FACULTY OF SCIENCES

SYLLABUS FOR THE BATCH FROM THE YEAR 2023 TO YEAR 2025

Programme Code: MMAT

Programme Name:M.Sc. Mathematics

(Semester I-IV)

Examinations: 2023-2025

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**	**5-6**
MHM-412	Algebra-I	6	5	1	0	6	**75**	**-**	**25**	**100**	**7-8**
MHM-413	Classical Mechanics and Calculus of variations	6	5	1	0	6	**75**	**-**	**25**	**100**	**9-10**
MHM-414	Complex Analysis	6	5	1	0	6	**75**	**-**	**25**	**100**	**11-12**
MHM-415	Differential Equations	6	5	1	0	6	**75**	**-**	**25**	**100**	**13-14**
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**	**15-16**
MHM-422	Algebra-II	6	5	1	0	6	**75**	**-**	**25**	**100**	**17-18**
MHM-423	Number Theory	6	5	1	0	6	**75**	**-**	**25**	**100**	**19-20**
MHM-424	Differential Geometry	6	5	1	0	6	**75**	**-**	**25**	**100**	**21-22**
MHM-425	Partial Differential Equations and Integral Equations	6	5	1	0	6	**75**	**-**	**25**	**100**	**23-24**
Total		30	25	5	0	30	-	-	-	**500**	

SCHEME											
SEMESTER - III											
Course Code	**Course Name**	**Hours/Week**	**Credits**			**Total Credits**	**Max Marks**				**Page No.**
			L	**T**	**P**		**Th**	**P**	**IA**	**Total**	
Major Courses											
MHM-531	Functional Analysis-I	6	5	1	0	6	**75**	**-**	**25**	**100**	**25-26**
MHM-532	Topology-I	6	5	1	0	6	**75**	**-**	**25**	**100**	**27-28**
MHM-533	Advanced Linear Algebra	6	5	1	0	6	**75**	**-**	**25**	**100**	**29-30**
MHM-534	Statistics-I	6	5	1	0	6	**75**	**-**	**25**	**100**	**31-32**
MHM-535	MatLab	6	3	0	3	6	**37**	**38**	**T 13** **P 12**	**100**	**33-34**
Total		30	23	4	3	30	**-**	**-**	**-**	**500**	

SEMESTER - IV											
Course Code	**Course Name**	**Hours/Week**	**Credits**			**Total Credits**	**Max Marks**				**Page No.**
			L	**T**	**P**		**Th**	**P**	**IA**	**Total**	
Major Courses											
MHM-541	Functional Analysis-II	6	5	1	0	6	**75**	**-**	**25**	**100**	**35-36**
MHM-542	Topology-II	6	5	1	0	6	**75**	**-**	**25**	**100**	**37-38**
MHM-543	Discrete Mathematics and Graph Theory	6	5	1	0	6	**75**	**-**	**25**	**100**	**39-40**
MHM-544	Statistics-II	6	5	0	1	6	**60**	**15**	**T 20** **P 05**	**100**	**41-42**
MHM-545	Operations Research	6	5	1	0	6	**75**	**-**	**25**	**100**	**43-44**
Total		30	25	4	1	30	**-**	**-**	**-**	**500**	

Khalsa College, Amritsar

(An Autonomous College)

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
TIME: 3HRS.

MAXIMUM MARKS: 100
(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.

Khalsa College, Amritsar

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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.

Khalsa College, Amritsar

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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.

Khalsa College, Amritsar

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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 .

Khalsa College, Amritsar

(An Autonomous College)

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.

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 **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 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

(An Autonomous College)

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.

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.

- .

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

Khalsa College, Amritsar

(An Autonomous College)

Syllabus for

PROGRAMME:M.Sc. Mathematics

(Semester-III)

COURSE CODE-MHM- 531

COURSE TITLE: FUNCTIONAL ANALYSIS-I

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 the main concepts and fundamental methods of functional analysis to enable a student to treat various concrete problems based on Hilbert spaces.
- Students will study the conjugate spaces and their properties.
- Students will learn about compact linear operators and spectral theory.

Unit-I

Normed linear spaces, Banach spaces, subspaces, quotient spaces. Continuous linear transformations.

Unit-II

Equivalent norms,Finite dimensional normed linear spaces and compactness, Riesz Lemma, The conjugate space N*.

Unit-III

The Hahn-Banach theorem and its consequences. The natural imbedding of N into N**, reflexivity of normed spaces. Open mapping theorem, projections on a Banach space, closed graph theorem, uniform boundedness principle.

Unit-IV

Conjugate operators. L_p -spaces: Holder's and Minkowski,s inequalities, completeness of L_p-spaces.

BOOKS PRESCRIBED:

1 .G.F. Simmons: Introduction to Topology and Modern Analysis, Ch. 9, Ch.10 (Sections 46 - 51), Mc.Graw-Hill International Book Company, 1963.
2. Royden, H. L. & P.M. Fitzpatrik: Real Analysis, Ch 6 (Sections 6.1 -6.3), Macmillan Co. 1988.
3. Erwin Kreyszig : Introduction. to Functional Analysis with Applications John Wiley & Sons,1978.
4. Balmohan V. Limaye: Functional Analysis, New Age International Limited.
5 .P.K.Jain and O.P Ahuja : Functional Analysis, New Age International (P) Ltd Publishers, 2010
6. K. Chanrashekhra Rao : Functional Analysis, Narosa, 2002
7. D. Somasundram: A First Course in Functional Analysis, Narosa, 2006

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

- Learn the main concepts and fundamental methods of functional analysis to treat various concrete problems based on Banach spaces.
- study the certain classes of functions defined in functional spaces.
- learn the various examples of banach spaces.
- verify the requirements of a norm and completeness with respect to a norm.
- compute the spectrum of operators and classify the set into sub-classes.

Khalsa College, Amritsar

(An Autonomous College)

Syllabus for

PROGRAMME:M.Sc. Mathematics

(Semester-III)

COURSE CODE-MHM- 532

COURSE TITLE: TOPOLOGY-I

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 Objective:

- To prove basic results about completeness, compactness, connectedness and convergence within these structures.
- To demonstrate an understanding the concepts of topological sciences and their role in mathematics.

Unit-I

Topological Spaces, Basic concepts, closure, interior, exterior and boundary of a set. Dense sets, Closure operator [Kuratowski function] and Interior operator. Neighbourhoods and neighbourhood system, Coarser and finer topologies. Local bases, bases and sub – bases for a topological space. Convergence of a sequence. First and second countable spaces. Lindeloff spaces, Separable spaces.Sub-spaces, Hereditary properties.

Unit-II

Separated sets, Connected sets, Connected and disconnected spaces, Connectedness on real line. Components, Locally connected space. Totally disconnected space, Continuous functions, Restriction and extension of a mapping. Sequential continuity at a point. Invariants under a continuous mapping. Open and closed mappings. Homeomorphism and embedding. Topological properties.

Unit-III

Product of two spaces, The product of n spaces. Base for a finite product topology. General product spaces. Sub-base and base for product topology. Productive properties. Quotient spaces.

Unit-IV

Separation Axioms: T_0, T_1, T_2 – spaces. Regular spaces, T_3 – spaces, Normal spaces, T_4 – space. Tychonoff lemma, Urysohn lemma, Tietze extension theorem.

BOOKS RECOMMENDED:

1. T.O. Moore : Elementary general topology (Chapter 2 to 8).
2. J.L. Kelley : General Topology (Chapter 1to 5).
3. J.R. Munkres : Topology.
4. G.F. Simmons: Introduction to Topology and Modern Analysis.

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

- Understand the mathematical tools that are useful to applied mathematicians and to theoretical physicists.
- understand the various topological spaces and their properties, separation axioms, Tietz extension theorem and Tychnoff theorem.

Khalsa College, Amritsar

(An Autonomous College)

Syllabus for

PROGRAMME:M.Sc. Mathematics

(Semester-III)

COURSE CODE-MHM- 533

COURSE TITLE: ADVANCED LINEAR ALGEBRA

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 basic concepts of dual spaces and its general proofs.
- The course is designed to introduce the relationship of matrices and linear transformations and different classes of linear operators on inner product spaces and their structures.
- The course gives introduction of inner product spaces, orthogonal vectors, orthogonal sets and Gram Schmidt orthogonalization process.
- The course explains the concepts of bilinear and quadratic forms on vector spaces.

Unit-I

Linear Functionals, Dual spaces and Dual basis, The double dual, Subspaces invariant under linear operators, Characteristic and minimal polynomials, Eigen values and Eigen Vectors of Linear Operators.

Unit-II

Triangulation, Diagonalization, Jordan canonical form, Generalized eigen vectors, canonical basis, rational canonical form.

Unit-III

Bilinear forms, Self-Adjoint Operators, Sylvester's theorem, quadratic forms, Hermitian forms.

Unit-IV

Inner Product Spaces, The Gram-Schmidt Orthogonalization, orthogonal complements. The Adjoint of a Linear operator on an inner product space, Normal and Unitary Operators, Spectral Theorem.

BOOKS PRESCRIBED:

1. Hoffman, K. and Kunze, R.: Linear Algebra, Second Edition, Prentice Hall,1971

2. Axler, S.: Linear Algebra Done Right, Second Edition, Springer- Verlag,1997

3. Friedberg, S.H.Insel,A.J, Spence, L.E. : Linear Algebra, Fourth Edition Prentice Hall, 2003

4. Lang, S.: Linear Algebra, Third edition Springer-Verlag, 1987.

5. Sahai, Vivek and Bist, Vikas: Linear Algebra, Narosa Publishing House, 2008

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

• become familiar with the concepts of linear independence, basis, span, linear maps, the properties of linear transformations and orthogonal decomposition of inner product spaces.

• have a good knowledge of inner product spaces, and will be able to define and use the adjoint of a linear map on a finite-dimensional inner product space.

• construct the matrix of a bilinear form and to find index, rank and signature of a bilinear form.

• determine a linear operator is normal, unitary and orthogonal projection and to construct the spectral decomposition of normal and self-adjoint operators.

Khalsa College, Amritsar

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Syllabus for

PROGRAMME:M.Sc. Mathematics

(Semester-III)

COURSE CODE-MHM- 534

COURSE TITLE: STATISTICS-I

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.
6. Use of non-programable sceintific calculator is allowed.

COURSE OBJECTIVES:

• The main objective of this course is to provide students with the foundation of probabilistic and statistical analysis mostly used in varied applications in engineering and science like disease modeling, climate prediction networks etc.

• With this course learner will have good understanding of exploratory data analysis.

• Students will learn the differences between discrete distributions and continuous distribution.

Unit-I

Classical and axiomatic approach to the theory of probability, additive and multiplicative law of probability, conditional probability and Bayes theorem, Random variable, probability mass function, probability density function, cumulative distribution function

Unit-II

Two and higher dimensional random variables, joint distribution, marginal and conditional distributions, Stochastic independence, function of random variables and their probability density functions, Mathematical expectations and moments, moment generating function and its properties.

Unit-III

Chebyshev's inequality and its application, Stochastic convergence, central limit (Laplace Theorem, Linderberg-Levy's Theorem), Discrete Probability Distributions: Uniform hyper geometric, Binomial, Poisson, Geometric, Hyper geometric, Multinomial.

Unit-IV

Continuous probability distributions: Uniform, Exponential, Gamma, Beta, Normal distributions. Least square principle, correlation and linear regression analysis for bi-variate data, partial and multiple correlation coefficients, correlation ratio, association of attributes.

Books Recommended:

1. Hogg, R.V., Mckean, J.W. and Craig, A.T.: Introduction to Mathematical Statistics.

2. Mukhopadhyay, P : Mathematical Statistics.

3. Goon,A.M.,Gupta, M.K. &Dasgupta B. : An Outline of Statistical Theory Vol.-I.

COURSE OUTCOMES:

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

•acquaint with the foundation of probabilistic and statistical analysis, mostly used inengineering and science like disease modeling, climate prediction networks etc.

• have good understanding of exploratory data analysis. Learner will be able to write a short-report describing a simple statistical data set.

• become informed consumer of statistical information provided in newspaper, magazine and journals.

Khalsa College, Amritsar
(An Autonomous College)

Syllabus for
PROGRAMME:M.Sc. Mathematics
(Semester-III)
COURSE CODE-MHM- 535

COURSE TITLE: MATLAB THEORY

L	T	P	Credits
3	0	3	6

CREDIT HOURS(PER WEEK): 6
TOTAL HOURS: 90 hrs.
MAXIMUM MARKS: 100
Theory : 37
Theory Internal Assessment: 13
Practical:38
Practical Internal Assessment:12

Time: 3Hrs
Medium -English

INSTRUCTIONS FOR THE 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 1.5 marks. Students are to attempt any six.
3. Sections–B, C, D & E will consist of two questions each. Students are to attempt any four questions in total by selecting one question from each section. Each question carries 7marks.
4. Teaching time for this paper would be six periods per week.

COURSE OBJECTIVES:

- To acquire the knowledge of MATLAB technical computing environment.
- To develop a basic understanding of MATLAB for its usage in higher learning.
- To solve mathematical concepts and sketching of graphs in fraction of seconds. convert the theoretical concepts in matrices to algorithms in MATLAB for their applications in real.

Course Content:

Unit-I

Introduction to MATLAB,Applications of MATLAB, Basics of MATLAB, MATLAB windows, Input/Output formats, General Commands.

Unit-II

MATLAB console and Editor windows, arithmetical operations (+, -, *, /, ^), the commands such as ;, format(16), //.//, clear, clc, sqrt, %e, %pi, %i, disp, factorial, exp, log, log10, sin, cos, sec, csc, tan, cotg, asin, acos, asec, acsc, atan, acot, sinh, cosh, etc., array operations (.+, .-, .*, ./, .^).

Unit-III

MATLAB files, matrices and matrix operations, relational operators (==, <>,,<=,>=,%T,%F, &, | , ~) , strings“ ”, for loop, if and elseif commands, user defined functions, feval, eigen values & eigen vectors, solving linear equations using MATLAB

Unit-IV

Graphics using MATLAB (2D and 3D graphics), plotting graphs of elementary functions, plotting parametric curves (param3d) and surfaces (surf), handling graphics.

Books Recommended:

1. **A Concise Introduction to Matlab; William J.Palm III.**
2. **Getting Started with Matlab; Rudhra Pratap.**

MATLAB PRACTICAL

COURSE CONTENT:

List of Practical's (using any software):- (a) Operations on matrices using Matlab:

1. Addition of matrices
2. Subtraction of matrices
3. Multiplication of matrices
4. Inverse of matrices
5. Determinants of matrices
6. Eigen values and Eigen vectors of matrices
7. (a)Rank of matrices

(b) Plotting of graphs of function eax+b , log (ax + b), 1/(ax + b), sin(ax + b), cos(ax + b), |ax + b| and to illustrate the effect of a and b on the graph.

(c) Plotting the graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.

(d) Sketching parametric curves (e.g. Parabola, ellipse, hyperbola).

BOOKS PRESCRIBED:

1. Thomas, George B., and Finney Ross L. Calculus. Pearson Education, 9th Ed, 2010.

2. Strauss, M.J., and G.L. Bradley and K. J. Smith. Calculus. Delhi: Dorling Kindersley (India) P. Ltd. (Pearson Education), 3rd Ed, 2007.

3. Anton, H., and I. Bivens, and S. Davis. Calculus. Singapore: John Wiley and Sons (Asia) P. Ltd., 7th Ed. 2002.

4. Courant, R., and F. John. Introduction to Calculus and Analysis. New York: Springer-Verlag (Volumes I & II), 1989

COURSE OUTCOMES:

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

- develop a basic understanding of MATLAB for its usage in higher learning.
- have a precise direction from theoretical learning to computational techniques.
- solve mathematical concepts and sketching of graphs in fraction of seconds.

Khalsa College, Amritsar

(An Autonomous College)

Syllabus for

PROGRAMME:M.Sc. Mathematics

(Semester-IV)

COURSE CODE-MHM- 541

COURSE TITLE: FUNCTIONAL 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 objective of this course is to provide the main concepts and fundamental methods of functional analysis to enable a student to treat various concrete problems based on Hilbert spaces.
- Students will study the conjugate spaces and their properties.
- Students will learn about compact linear operators and spectral theory.

Unit-I

Inner product spaces, Hilbert spaces, orthogonal complements, orthonormal sets,

Unit-II

The conjugate space H*,Strong and weak convergence in finite and infinite dimensional normed linear spaces. Weak convergences in Hilbert spaces, weakly compact set in Hilbert spaces.

Unit-III

The adjoint of an operator, self adjoint operators, positive operators, normal operators, Unitary operators. Projections on a Hilbert space.

Unit-IV

Spectral Theorem for normal operators, Compact linear operators on normed spaces, properties of Compact linear operators.

BOOKS PRESCRIBED:

1. Simmon G.F.:Introduction to topology and Modern Analysis Ch.X (sections 52-59) Ch. XI (Sections 61-62) Mc Graw- Hill (1963) International Book Company.

2. Erwin Kreyszig: Introduction to Functional Analysis with Applications, John Wiley & Sons (1978).

3. Limaye, Balmohan V.: Functional Analysis, New Age International Limited, 1996.

4. Jain, P.K. & Ahuja, O.P.: Functional Analysis, New Age International (P) Ltd. Publishers, 2010

5. Chandrasekhra Rao, K.: Functional Analysis, Narosa, 2002.

6. Somasundram, D.: A First Course in Functional Analysis, Narosa, 2006

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

- Learn the main concepts and fundamental methods of functional analysis to enable a student to treat various concrete problems based on Hilbert spaces .
- Study functional spaces which play vital role in study of existence and uniqueness of solutions of differential equations, boundary value problems, optimization techniques etc.
- distinguish between Banach spaces and Hilbert spaces.
- classify operators into self-adjoint, unitary and normal operators.
- represent a bounded linear functional in terms of inner product.

Khalsa College, Amritsar

(An Autonomous College)

Syllabus for

PROGRAMME:M.Sc. Mathematics

(Semester-IV)

COURSE CODE-MHM- 542

COURSE TITLE: TOPOLOGY-II

L	T	P	Credits
5	1	0	6

CREDIT HOURS(PER WEEK): 6

TOTAL HOURS: 90 hrs.

MAXIMUM MARKS: 100

(Theory : 75

Internal Assessment: 25)

Time: 3Hrs

Medium -English

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 Objective

- To prove results of higher separation axioms
- To have and idea about the compact spaces, regular spaces,normal spaces.
- Understanding of directed sets and nets.

Unit-I

Higher Separation Axioms: Completely regular spaces. Tychonoff spaces, Completely normal space, T_5 – spaces. Metric spaces as Hausdorff regular, normal and completely normal space. Product of metric spaces.

Unit-II

Compact spaces, Compact sets, Subsets of compact space. Finite intersection property. Compactness of subsets of real line. Relation of compact spaces with Hausdorff spaces, Regular spaces and normal spaces, Sequentially compact spaces, Bolzano Weierstrass property. Countably compact spaces. Locally compact spaces. Compactness in terms of base element and sub – base elements. Tychonoff theorem. One point compactification.

Unit-III

The Stone-Čechcompactification, Evaluation mappings, Separate point family, Separate point and closed set family. Embedding lemma, Tychonoff cube, Embedding theorem, Metrization.

Urysohnmetrization theorem.

Unit-IV

Directed sets and nets. Convergence of a net in a space, Clustering of a net, nets and continuity, Nets in product spaces, Ultra nets. Compactness in term of nets, Topologies determined by nets. Filters and their convergence. Canonical way of converting nets to filters and vice-versa. Ultrafilters and compactness.

BOOKS RECOMMENDED:

1. T.O. Moore : Elementary general topology (Chapter 2 to 8).
2. J.L. Kelley : General Topology (Chapter 1to 5).
3. J.R. Munkres : Topology.
4. G.F. Simmons: Introduction to Topology and Modern Analysis**.**

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

- prove results of higher separation axioms
- Understand about the compact spaces, regular spaces,normal spaces.
- Understand directed sets and nets.

Khalsa College, Amritsar

(An Autonomous College)

Syllabus for

PROGRAMME:M.Sc. Mathematics

(Semester-IV)

COURSE CODE-MHM- 543

COURSE TITLE: DISCRETE MATHEMATICS AND GRAPH THEORY

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 gain knowledge about computing and mathematics appropriate to the discipline.
- To represent the problem using propositional logic and convert it as gates and truth table.
- To visualize the given problem as graphical representation.
- To get familiar with the concept of lattices.

UNIT-I

Partial order relations, Hasse diagram, Lattices: Lattices as partially ordered sets, properties, lattices as algebraic systems, sublattices, direct products, Homomorphism, some special lattices (complete, complemented, distributive lattices).

UNIT-II

Boolean Algebra: Boolean algebra as lattices, Boolean identities, sub-algebra, direct product, Homomorphism, join-irreducible elements, atoms and minterms, Boolean forms and their equivalence, sum of product & product of sum canonical forms, application of Boolean algebra in switching circuits.

UNIT-III

Graph Theory: Definition, undirected graphs, paths, circuits, cycles, subgraphs, induced subgraphs, degree of vertex, connectivity, planner graph, complete, bipartite complete graph, matrix representation of graph, adjacency and incident matrix for graph.

UNIT-IV

Euler's theorem on the existence of Eulerian paths and circuits, Trees: Rooted tree, search tree, tree traversals, spanning trees, minimal spanning trees, Kruskal's algorithm, colouring of the graph, four-colour problem, chromatic polynomials.

BOOKS RECOMMENDED :

1. Trambley,J.P. and Manohar,R : Discrete mathematical structure with applications to computer science
2. Liu C.L. : Elements of Discrete Mathematics.
3. Alan Doer : Applied discrete structure for computer science.
4. Deo, N. : Graph theory with applications to engineering and computer sciences.

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

- apply laws of set theory, recurrence relations, grammar and language, logic and propositional calculus in various fields of computer science, electronic engineering and medical sciences.
- explore and apply the basic method in subsequent courses in the design and analysis algorithms, computability theory and software engineering.
- Apply the concepts of discrete mathematics in analyzing, designing and simplifying electronic devices

Khalsa College, Amritsar
(An Autonomous College)

Syllabus for
PROGRAMME:M.Sc. Mathematics
(Semester-IV)
COURSE CODE-MHM- 544

COURSE TITLE: STATISTICS-II

L	T	P	Credits
5	0	1	6

CREDIT HOURS(PER WEEK): 6
TOTAL HOURS: 90 hrs.
MAXIMUM MARKS: 100
(Theory : 60
Internal Assessment Theory:20
Practical marks:15
Practical Internal Assessment Marks:05)

Time: 3Hrs
Medium -English

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 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 12 marks.
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.
6. Use of non-programable scientific calculator is allowed.

COURSE OBJECTIVES:

- To understand the concept of estimation of parameters.
- To get familiar with testing of hypothesis.
- To learn the use of various statistical tests to solve practical problems.

UNIT-I

Sampling Distributions: Chi-square, t and F-distributions with their properties, distribution of sample mean and variance, distribution of order statistics and sample range from continuous populations.

UNIT-II

Point Estimation: Estimators, Properties of unbiasedness, consistency, sufficiency, efficiency, completeness, uniqueness, methods of estimation, Testing of Hypothesis: Null hypothesis and its test of significance, p-value simple and composite hypothesis, M.P. test, UMP test

UNIT-III

Likelihood tests (excluding properties of Likelihood Ratio Tests), Applications of Sampling Distributions: Test of mean and variance in the normal distribution, Tests of single proportion and equality of two proportions, Chi-square test, t-test, F-test.

UNIT-IV

Linear Estimation: Gauss Markoff linear models, BLUE, Gauss Markoff Theorem, estimation with linear restrictions on parameters, residual sum of squares, analysis of variance, analysis of variance for one way and two way classified data with one observation per cell.

BOOKS RECOMMENDED:

1. Hogg R.V., Mckean, J.W. and Craig A.T. : Introduction to Mathematical Statistics
2. Hoel P.G. : Introduction to Mathematical Statistics
3. Mukhopadhyay,P : Mathematical statistics
4. Goon,A.M.,Gupta M.K. & Das Gupta B. : Fundamental of statistic, Vol. I
5. Goon,A.M.,Gupta M.K. & Das Gupta B. : An outline of statistical theory, Vol. I

COURSE OUTCOMES: On successful completion of this course, students will be able to:

- Solve the problems based on estimation and to test the efficiency of various estimators.
- Handle the practical problems using hypothesis testing.
- Solve the practical problems using t-test, F-test, Z-test, chi-square test for various types of data.

Khalsa College, Amritsar

(An Autonomous College)

Syllabus for

PROGRAMME:M.Sc. Mathematics

(Semester-IV)

COURSE CODE-MHM- 545

COURSE TITLE:OPERATIONS RESEARCH

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 graphical solutions of linear programming problems with two variables, and illustrate the concept of convex set and extreme points.
- The course is designed to introduce the relationships between the primal and dual problems, and to understand sensitivity analysis.
- The course gives introduction of simplex method.
- The course explains the detailed procedure of transportation, assignment and two-person zero-sum game problems

Unit-I

The linear programming problem, properties of a solution to the linear programming problem, generating extreme point solution, simplex computational procedure, development of minimum feasible solution, the artificial basis techniques, a first feasible solution using slack variables, two phase and Big-M method with artificial variables.

Unit-II

General Primal-Dual pair, formulating a dual problem, primal-dual pair in matrix form, Duality theorems, complementary slackness theorem, duality and simplex method, economic interpretation of duality, dual simplex method.General transportation problem, transportation table, duality in transportation problem, loops in transportation tables, LP formulation, solution of transportation problem, test for optimality, degeneracy, transportation algorithm (MODI method), time- minimization transportation problem.

Unit-III

Mathematical formulation of assignment problem, assignment method, typical assignment problem, the traveling salesman problem. Game Theory: Two-person zero-sum games, maximin- minimax principle, games without saddle points(Mixed strategies), graphical solution of 2× n and m× 2 games, dominance property, arithmetic method of n× n games, general solution of m× n rectangular games.

Unit-IV

Queueing Theory: Introduction, Queueing System, elements of queueing system, distributions of arrivals, inter arrivals, departure and service times. Classification of queueing models, single service queueing model with infinite capacity (M/M/1): (∞/FIFO), Queueing Models:(M/M/1): (N/FIFO), Generalized Model: Birth-Death Process.

BOOKS RECOMMENDED:

1. Gass, S. L. : Linear Programming
2. Hadley, G. : Mathematical Programming
3. Kambo, N. S. : Mathematical Programming
4. Panneerselvam, R. : Operations Research

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

- understand special situations such as redundancy, infeasibility, unboundedness and alternate optimal solutions in linear programming problems.
- acquire quantitative, analytical tools to support decision making in the optimization of economic processes.
- develop the functional mathematical relationship that describe decision variables, objective function, constraints of the problem and non-negativity conditions.
- decide optimum allocation of various limited resources to arrive at the optimum decision by using various techniques like assignment, transportation problems etc.
- extend their knowledge of basic optimization techniques to do interesting research work on these types of optimization techniques.