familiar with the Riemann Stieltje’s integral which is generalization of the Riemann integral.
- Students will analyze the applications of Power series in the field of engineering i.e in spectrum analysis, radio, audio, and light applications.

COURSE CONTENT:

Unit-I

Sequence and Series of functions: Discussion of main problem, Uniform Convergence, Uniform Convergence and Integration, Uniform Convergence and Differentiation, Equicontinuous families of functions, Arzela’s Theorem, Weierstrass Approximation theorem.

Unit-II

Outer Measure, Lebesgue Measure, Properties of Measurable Sets, Non Measurable Sets, Measurable Functions: Definition & Properties of Measurable functions.

Unit-III

Characteristic functions, Step Functions and Simple Functions, Littlewood’s three Principles, Lebesgue Integral: Lebesgue Integral of bounded function, Comparison of Riemann and Lebesgue Integral, Integral of a non negative function, General Lebesgue Integral, Convergence in measure.

Unit-IV

Differentiation and Integration: Differentiation of monotone functions, Differentiation of an integral, Absolute Continuity.

Books Recommended:

1. Walter Rudin :Principles of Mathematical Analysis (3rd edition) McGraw Hill Ltd. Ch. 7 (7.1-7.27)
2. Royden, H.L. and Fitzpatrik, P.M. :Real Analysis, Macmillan Co. (Ch. 3, 4, 5 excluding section 2, 5)

COURSE OUTCOMES: On completing the course, the students will be able to:

- study the behavior of sequences and series of functions.
- get familiar with the Riemann Stieltje's integral which is generalization of the Riemann integral.
- analyze the applications of Power series in the field of engineering i.e in spectrum analysis, radio, audio, and light applications.
- understand Riemann Stieltjesintegrability of a bounded function and prove a selection of theorems concerning integration.
- recognize the difference between pointwise and uniform convergence of sequence and series of functions, equicontinuous families of functions, Arzela Ascoli's theorem and Weierstrass Approximation Theorem .

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Syllabus for

PROGRAMME:M.Sc.-Mathematics (Semester-II)

COURSE CODE-MHM- 422

COURSE TITLE: ALGEBRA –II

L	T	P	Credits
5	1	0	6

CREDIT HOURS(PER WEEK): 6

TOTAL HOURS: 90 hrs.

MAXIMUM MARKS: 100

Time: 3Hrs **(Theory : 75**

Medium -English **Internal Assessment: 25)**

INSTRUCTIONS FOR PAPER SETTERS

1. The question paper will consists of five sections namely Section-A, which will be from entire syllabus (equally distributed from each unit), Section–B, C, D and E from Unit-I, II, III and IV, respectively.
2. Section–A will consists of eight short answer type questions, each of 2.5 marks. Students are to attempt any six.
3. Sections–B, C, D & E will consist of two questions each **(each question should be sudivided into two parts)**. Students are to attempt any four questions in total by selecting one question from each section. Each question carries 15marks.
4. Question paper should cover at least 40% article work from the recommended books.
5. Teaching time for this paper would be eight periods per week.

COURSE OBJECTIVES:

- To have an idea about the concept of ring.
- To study various properties of rings and subrings.
- To get familiar with the concept of modules.

COURSE CONTENT:

Unit-I

Rings, Subrings, Ideals, Factor Rings, Homomorphism, Integral Domains. Maximal and prime ideals.

Unit-II

The field of Quotients of an integral domain. Principal Ideal domains, Euclidean Rings. The ring of Gaussian Integers, Unique Factorization domains, Polynomial Rings, Gauss's theorem and irreducibility of a polynomial.

Unit-III

Extension Fields: Finite and Infinite, Simple and Algebraic Extensions, Splitting fields: Existence and uniqueness theorem. Separable and inseparable extensions, perfect fields, finite fields.

Unit-IV

Existence of $GF(p^n)$, construction with straight edge ruler and compass, Galois Theory: Group of automorphisms of a field. Normal extensions and Fundamental Theorem of Galois theory. Symmetric rational functions, Solvability by radicals.

Chairperson, BoS in Mathematics

BOOKS RECOMMENDED:

1. Herstein, I.N. : Topics in Algebra, Willey Eastern 1975.
2. Fraleigh, J. B. : An Introduction to Abstract Algebra.
3. Surjit Singh : Modern Algebra.
4. Bhattacharya, P.B., Jain, : Basic Abstract Algebra (1997); Ch-14 (Sec. 1-5) S.K. &Nagpal S.R.

COURSE OUTCOMES: On completing the course, the students will be able to:

- use ring theory in wide areas of current research in mathematics, computer science and mathematical/theoretical physics.
- introduce themselves with the concepts and develop working knowledge on simple ring and ring homomorphism.
- know the structure of rings, their representations, modules, special classes of rings (group rings, division rings, and universal enveloping algebras).
- deal with developments of commutative ring theory, which is a major area of modern mathematics.
- appreciate the significance of unique factorization in rings and integral domains.

Khalsa College Amritsar

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Syllabus for

PROGRAMME:M.Sc.-Mathematics (Semester-II)

COURSE CODE-MHM- 423

COURSE TITLE:NUMBER THEORY

L	T	P	Credits
5	1	0	6

CREDIT HOURS(PER WEEK): 6

TOTAL HOURS: 90 hrs.

Time: 3Hrs
Medium: English

MAXIMUM MARKS: 100
(Theory : 75
Internal Assessment: 25)

INSTRUCTIONS FOR PAPER SETTERS

1. The question paper will consists of five sections namely Section-A, which will be from entire syllabus (equally distributed from each unit), Section–B, C, D and E from Unit-I, II, III and IV, respectively.
2. Section–A will consists of eight short answer type questions, each of 2.5 marks. Students are to attempt any six.
3. Sections–B, C, D & E will consist of two questions each **(each question should be sudivided into two parts)**. Students are to attempt any four questions in total by selecting one question from each section. Each question carries 15marks.
4. Question paper should cover at least 40% article work from the recommended books.
5. Teaching time for this paper would be eight periods per week.

COURSE OBJECTIVES:

- The content of this course is designed to make the students understand the various types of numbers and their properties.
- It will help the students to use various arithmetic functions and the concept of congruences to solve various arithmetic problems.
- Students will analyze the concept of continued fractions and Pythagorean triplets and insolvability of Diophantine equations.

COURSE CONTENT:

Unit-I

Simultaneous Linear Congruences, Chinese Remainder theorem with applications, Wolsten-Holme's theorem, Lagrange's proof of Wilson theorem, Fermat numbers, The order of an integer modulo n. Primitive roots, Existence and number of primitive roots.

Unit-II

Indices and their applications, Quadratic residues , Euler's criterion, Product of quadratic residues and quadratic non-residues, The Legendre symbol and its properties, Gauss's Lemma, Quadratic reciprocity law, Jacobian symbol and its properties..

Unit-III

Arithmetic functions $\tau(n)$, $\sigma(n)$, $\sigma_k(n)$, $\mu(n)$, Perfect numbers, Mobius inversion formula, Diophantine equation $x^2 + y^2 = z^2$ and its applications to $x^n + y^n = z^n$ when $n = 4$.,Criterion for an integer to be expressible as sum of two squares and sum of four squares

Unit-IV

Farey series, Farey dissection of a circle and its applications to approximations of irrationals by rationals, Finite and Infinite simple continued fractions, periodic and purely periodic continued fractions, Lagrange's Theorem on periodic continued fractions. Applications to Pell's equation. The fundamental solution of Pell's equation.

BOOKS RECOMMENDED:

1. Hardy, G.H. and Wright, Herbert, S. : Theory of Numbers.
2. Niven, Ivan and Zuckerman, E.M. : An introduction to number theory.
3. Burton, David M. : Elementary Number Theory, McGraw Hill 2002.

COURSE OUTCOMES: On completing the course, the students will be able to:

- form the bridge between pure mathematics and applied mathematics.
- apply Number Theory in mathematics as well in practical applications such as security system like in banking securities, coding theory, barcodes and memory management systems.
- understand the various types of numbers and their properties.
- use various arithmetic functions and the concept of congruences to solve various arithmetic problems.
- analyze the study of integers and integer-valued functions.

Khalsa College, Amritsar

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Syllabus for

PROGRAMME:M.Sc.-Mathematics (Semester-II)

COURSE CODE-MHM- 424

COURSE TITLE: DIFFERENTIAL GEOMETRY

L	T	P	Credits
5	1	0	6

CREDIT HOURS(PER WEEK): 6

TOTAL HOURS: 90 hrs.

MAXIMUM MARKS: 100

Time: 3Hrs **(Theory : 75**

Medium -English **Internal Assessment: 25)**

INSTRUCTIONS FOR PAPER SETTERS

1. The question paper will consists of five sections namely Section-A, which will be from entire syllabus (equally distributed from each unit), Section–B, C, D and E from Unit-I, II, III and IV, respectively.
2. Section–A will consists of eight short answer type questions, each of 2.5 marks. Students are to attempt any six.
3. Sections–B, C, D & E will consist of two questions each**(each question should be sudivided into two parts)**. Students are to attempt any four questions in total by selecting one question from each section. Each question carries 15marks.
4. Question paper should cover at least 40% article work from the recommended books.
5. Teaching time for this paper would be eight periods per week.

COURSE OBJECTIVES:

- The aim of this course is to get the students familiar with curvature and torsion of space curves, the relation of tangent planes, principle normals and binormals, the intrinsic and non-intrinsic properties of surfaces and geodesics, tensors analysis and its applications.

COURSE CONTENT:

Unit-I

Notation and summation convention, transformation law for vectors, Kronecker delta, Cartesian tensors, addition, multiplication, contraction and quotient law of tensors. Differentiation of Cartesians tensors, metric tensor, contra-variant, covariant and mixed tensors, Christoffel symbols. Transformation of christoffel symbols and covariant differentiations of a tensor.

Unit-II

Theory of Space Curves: Tangent, principal normal, bi-normal, curvature and torsion. Serret-Frenet formulae. Contact between curves and surfaces. Locus of centre of curvature, spherical curvature, Helices. Spherical indicatrix, Bertrand curves.

Unit-III

Surfaces, envelopes, edge of regression, developable surfaces, two fundamental forms. Curves on a surface, Principle Directions, Lines of Curvature, Principal Curvatures, Mainardi-Codazzi equations.

Unit-IV

Geodesics, Differential Equation of Geodesic, torsion of Geodesic, Geodesic Curvature, Clairaut's theorem, Gauss- Bonnet theorem, Joachimsthal's theorem, Geodesic Mapping, Tissot's theorem.

Chairperson, BoS in Mathematics

Books Recommended:

1. Lass, H.: Vector and Tensor Analysis
2. Shanti Narayan: Tensor Analysis
3. Weather burn, C.E.: Differential Geometry
4. Willmore, T.J.: Introduction to Differential Geometry
5. Bansi Lal : Differential Geometry

COURSE OUTCOMES: On completing the course, the students will be able to:

- familiar with curvature and torsion of space curves, the relation of tangent planes, principle normals and binormals.
- know the intrinsic and non-intrinsic properties of surfaces and geodesics, tensors analysis and its applications.

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Khalsa College, Amritsar

(An Autonomous College)

Syllabus for

PROGRAMME:M.Sc. Mathematics

(Semester-II)

COURSE CODE-MHM- 425

COURSE TITLE: PARTIAL DIFFERENTIAL EQUATIONS AND INTEGRAL EQUATIONS

L	T	P	Credits
5	1	0	6

CREDIT HOURS(PER WEEK): 6

TOTAL HOURS: 90 hrs.

MAXIMUM MARKS: 100

Time: 3Hrs **(Theory : 75**

Medium -English **Internal Assessment: 25)**

INSTRUCTIONS FOR PAPER SETTERS

1. The question paper will consists of five sections namely Section-A which will be from entire syllabus (equally distributed from each unit), Section–B, C, D and E from Unit-I, II, III and IV, respectively.
2. Section–A will consists of eight short answer type questions, each of 2.5 marks. Students are to attempt any six.
3. Sections–B, C, D & E will consist of two questions each**(each question should be sudivided into two parts)**. Students are to attempt any four questions in total by selecting one question from each section. Each question carries 15marks.
4. Question paper should cover at least 40% article work from the recommended books.
5. Teaching time for this paper would be eight periods per week.

COURSE OBJECTIVES:

- The objective of this course is to provide students an understanding of Laplace and Fourier Transforms and enable them to apply these for solving simultaneous, linear and partial differential equations.
- The concept of Volterra and Fredholm integral equations and solutions of these equations using various methods.

COURSE CONTENT:

Unit-I

Partial Differential Equations of First Order: origin of first order partial differential equations. Cauchy problem of first order equations. Integral surface through a given curve. Surface orthogonal to given system of surfaces. Non linear p.d.e of first order, Charpit's method and Jacobi's method. Partial differential equations of the 2nd order. Origin of 2nd order equations.
Linear p.d.e. with constant coefficients and their complete solutions.

Unit-II

Second order equation with variable coefficient and their classification and reduction to standard form. Solution of linear hyperbolic equation. Non-linear equations of second order, Monge's Method. Solution of Laplace, wave and diffusion equations by method of separation of variables and Fourier transforms. Green function for Laplace, waves and diffusion equation.

Unit-III

Volterra Equations : Integral equations and algebraic system of linear equations. Volterra equation L2 Kernels and functions. Volterra equations of first & second kind. Volterra integral equations and linear differential equations.

Unit-IV

Fredholm equations, solutions by the method of successive approximations. Neumann's series. Fredholm's equations with

Pincherte-Goursat Kernel's, The Fredholm theorem (Scope same in chapters I and II excluding 1.10 to 1.13 and 2.7 of integral equations by F.G. Tricomi's.

BOOKS PRESCRIBED:

1. Tricomi, F.G. : Integral Equation (Ch. I and II)
2. Kanwal R, P : Linear Integralequations
3. S.G. Mikhlin : Integral equations
4. Pinckus, A. and Zafrany, S.: Fourier Series and Integral Transforms

COURSE OUTCOMES: On completing the course, the students will be able to:

- prepare themselves with mathematical tools and techniques that are required in advanced courses offered in the applied mathematics and engineering problems.
- apply concept of mathematical methods in diverse areas of science and technology such as electric analysis, communication engineering,solution of partial differential operation.
- learn to solve the Integral equations which are encountered in various problems including radiative transfer, and the oscillation of a string, membrane, or axle.
- understand the concept of Laplace and Fourier Transforms and enable them to apply these for solving simultaneous, linear and partial differential equations.
- interpret the concept of Volterra and Fredholm integral equations and find solutions of these equations using various methods