R.E. Society's

R. P. Gogate College of Arts & Science and R. V. Jogalekar College of Commerce, Ratnagiri (Autonomous)

Master of Science (M.Sc.) Mathematics Programme

Two Year Integrated Programme

Four Semesters

Syllabus for Semester : I & II

Under Choice Based Credit System (CBCS)

To be implemented from Academic Year 2023-2024

Name of Programme	**M.Sc. Mathematics**
Level	PG
No of Semesters	04
Year of Implementation	**2023-24**
Programme Specific Outcomes (PSO)	1) Students demonstrate an understanding of commonly used facts, formulas, terminology, and definitions. Students can write well-constructed and logical mathematical proofs. 2)Studentswill get advanced knowledge of principles, methods andclear perception of innumerous power of mathematical ideas and tools. 3) Student will get knowledge about both pure as well as applied mathematics branches
Relevance of PSOs to the local, regional, national, and global developmental needs (200 words)	The study of M.Sc. mathematics helps to 1)inculcate critical thinking to carry out scientific investigation objectively without being biased, prepare students for pursuing research or careers in industry in mathematical sciences. 2)Create awareness to become an enlightened citizen with commitment to deliver one's responsibilities. 3)to create Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources 4) Enhance Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination in a smooth and efficient way.

Master of Science (M.Sc) Programme
Under Choice Based Credit System (CBCS)
Course Structure

M.Sc I Subject- Mathematics
(To be implemented from Academic Year 2023-24)

M.Sc I Subject- Mathematics

Course code	Semester I	Credits	Course code	Semester II	Credits
	Major Mandatory			Major Mandatory	
PSMT101	Algebra I	4	PSMT201	Algebra II	4
PSMT102	Analysis I	4	PSMT202	Topology	4
PSMT103	Complex Analysis	4	PSMT203	Analysis II	4
PSMT104	Discrete Mathematics I	2	PSMT204	Partial Differential Equation	2
	Major Electives			Major Electives	
PSMT105 PSMT106	Ordinary Differential Equations OR Business statistics	4	PSMT205 PSMT206	Probability Theory OR Elementary number theory	4
PSMT107	Research Methodology	4	PSMT207 PSMT208	On Job Training OR Field Project	4
Total Credits		22	Total Credits		22

Teaching pattern for theory courses –
1. Four lectures per week for the courses of 4 credits
2. Two lectures per week for courses of 2 credits.
3. Each lecture will be of 60 minutes.

Note: for Sem I student will select one elective paper from the follwing-
1)Ordinary Differential equations
2) Business statistics
forSem II student will select one elective paper from the follwing-
1) Prbability theory
2) Elementary number theory

Revised syllabus of courses of Master in Science I (M.Sc. I) -semester I with effect from academic year 2023-24

Course Code	Semester I	Credits
	Major Mandatory	
PSMT101	Algebra I	4
PSMT102	Analysis I	4
PSMT103	Complex Analysis	4
PSMT104	Discrete Mathematics I	2
	Major Electives	
PSMT105 PSMT106	Ordinary Differential Equations OR Business statistics	4
PSMT107	Research Methodology	4
Total Credits		22

Syllabus for M.Sc. Mathematics Autonomous from the year 2023-24

Name of the Course	Algebra I
Course Code	PSMT101
Class	M.Sc. I
Semester	I
No of Credits	04
Nature	Theory
Type	Major mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	Linear algebra is the branch of mathematics concerning vector spaces, often finite or countable infinite dimensional, as well as linear mappings between such spaces. Such an investigation is initially motivated by a system of linear equations in several unknowns. Such equations are naturally represented using the formalism of matrices and vectors. Linear algebra is central to both pure and applied mathematics. For instance, abstract algebra arises by relaxing the axioms of a vector space, leading to a number of generalizations. Functional analysis studies the infinite-dimensional version of the theory of vector spaces. Combined with calculus, linear algebra facilitates the solution of linear systems of differential equations. Techniques from linear algebra are also used in analytic geometry, engineering, physics, natural sciences, computer science, computer animation, and the social sciences (particularly in economics). Because linear algebra is such a well-developed theory, nonlinear mathematical models are sometimes approximated by linear ones.

Nomenclature: Algebra I

Course Outcomes:

CO1: Students will be able to define dual space and double dual, Annihilator of a subspace, to find dimensions of a finite dimensional vector space .

CO2: Students will be able to solve a system of equations using determinants.

CO3: Students will be able to define Nilpotent operators, invariant subspaces

CO4: Students will be able to identify adjoint of a linear operator, unitary operators, self adjoint operators, normal operators , to find rank of a bilinear forms,
Sylvesters law to solve the problem**.**

Unit No.	**Units**	**No. of lectures**
1	Dual Spaces	15
2	Determinants & Characteristic Polynomial	15
3	Triangulation of matrices	15
4	Bilinear forms	15

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Dual Spaces**	1.1 Vector spaces, linearly independent vectors, basis of a vector space, dimensions of a vector space 1.2 kernel& image of a linear transformation, Rank - Nullity theorem, relation of linear transformation & matrices 1.3 Linear functionals, dual spaces, dual basis, annihilator, double dual. 1.4 Transpose of a linear transformation, relation between rank of linear transformation and its transpose	**15**
II	**Determinants & Characteristic Polynomial**	2.1 Rank of matrix, Matrix of a linear transformation, similar matrices 2.2 Determinants as alternating n - forms, existence & uniqueness, Laplace expansion of determinant 2.3 determinants& linear transformations, determinant of linear transformation, solution of system of linear transformation by Cramer's rule 2.4 Eigenvalues and eigen vectors of a linear transformation, characteristic polynomial, minimal polynomial, Cayley Hamilton theorem	**15**
III	**Triangulation of matrices**	3.1 Triangulable, diagonalizable linear operators 3.2 Nilpotent transformation 3.3 Jordan canonical form	**15**
IV	**Bilinear forms**	4.1 Inner product spaces, orthogonal basis, Gram - schmidt process 4.2 Adjoint of linear operator, normal operator, self adjoint	**15**

		operator, unitary operator 4.3 Bilinear forms, rank of bilinear form, non - degenerate bilinear form 4.4 Symmetric bilinear form, orthogonal basis & Sylvester's law, signature of symmetric bilinear form	

Learning Resources recommended:

1. Hoffman K and Kunze R: Linear Algebra, Prentice-Hall India.
2. I.N.Herstein: Topics in Algebra, Wiley-India.
3. Serge Lang: Linear Algebra, Springer-Verlag Undergraduate Text in Mathematics.
4. Michael Artin: Algebra, Prentice-Hall India.
5. N.S. Gopalkrishnan: University Algebra, New Age International, third edition,2015.

Evaluation Pattern

A. Continuous Internal Evaluation (40 marks)

Method	**Marks**
Online / Class Tests Online test of MCQs / Short Answer Questions / Long Answer Questions	20
Assignments / seminars /viva	10
Attendance and overall performance	10

B. Semester End Evaluation (60 M)

Comprehensive written examinationof 2-hour duration will be conducted at the end of each semester to evaluate students' understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions or fill in the blanks or one line sentence, short answer questions and descriptive type questions, problems.

Question Paper Pattern (60M – 2 hours)

Q. No	Unit	Marks
1	I	12
2	II	12
3	III	12
4	IV	12
5	I II III IV	03 03 03 03

Syllabus for M.Sc. Mathematics Autonomous from the year 2023-24

Name of the Course	Analysis I
Course Code	PSMT102
Class	M.ScI
Semester	1
No of Credits	4
Nature	Theory
Type	Major mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	Real analysis develops a rigorous theory of integration which extends the familiar notions of calculus to a broader class of functions, and in particular provides a foundation for many concepts in probability. Real analysis is a branch of mathematics that studies the properties and applications of real numbers, sequences, functions, and other mathematical objects. It has many practical applications in fields such as engineering, economics, physics and computer science.

Nomenclature: Analysis I

Course Outcomes:

CO1 - Students will be able to understand Euclidean space, inner product on Euclidean space, norm on Euclidean space,properties of operator norm , properties of compactness of the set in R^n ,examples on open sets,closed sets, boundary of sets in Euclidean space ,

CO2: Students will be able to solve the examples on total derivative, partial derivative, Directional derivatives,application of derivatives such as chain rule,

CO3 :Students will be able to solve the examples onapproximation of a differentiable function localized at a point,mean value theorem,contraction mapping theorem.

CO4: Students will be able to solve the examples on Riemann integration

Unit No.	**Units**	**No. of lectures**
1	Euclidean Space	15
2	Differentiable Functions	15
3	Inverse Function Theorem and Implicit Function Theorem	15
4	Riemann Integration	15

Curriculum:

Unit	Title	Learning Points	No of Lectures
1	**Euclidean Space**	1.1 norm and inner product on Euclidean space and its properties 1.2 standard topology on Euclidean space 1.3 compactness,connectedness, continuity.	**15**
2	**Differentiable Functions**	2.1 differentiability on euclidean space 2.2 Applications of chain rule 2.3 results of total derivative, directional derivative, partial derivative. 2.4 continuously differentiable functions.	**15**
3	**Inverse Function Theorem and Implicit Function Theorem**	3.1 Mean value theorem, Taylor's expansion 3.2 maxima, minima, saddle Points. 3.2Contraction mapping theorem. Inverse function theorem, Implicit function theorem	**15**
4	**Riemann Integration**	4.1Riemann Integrable functions 4.2 Measure zero sets, Lebesgues Theorem. 4.3Fubini's Theorem and Applications.	**15**

Learning Resources recommended:

1. C. C. Pugh, Mathematical Analysis, Springer UTM.
2. A. Browder, Mathematical Analysis and Introduction, Springer.
3. T. Apostol, Mathematical Analysis, Narosa.
4. W. Rudin, Principals of Mathematical Analysis, McGraw-Hill India.
5. M. Spivak, Calculus on Manifolds, Harper-Collins Publishers

Evaluation Pattern

A. ContinuusInternalEvaluation(40 marks)

Method	**Marks**
Online / Class Tests Online test of MCQs / Short Answer Questions / Long Answer Questions	20
Assignments / seminars /viva	10
Attendance and overall performance	10

B. Semester End Evaluation ((60 M)

Comprehensive written examinationof 2-hour duration will be conducted at the end of each semester to evaluate students' understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions or fill in the blanks or one line sentence, shortanswer questions, and descriptive type questions, problems.

Question Paper Pattern(60M – 2 hours)

Q. No	Unit	Marks
1	I	12
2	II	12
3	III	12
4	IV	12
5	I II III IV	03 03 03 03

Syllabus for M.Sc. Mathematics Autonomous from the year 2023-24

Name of the Course	Complex Analysis
Course Code	PSMT 103
Class	M.Sc. I
Semester	I
No of Credits	4
Nature	Theory
Type	Major mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	Complex analysis, traditionally known as the theory of functions of a complex variable, is the branch of mathematical analysis that investigates functions of complex numbers. It is helpful in many branches of mathematics, including algebraic geometry, number theory, analytic combinatorics, applied mathematics; as well as in physics, including the branches of hydrodynamics, thermodynamics, and particularly quantum mechanics. By extension, use of complex analysis also has applications in engineering fields such as nuclear, aerospace, mechanical and electrical engineering.

Nomenclature: Complex Analysis

Course Outcomes:

CO1. In this course the students will learn about series of functions and power series. The concept of radius of convergence will be introduced and calculated

CO2. This course gives insight of complex integration which is different from integration of real valued functions. In particular, Cauchy integral formula will be proved.

CO3. The students will learn that if a function is once (complex) differentiable then it is infinitely many times differentiable.

CO4. Student wil study properties of Mobius transformations that have a wide variety of applications ,Cauchy-Goursattheorem, Morera's theorem, Rouche's theorem and Casorati-Weierstrass theorem.

Unit No.	Units	No. of lectures
1	Holomorphic Functions	15
2	Contour Integrationand Cauchy-Goursat theorem	15
3	Holomorphic Functions and Their Properties	15
4	Residue Calculus and Mobius Transformation	15

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Holomorphic Functions**	1.1 Stereographic projection 1.2 Sequence and series of complex numbers 1.3 Power series of complex numbers	**15**
II	**Contour Integrationand Cauchy-Goursattheorem**	2.1 Contour integration 2.2 Cauchy integral formula and applications 2.3 Power series representation of holomorphic function	**15**
III	**Holomorphic Functions and TheirProperties**	3.1 Entire functions 3.2 Zeros of holomorphic functions 3.3 Isolated singularities	**15**
IV	**Residue Calculus and Mobius Transformation**	4.1 Residue Theorem and evaluation of standard types of integrals by the residue calculus method 4.2 Mobius Transformation.	**15**

Learning Resources recommended:

1. A.R. Shastri: An introduction to complex analysis, Macmillan.
2. J.W. Brown and R.V. Churchill:Complex variables and Applications, McGraw-Hill.
3. S.Lang:complex analysis, Springer.
4. J.B. Conway, Functions of one Complex variable, Springer.

5. L.V. Ahlfors:Complex analysis, McGraw Hill.

Evaluation Pattern

A. Continuous Internal Evaluation (40 marks)

Method	**Marks**
Online / Class Tests Online test of MCQs / Short Answer Questions / Long Answer Questions	20
Assignments / seminars /viva	10
Attendance and overall performance	10

B. Semester End Evaluation (60 M)

Comprehensive written examinationof 2-hour duration will be conducted at the end of each semester to evaluate students' understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions or fill in the blanks or one line sentence, short answer questions and descriptive type questions, problems.

Question Paper Pattern (60M – 2 hours)

Q. No	Unit	Marks
1	I	12
2	II	12
3	III	12
4	IV	12
5	I II III IV	03 03 03 03

Syllabus for M.Sc. Mathematics Autonomous from the year 2023-24

Name of the Course	Discrete Mathematics I
Course Code	PSMT104
Class	M.Sc. I
Semester	I
No of Credits	02
Nature	Theory
Type	Major mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	Discrete mathematics used in programming language, software development, cryptography, algorithms etc. It covers some important concepts such as set theory, set theory, graph theory, logic, coding, probabilistic problems of discrete mathematics, algorithms and their complexity,permutation and combination as well. It has better reasoning power and problem- solving skills. It is an excellent tool for improving reasoning and problem-solving abilities. The problem-solving techniques are necessary for writing complicated software. Solve problems involving recurrence relations and generating functions. Construct functions and apply counting techniques on sets in the context of discrete probability.

Nomenclature: Discrete Mathematics I

Course Outcomes:

CO1:Students will able to solve Linear Diophantine equations, cubic equations by Cardanos Method, Quadratic Congruence equations, examples on multiplicativity of function d, σ and φ.

CO2 : Students will be able to understand the pigeonhole principle, inclusion exclusion principle proof of Erdos- Szekers theorem, derangement .

Unit No.	**Units**	**No. of lectures**
1	Number theory	15
2	Advanced counting	15

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Number theory**	1.1 Linear Diophantine equations. 1.2 Arithmetic functions σ,τ,φ and their multiplicative property. 1.3 Cardano's Method.	**15**
II	**Advanced counting**	2.1 Stirling numbers, Pigeon-hole principle 2.2 Inclusion Exclusion Principle and its applications 2.3 Derangement and Permutations,Properties 2.4 Types of occupancy problems	**15**

Learning Resources recommended:

1. Nadkarni and Telang, Introduction to Number Theory.
2. A. Tucker: Applied Combinatorics, John Wiley & Sons.
3. Sharad S. Sane, Combinatorial Techniques, Hindustan Book Agency, 2013.

Evaluation Pattern

A. Continuous Internal Evaluation (40 marks)

Method	Marks
Online / Class Tests Online test of MCQs / Short Answer Questions / Long Answer Questions	20
Assignments / seminars /viva	10
Attendance and overall performance	10

B. Semester End Evaluation (60 M)

Comprehensive written examinationof 2-hour duration will be conducted at the end of each semester to evaluate students' understanding of the course material. The examination will

cover the entire syllabus and include a mix of multiple-choice questions or fill in the blanks or one line sentence, short answer questions and descriptive type questions, problems.

Question Paper Pattern (60M – 2 hours)

Q. No	Unit	Marks
1	I	12
2	II	12
3	III	12
4	IV	12
5	I II III IV	03 03 03 03

Note - Continuous Internal Evaluation of 40 marks will be converted to 20 marks. AlsoSemester End Evaluation of 60 Marks will be converted to 30 marks.

Syllabus for M.Sc. Mathematics Autonomous from the year 2023-24

Name of the Course	Ordinary Differential Equations
Course Code	PSMT105
Class	M.Sc.I
Semester	I
No of Credits	04
Nature	Theory
Type	elective
Highlight revision specific to employability/ entrepreneurship/ skill development	An Ordinary Differential Equation (ODE) is a mathematical equation that relates a function and its derivatives and are used to model the change in a physical quantity over time. Ordinary differential equations have important applications and are a powerful tool in the study of many problems in the natural sciences and in technology; they are extensively employed in mechanics, astronomy, physics, and in many problems of chemistry and biology.

Nomenclature: Ordinary Differential Equations

Course Outcomes:

CO1: Students will be able to outline the basic concepts of existence and uniqueness of solutions of Ordinary Differential Equations (ODEs).

CO2: Students will be able to solve homogeneous and non homogeneouseqations .

CO3: Students will be able to solve initial value probem, nonomogeneous equation of order n.

CO4: Students will be able to identify Sturm Liouville problems and to understand the special functions like Legendre's polynomials and Bessel's function.

Unit	Title	No of Lectures
1	Existence and Uniqueness of Solutions	15

2	Linear Equations with constant coefficients	15
3	Linear Equations with variable coefficients	15
4	Sturm-Liouville Problem & Qualitative Properties of Solutions	15

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Existence and Uniqueness of Solutions**	1.1 Existence and Uniqueness of solutions to initial value problem of first order ODE- both autonomous, non autonomous 1.2 Epsilon-approximate solutions 1.3 Lipschitz condition 1.4 Picard's method of successive approximations 1.5 System of Differential equations. Reduction of n-th order differential equations.	**15**
II	**Linear Equations with constant coefficients**	2.1 The second order homogeneous equations 2.2 Initial value problem for second order equations, Uniqueness theorem 2.3 linear dependence and independence of solutions 2.4 Wronskian 2.5 The second order non-homogeneous equations 2.6 The homogeneous equations of order n, Initial value problem for nth order Equations, The non-homogeneous equations of order n, Algebra of constant coefficient operators.	**15**
III	**Linear Equations with variable coefficients**	3.1 Initial value problem for the homogeneous equation of order n 3.2 Existence and Uniquenesstheorem solution of the homogeneous equations 3.3 Wronskian and linear independence	**15**

		3.4 reduction of the order of a homogeneous equation 3.5 the non-homogeneous equations oforder n.	
IV	**Sturm-Liouville Problem &Qualitative Properties of Solutions**	4.1Eigenvalue problem, Eigenvalues and Eigenfunctions, the vibrating string problem, Sturm Liouville problems 4.2 homogeneous and non-homogeneous boundary conditions 4.3 orthogonality property of eigenfunctions Existence of Eigenvalues and Eigen functions 4.4 Power series solution of second order linear equations 4.5 ordinary points, singular points, regular singular points 4.6 existence of solution of homogeneous second order linear equation 4.7 Legendre's polynomials 4.8 Bessel functions, Properties of Bessel function, orthogonalityof Bessel functions.	**15**

Learning Resources recommended:

1. Earl A. Coddington, An Introduction to Ordinary Differential Equations, Prentice- Hall of India.
2. G. F. Simmons, Differential Equations with Applications and Historical Notes, Second Edition, Tata McGraw Hill, India
3. Hurewicz W., Lectures on ordinary differential equations, M.I.T. Press.
4. Morris W. Hirsch and Stephen Smale, Differential Equations, Dynamical Systems, Linear Algebra, Elsevier.

Evaluation Pattern

A. Continuous Internal Evaluation (40 marks)

Method	**Marks**
Online / Class Tests Online test of MCQs / Short Answer Questions / Long Answer Questions	20

Assignments / seminars /viva	10
Attendance and overall performance	10

B. Semester End Evaluation (60 M)

Comprehensive written examinationof 2-hour duration will be conducted at the end of each semester to evaluate students' understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions or fill in the blanks or one line sentence, short answer questions and descriptive type questions, problems.

Question Paper Pattern (60M – 2 hours)

Q. No	Unit	Marks
1	I	12
2	II	12
3	III	12
4	IV	12
5	I II III IV	03 03 03 03

Syllabus for M.Sc. Mathematics Autonomous from the year 2023-24

Name of the Course	Business Statistics
Course Code	PSMT106
Class	M.Sc.I
Semester	I
No of Credits	04
Nature	Theory
Type	elective
Highlight revision specific to employability/ entrepreneurship/ skill development	Business statistics help companies understand their present and predict their future. This can save organizations money, help them find new opportunities, and improve their efficiency. It allows product comparison between businesses. It identifies flaws and deals with uncertainties by predicting general economic fluctuations.It measures variations in product performance.It enhances the effectiveness and efficiency of business units and sales teams.It analyzes the data of market research. For all these reasons study of business statistics is veryimportant. Students should get knowledge about this.

Nomenclature: business statistics

Course Outcomes:

CO1: Students will be able to understand types of data ,various methods of data collection.
CO2: Students will be able to understand measures of central tendencies.
CO4: Students will be able to understand the measures of dispersion.
CO4: Students will be able to understand the skewness,kurtosis.

Unit No.	Units	No. of lectures
1	Data Classification, Tabulation and Presentation	15
2	Measures of Central Tendency	15
3	Measures of Dispersion	15
4	Skewness, Moments and Kurtosis	15

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Data Classification, Tabulation and Presentation**	1.1 Requisites of Ideal Classification, Basis of Classification. 1.2 Frequency Distribution, Methods of Data Classification 1.3 Bi-variate Frequency Distribution, Types of Frequency Distributions. 1.4 Tabulation of Data 1.5 Graphical Presentation of Data, Advantages and Limitations of Diagrams(Graph), One-Dimensional Diagrams, Two-Dimensional Diagrams, Three-Dimensional Diagrams, Pictograms for Ideographs, Cartograms for Statistical Maps. Exploratory Data Analysis: Stem-and-Leaf Displays.	**15**
II	**Measures of Central Tendency**	2.1 Objectives of Averaging, Requisites of a Measure of Central Tendency, Arithmetic Mean of Ungrouped Data, Arithmetic Mean of Grouped (or classified)Data. Advantages and Disadvantages of Arithmetic Mean.	**15**

		2.2 Weighted ArithmeticMean. Geometric Mean Combined Geometric Mean, Weighted Geometric Mean, Advantages, Disadvantages and Applications of GM. Harmonic Mean: Advantages, Disadvantages and Applications of H.M. Relationship Between A.M,G.M.and H.M. 2.3Averages Position: Median, Advantages, Disadvantages and Applications of Median. PartitionValues quartiles, Deciles and Percentiles: Graphical Method for Calculating Partition Values. 2.4 Mode:Graphical Method for Calculating Mode Value. Advantages and Disadvantages of ModeValue. 2.5 Relationship Between Mean, Median and Mode,Comparison Between Measures of Central Tendency.	
III	**Measures of Dispersion**	3.1 Significance of Measuring Dispersion(Variation) 3.2 Classification of Measures of Dispersion. 3.3 Range, In-Range or Deviation. 3.4 AverageDeviation Measures: Mean Absolute Deviation, Variance and Standard Deviation,	**15**

		3.5 Mathematical Properties of Standard Deviation Chebyshev'sTheorem, Coefficient of Variation.	
IV	**Skewness, Moments and Kurtosis**	4.1 Measures of Skewness: Relative Measures of Skewness. 4.2 Moments: Moments About Mean,Moments About Arbitrary Point, Moments About Zero or Origin. 4.3 Relationship Between Central Moments and Moments About Any Arbitrary Point. 4.4 Moments in Standard Units, Sheppard's Correction for Moments. 4.5 Kurtosis: Measures of Kurtosis.	**15**

Learning Resources recommended:

1. S.C.GuptaAndV.K.Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand &Sons,1994.
2 J.K.Sharma, Business Statistics, Pearson Education India,2012

Evaluation Pattern

A. Continuous Internal Evaluation (40 marks)

Method	**Marks**
Online / Class Tests Online test of MCQs / Short Answer Questions / Long Answer Questions	20
Assignments / seminars /viva	10
Attendance and overall performance	10

B. Semester End Evaluation (60 M)

Comprehensive written examinationof 2-hour duration will be conducted at the end of each semester to evaluate students' understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions or fill in the blanks or one line sentence, short answer questions and descriptive type questions, problems.

Question Paper Pattern (60M – 2 hours)

Q. No	Unit	Marks
1	I	12
2	II	12
3	III	12
4	IV	12
5	I II III IV	03 03 03 03

Name of the Course	Research Methodology
Course Code	PSMT107
Class	M.Sc.I
Semester	I
No of Credits	04
Nature	Theory
Type	compulsory

Highlight revision specific to employability/ entrepreneurship/ skill development	Research methodology is a collective term for the structured process of conducting research.Research methodology seeks to inform: Why a research study has been undertaken, how the research problem has been defined, in what way and why the hypothesis has been formulated, what data have been collected and what particular method has been adopted, why particular technique of analyzing data has been used and a host of similar other questions are usually answered when we talk of research methodology concerning a research problem or study. The purpose of a research methodology is to explain the reasoning behind your approach to your research .The research methodology section of study will indicate how valid your findings are and how well-informed your paper is. It also assists future researchers planning to use the same methodology, who want to cite your study or replicate it.

Syllabus for M.Sc. Mathematics Autonomous from the year 2023-24

Nomenclature: Research methodology

Course Outcomes:

CO1: Students will be able to understand objectives of Research
CO2: Students will be able to use techniques of data analysis.
CO3: Students will be able to present the research.
CO4: Students will be undestand basic concepts of LaTeX

Unit No.	Units	No. of lectures
1	Introduction to scientific Research	15
2	Data analysis	15
3	Methods of Scientific Research And Writing Scientific Papers	15
4	Introduction to LaTeX	15

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	Fundamentals of Research Methods	1.1Definition of research, Role and objectives of research. 1.2 importance of research, Applications and types of	**15**

		Research. 1.3 Creativity and innovation, Critical thinking. 1.4 Research process and steps in it, Collecting and reviewing the Literature, Conceptualization and Formulation of: research problem, identifying variables, constructing hypothesis and Synopsis. Interpretation of results And discussion.	
II	Research Design and Measurement Concepts and Literature Searching	2.1 Selecting and defining a research problem, Need for research design, Features of a good research design, Different research designs, Scales of measurements, Nominal, Ordinal, Internal and ratio scales, Errors in measurements, Validity and Reliability in measurement, Scale Construction Techniques. 2.2 Digital: Web sources, E-journals, Journal access, Citation Index, Impact factor, H-index, E-consortium, UGC info net, eBooks, Internet discussion groups and communities, Blogs, preprint servers, Search engines, Scirus, Google Scholar, Scopus.	**15**
III	Documentation, scientific writing and Academic Integrity	3.1 Documentation and scientific writing: Results and Conclusions, Preparation of manuscript for Publication of Research paper, Presenting a paper in scientific seminar, Thesis writing. Structure and Components of Research Report, Types of Report: research papers, thesis, Research Project Reports, Pictures and Graphs, citation styles, writing a review of paper, Bibliography. for illustration, style, publications of scientific work. 3.2 Research and Academic	**15**

		Integrity: Intellectual property rights (IPRs). Plagiarism, Copyright issues, Ethics in research, and case studies.	
IV	Introduction to LaTeX	4.1 Introduction to LaTeX, Installation of LaTeX, Layout Design, LaTeX input files 4.2Understanding Latex compilation Basic Syntax, Input file structure, document classes 4.3 packages (Geometry, Hyperref, amsmath, amssymb, algorithms, algorithmic graphic, color), page styles 4.4 Typesetting Mathematical formulae: fractions, Integrals, sums, products, Fancy Header, tables.	**15**

Learning Resources recommended:

1. Kothari C.R., "Research Methodology, Methods and Techniques" (Second revised edition, NewAge International Publication, 2004).
2. Saravanavel P., "Research Methodology" (KitabMahal, Sixteenth edition, 2007).
3. Ranjit Kumar, "Research Methodology, a step-by-step guide for beginners" (Pearson education Australia, Second edition 2005).
4. Mark Saunders, Philip Lewis, AdrainThornhiu, "Research Methods for Business students"(Pearson Education ltd, Seventh edition, 2016)
5. Lamport, Leslie (1994). LaTeX: A Document Preparation System, User's Guide and Reference Manual (2nd ed.). Pearson Education. Indian Reprint.

Evaluation Pattern

A. Continuous Internal Evaluation (40 marks)

Method	**Marks**
Online / Class Tests Online test of MCQs / Short Answer Questions / Long Answer Questions	20
Assignments / seminars /viva	10
Attendance and overall performance	10

B. Semester End Evaluation (60 M)

Comprehensive written examinationof 2-hour duration will be conducted at the end of each semester to evaluate students' understanding of the course material. The examination will

cover the entire syllabus and include a mix of multiple-choice questions or fill in the blanks or one line sentence, short answer questions and descriptive type questions, problems.

Question Paper Pattern (60M – 2 hours)

Q. No	Unit	Marks
1	I	12
2	II	12
3	III	12
4	IV	12
5	I II III IV	03 03 03 03

Revised syllabus of courses of Master in Science I (M.Sc I) at semsterIIwith effect from accademic year 2023-24

CourseCode	Semester II	Credits
	Major Mandatory	
PSMT201	Algebra II	4
PSMT202	Topology	4
PSMT203	Analysis II	4
PSMT204	Partial Differential equation	2
	Major Electives	
PSMT205	Probability Theory	4

PSMT206	OR Elementary number theory	
PSMT207 PSMT208	On Job Training OR Field Project	4
Total Credits		22

Syllabus for M.Sc. Mathematics Autonomous from the year 2023-24

Name of the Course	Algebra II
Course Code	PSMT201
Class	M.Sc. I
Semester	II
No of Credits	04
Nature	Theory
Type	Major mandatory
Highlight revision specific to employability/	In mathematics more specifically algebra, **abstract algebra** or **modern algebra** is the study of algebraic structures. Algebraic structures include

entrepreneurship/ skill development	groups, rings, fields, modules, vector spaces, lattices and algebra over fields.The term *abstract algebra* was coined in the early 20th century to distinguish it from older parts of algebra, and more specifically from elementary algebra, the use of variables to represent numbers in computation and reasoning. Presently, the term "abstract algebra" is typically used for naming courses in mathematics education and is rarely used in advanced mathematics.

Nomenclature: Algebra II

Course Outcomes:

CO1: Students will be able to solve Dihedral groups, Matrix Groups, Automorphism Group. group homomorphism, inner automorphism.

CO2: Students will be able to apply group action and orbit stabilizer formula to solve the Problems ,to apply Sylow theorems to classify the groups of small order.

CO3: Students will be able to solve problems based on Rings, Ideals, ring homomorphisms and the Chinese remainder theorem.

CO4: Students will be able to identify Euclidean domain, Principal Ideal Domain, Unique Factorisation Domain.

Unit No.	Units	No. of lectures
1	Groups and Group Homomorphisms	15
2	Groups acting on sets and Sylow theorems	15
3	Rings and Fields	15
4	Divisibility in integral domains	15

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Groups and Group Homomorphisms**	1.1 Quotient groups, isomorphism theorems, 1.2 Internal& external direct product of groups 1.3 Automorphisms& inner automorphisms of a group 1.4 Statement& applications of structure theorem of abelian	**15**

		group	
II	**Groups acting on sets and Sylow theorems**	2.1 Conjugate class of an element in a group 2.2 Class equation and its applications 2.3 Groups action on a set 2.4 Cauchy's Theorem 2.5 p - groups, Sylow theorems & applications	**15**
III	**Rings and Fields**	3.1 Prime& maximal ideals 3.2 Ring homomorphisms 3.3 Chinese remainder theorem in rings & its applications 3.4 Fields, characteristic of field 3.5 Polynomial ring, irreducible polynomials, unique factorization theorem	**15**
IV	**Divisibility in integral domains**	4.1 Euclidean domain, principal ideal domain, unique factorization domain 4.2 Prime element, irreducible element 4.3 Irreducibility criterion, Eisenstein's criterion, Gauss lemma	**15**

Learning Resources recommended:

1. Hoffman K and Kunze R: Linear Algebra, Prentice-Hall India.
2. I.N.Herstein: Topics in Algebra, Wiley-India.
3. Serge Lang: Linear Algebra, Springer-Verlag Undergraduate Text in Mathematics.
4. Michael Artin: Algebra, Prentice-Hall India.
5. N.S. Gopalkrishnan: University Algebra, New Age International, third edition,2015

Evaluation Pattern

A. Continuous Internal Evaluation (40 marks)

Method	**Marks**
Online / Class Tests Online test of MCQs / Short Answer Questions / Long Answer Questions	20
Assignments / seminars /viva	10
Attendance and overall performance	10

B. Semester End Evaluation (60 M)

Comprehensive written examinationof 2-hour duration will be conducted at the end of each semester to evaluate students' understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions or fill in the blanks or one line sentence, short answer questions and descriptive type questions, problems.

Question Paper Pattern (60M – 2 hours)

Q. No	Unit	Marks
1	I	12
2	II	12
3	III	12
4	IV	12
5	I II III IV	03 03 03 03

Syllabus for M.Sc. Mathematics Autonomous from the year 2023-24

Name of the Course	Topology
Course Code	PSMT202
Class	M.ScI
Semester	2
No of Credits	4
Nature	Theory
Type	Major mandatory

Highlight revision specific to employability/ entrepreneurship/ skill development	Topology is a branch of mathematics concerned with the study of properties of spaces and objects that are invariant under continuous transformations. It deals with concepts such as continuity, compactness, connectedness, and more.Applications of topology includeNetworkdesign,Dataanalysis,Robotics,Cryptography

Nomenclature: Topology

Course Outcomes:

CO1-Students will be able to form new spaces from old one using product, box and quotient topology.

CO2-Students will be able to solve problems on connectedness and path connectedness of set, connected components and path components of set.

CO3 - Students will understand first and second countable spaces,separable spaces, Lindeloff Spaces, compact spaces ,limit point compactness, local compactness, separation axioms, extension theorems such Tietze extension theorem,Tychnofftheorem,Urysohn metrization theorem.

CO4-Students will understand metrisable spaces and Tychonof theorem.

Unit No.	Units	No. of lectures
1	Topology and Topological spaces	15
2	Connected topological spaces	15
3	Compact topological spaces	15
4	Metrizable spaces and Tychonof theorem	15

Curriculum:

Unit	Title	Learning Points	No of Lectures
1	**Topology and Topological spaces**	1.1Topological spaces, basis,subbasis,types of topologies,T_0; T_1,T_2 spaces 1.2 closed sets, limit points, closure, interior 1.3 continuous functions,	**15**

		homeomorphism	
2	**Connected topological spaces**	2.1 Quotient spaces. Connected topological spaces, 2.2path-connected topological spaces, Connected components, path components 2.3 Countability Axioms, first and second countable spaces, Lindelof spaces.	**15**
3	**Compact topological spaces**	3.1continuity and compactness, tube lemma, finite product of compact spaces. 3.2 Lebesgue number lemma, uniform continuity theorem, compact Hausdorff space. 3.3 Limit point compact spaces, local compactness, one point compactification.	**15**
4	**Metrizable spaces and Tychonof theorem**	4.1 Metrizable spaces, separation axioms 4.2 Urysohn lemma, Urysohn metrization theorem, Tietze extension theorem. Tychonof theorem.	**15**

Learning Resources recommended:

1. J. F. Munkres: Topology, Pearson; 2 edition (January 7, 2000).
2. G. F. Simmons: Introduction to Topology and Modern Analysis, Tata McGraw Hill, 2004.

Evaluation Pattern

A.

Continuous Internal Evaluation (40 marks)

Method	**Marks**
Online / Class Tests Online test of MCQs / Short Answer Questions / Long Answer Questions	20

Assignments / seminars /viva	10
Attendance and overall performance	10

B. Semester End Evaluation (60 M)

Comprehensive written examinationof 2-hour duration will be conducted at the end of each semester to evaluate students' understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions or fill in the blanks or one line sentence, short answer questions and descriptive type questions, problems.

Question Paper Pattern (60M – 2 hours)

Q. No	Unit	Marks
1	I	12
2	II	12
3	III	12
4	IV	12
5	I II III IV	03 03 03 03

Syllabus for M.Sc. Mathematics Autonomous from the year 2023-24

Name of the Course	Analysis II
Course Code	PSMT203
Class	M.Sc. I
Semester	II

No of Credits	04
Nature	Theory
Type	Major mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	Measure theory is a branch of mathematics that deals with the study of measures and their properties. Measures are mathematical functions that assign a numerical value to sets in a certain space, and measure theory provides a framework for studying these functions and their relationships to sets and functions. Measure Theory formalizes and generalizes the notion of integration. It is essential for many advanced areas of mathematics and has applications in other fields such as physics and economics.

Nomenclature: Analysis II

Course Outcomes:

CO1: students will be able to understand the fundamentals of measure theory and be acquainted with the proofs of the fundamental theorems underlying the theory of integration.

CO2: students will be able to use the mathematical concepts such as volume, area, and integration

CO3: students will be able to understand convergence theorems.

CO4: students will be able to understand space of integrable functions.

Unit No.	Units	No. of lectures
1	Measures and Measurable Sets	15
2	Measurable functions and their Integration	15
3	Convergence Theorems on Measure space	15
4	Space of Integrable functions	15

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Measures and Measurable Sets**	1.1 Additive set functions, σ-algebra countable additivity 1.2 Outer measure, constructing	**15**

		measures, measurable sets (Definitions due to Caratheodory), measure space(X,P,μ). 1.3 properties of exterior measure 1.4 Measurable sets and Lebesgue measure, properties of measurable sets. 1.5 Existence of a subset of R which is not Lebesgue measurable.	
II	**Measurable functions and their Integration**	2.1 Measurable functions on (X,P, μ) 2.2 simple functions, properties of measurable functions. 2.3 Integral of nonnegative simple measurable functions defined on the measure space (X,P, μ) and their properties. 2.4 Integral of a non-negative measurable function.	**15**
III	**Convergence Theorems on Measure space**	3.1 Monotone convergence theorem. 3.2 Fatou's lemma 3.3 summable functions, vector space of summable functions 3.4 Lebesgue's dominated convergence theorem. 3.5 Lebesgue integral of bounded functions over a set of finite measure 3.6 Lebesgue and Riemann integrals	**15**
IV	**Space of Integrable functions**	4.1 Borel set, Borel algebra 4.2 Signed Measures, positive set, negative set and null set. 4.3 Complex valued Lebesgue measurable functions f 4.4 Lebesgue integral of complex valued measurable functions. 4.5 Approximation of Lebesgue integrable functions by continuous functions.	**15**

		4.6 The space L^1(μ) of integrable functions, properties of L1 integrable functions	

Learning Resources recommended:

1. Andrew Browder, Mathematical Analysis, An Introduction, Springer Undergraduate Texts in Mathematics.
2. Elias M. Stein and Rami Shakarchi, Real Analysis, Measure Theory, Integration and Hilbert Spaces, New Age International Limited, India
3. Royden H. L. Real Analysis, PHI.
4. Terence Tao, Analysis II, Hindustan Book Agency (Second Edition).

Evaluation Pattern

A. Continuous Internal Evaluation (40 marks)

Method	**Marks**
Online / Class Tests Online test of MCQs / Short Answer Questions / Long Answer Questions	20
Assignments / seminars /viva	10
Attendance and overall performance	10

B. Semester End Evaluation (60 M)

Comprehensive written examinationof 2-hour duration will be conducted at the end of each semester to evaluate students' understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions or fill in the blanks or one line sentence, short answer questions and descriptive type questions, problems.

Question Paper Pattern (60M – 2 hours)

Q. No	Unit	Marks
1	I	12
2	II	12
3	III	12
4	IV	12
5	I II III IV	03 03 03 03

Syllabus for M.Sc. Mathematics Autonomous from the year 2023-24

Name of the Course	Partial Differential Equation
Course Code	PSMT204
Class	M. Sc. I
Semester	II
No of Credits	02
Nature	Theory
Type	Major mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	A **partial differential equation** (or briefly a **PDE**) is a mathematical equation that involves two or more independent variables, an unknown function (dependent on those variables), and partial derivatives of the unknown function with respect to the independent variables. Partial Differential Equations are used to mathematically formulate and thus an aid the solution of, physical and other problems involving functions of several variables, such as the propagation of heat or sound, fluid flow, elasticity, electrostatics, electrodynamics, etc. The use of partial derivatives in real world is very common. Partial Derivatives are used in basic laws of physics for example Newton's law of linear motion, maxwell's equations of Electromagnetism and Einstein's equation in General Relativity.

Nomenclature: Partial Differential Equation

Course Outcomes:

CO1 : Students are expected to understand the basic concepts and method of finding the solution of first and second order Partial Differential Equations (PDEs).

CO2 : Students will be able to know the classification of second order PDEs, singularity and fundamental solution

Unit No.	**Units**	**No. of lectures**
1	First Order Partial Differential Equations	15
2	Second Order Partial Differential Equations	15

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**First Order Partial Differential Equations**	1.1 First order partial differential equations in two independent variables. 1.2 Semilinear and Quasilinear equations. 1.3 Non-linear equations in two independent variables: Monge Strip and Charpit Equations 1.4 Solution to the Cauchy problem.	**15**
II	**Second Order Partial Differential Equations**	2.1 Classifications of second order partial differential equations (PDE's) 2.2 Method of reduction to normal form 2.3 Boundary value problems 2.4 Poisson's theorem	**15**

Learning Resources recommended:

1. Phoolan Prasad &RenukaRavindran, Partial Differential Equations, Wiley EasternLimited, India.
2. F. John, Partial Differential Equations, Springer publications
3. T. Amaranath- An elementary course in partial differential equation (second edition)
4. Ian N. sneddon – Elements of Partial Differential Equation.

Evaluation Pattern

A. Continuous Internal Evaluation (40 marks)

Method	Marks
Online / Class Tests Online test of MCQs / Short Answer Questions / Long Answer Questions	20
Assignments / seminars /viva	10
Attendance and overall performance	10

B. Semester End Evaluation (60 M)

Comprehensive written examinationof 2-hour duration will be conducted at the end of each semester to evaluate students' understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions or fill in the blanks or one line sentence, short answer questions and descriptive type questions, problems.

Question Paper Pattern (60M – 2 hours)

Q. No	Unit	Marks
1	I	12
2	II	12
3	III	12
4	IV	12
5	I II III IV	03 03 03 03

Note - Continuous Internal Evaluation of 40 marks will be converted to 20 marks.
AlsoSemester End Evaluation of 60 Marks will be converted to 30 marks.

Syllabus for M.Sc. Mathematics Autonomous from the year 2023-24

Name of the Course	Probability Theory
Course Code	PSMT205
Class	M.Sc. I
Semester	II
No of Credits	04
Nature	Theory
Type	Elective
Highlight revision specific to employability/ entrepreneurship/ skill development	Probability is one of the most important branches of mathematics. It is used in almost every other area to define a random event or an event with uncertainty.The probability is important as it enables us to calculate the possible results of a random experiment statistically. It is vital in predicting the behavior of variables influenced by chance.

Nomenclature: Probability Theory

Course Outcomes:

CO1: Students will be able to explain concept of Modelling Random Experiments, Classical probability spaces, sigma-fields generated by a family of sets, sigma-field of Borel sets, Limitsuperior and limit inferior for a sequence of events.

CO2: Students will be able to earn knowledge of discrete and absolutely continuous probability measures, conditional probability, total probability formula, Bayes formula.

CO3: Students will be able to express distribution of a random variable, distribution function of a random variable, Bernoulli, Binomial, Poisson and Normal distributions

CO4: Students will be able to apply limit theorems of Probability Theory.

Unit No.	**Units**	**No. of lectures**
1	Probability basics	15
2	Probability measure	15
3	Random variables	15
4	Limit Theorems	15

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Probability basics**	1.1 Modelling Random Experiments: Introduction to probability, probability space, events. 1.2 Classical probability spaces: uniform probability measure, 1.3 fields, finite fields 1.4 finitely additive probability 1.5 σ-fields, σ-fields generated by a family of sets, σ-field of Borel sets 1.6 Limit superior and limit inferior for a sequence of events.	**15**
II	**Probability measure**	2.1 Probability measure, Continuity of probabilities 2.2 Discussion of Lebesgue measure on σ-field of Borel subsets of assuming its existence 2.3 Discussion of Lebesgue integral for non-negative Borel functions assuming its construction. 2.4 Discrete and absolutely continuous probability measures 2.5 conditional probability, total probability formula, Bayes formula, Independent events.	**15**
III	**Random variables**	3.1 Random variables, simple random variables, discrete and absolutely continuous random variables, 3.2 distribution of a random variable, distribution function of a random variable 3.3 Bernoulli, Binomial, Poisson and Normal distributions 3.4 Independent random	**15**

		variables 3.4 Expectation and variance of random variables both discrete and absolutely continuous.	
IV	**Limit Theorems**	4.1 Conditional expectations and their properties 4.2 Characteristic functions, Examples. 4.3 Higher moments examples 4.4 Chebyshev inequality, Weak law of large numbers 4.5 Convergence of random variables, Kolmogorov strong law of large numbers (statement only), Central limit theorem (statement only).	**15**

Learning Resources recommended:

1. M. Capinski, Tomasz Zastawniak: Probability through Problems.
2. J. F. Rosenthal: A First Look at Rigorous Probability Theory, World Scientist.
3. Kai Lai Chung, FaridAitSahlia: Elementary Probability Theory, Springer Verlag.
4. Ross, Sheldon M. A first course in probability(8th Ed), Pearson.

Evaluation Pattern

A. Continuous Internal Evaluation (40 marks)

Method	**Marks**
Online / Class Tests Online test of MCQs / Short Answer Questions / Long Answer Questions	20
Assignments / seminars /viva	10
Attendance and overall performance	10

B. Semester End Evaluation (60 M)

Comprehensive written examinationof 2-hour duration will be conducted at the end of each semester to evaluate students' understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions or fill in the blanks or one line sentence, short answer questions and descriptive type questions, problems.

Question Paper Pattern (60M – 2 hours)

Q. No	Unit	Marks
1	I	12
2	II	12
3	III	12
4	IV	12
5	I II III IV	03 03 03 03

Syllabus for M.Sc. Mathematics Autonomous from the year 2023-24

Name of the Course	Elementary number theory
Course Code	PSMT206
Class	M.Sc. I
Semester	II
No of Credits	04
Nature	Theory
Type	Elective
Highlight revision specific to employability/ entrepreneurship/ skill development	1)Number theory is the foundation of many other areas of mathematics: Number theory provides the basis for many other branches of mathematics, such as algebra, geometry, and calculus. A strong understanding of number theory is essential for further studies in these areas. 2)Number theory is used in cryptography: Number theory plays a crucial role in modern cryptography. Cryptography is the practice of protecting information from unauthorized access, and many encryption techniques are based on the properties of prime numbers and other concepts from number theory.

Nomenclature: Elementary number theory

Course Outcomes

CO1: Students will be able to define The Mobius function, the Euler function and will be able to explain the Fundamental Theorem of Arithmetic, the Euclidean Algorithm.

CO2: Students will be able to evaluate Dirichlet inverses and Mobius inversion formulaandwill be able To Classify Multiplication functions andCompletely Multiplication function.

CO3: Students will be able to interpret Residue Classes and Complete Residue Systems Linear Congruences.

CO4:Students will be able toanalyze Chinese remainder theorem Quadratic reciprocity law. And to Solve system of linear congruences using Chinese Remainder theorem

Unit No.	**Units**	**No. of lectures**
1	The Fundamental Theorem of Arithmetic	15
2	Product formula for $\emptyset_n$	15
3	Congruence	15
4	Chinese remainder theorem and its application	15

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	The Fundamental Theorem of Arithmetic	Divisibility - GCD - Prime Numbers -Fundamental theorem of Arithmetic-the Series of Reciprocal of the Primes -The Euclidean AlgorithmArithmetic function and Dirichlet Multiplication:-The Mobius function –The Euler Totient function a Relation connecting them.	**15**
II	Product formula for $\emptyset_n$	Product formula for -The Dirichlet Product of Arithmetical functions - Dirichlet inverses and Mobius inversion formula - Mangoldt function Λ(n)-Multiplication functions-Multiplication functions and Dirichlet Multiplication-Inverse of a Completely Multiplication function - Liouville'sfunction λ(n)-the Divisor functions	**15**
III	Congruence	Congruence: Definitions and Basic properties of Congruences - Residue Classes and Complete Residue Systems Linear Congruences - Reduced Residue System and Euler Fermat theoremPolynomialCongruences modulo p- Lagrange's theorem-Application of Lagrange's theorem	**15**
IV	Chinese remainder theorem and its application	Chinese remainder theorem and its application -Polynomial Congruences with prime power moduli. Quadratic residues and Quadratic reciprocity law: Quadratic residues- Legendre's symbol and its properties - Evaluation of (-1/p) and (2/p)-Gauss Lemma-the Quadratic reciprocity law and its	**15**

		applications.	

Learning Resources recommended:

1. Tom. M.Apostol,"Introduction to Analytic Number Theory", Springer International Edition, First Indian Reprint 2010.
2. Thomas Koshy," Elementary Number Theory with Applications", Second Edition , ELSEVIER, Imprint- Academic Press.
3. David M Burton , "Elementary Number Theory," fifth Edition , Pearson Publishers.
4. K Chandrashekaran,"Introduction to Analytic Number Theory", Springer International Edition

Evaluation Pattern

A. Continuous Internal Evaluation (40 marks)

Method	**Marks**
Online / Class Tests Online test of MCQs / Short Answer Questions / Long Answer Questions	20
Assignments / seminars /viva	10
Attendance and overall performance	10

B. Semester End Evaluation (60 M)

Comprehensive written examinationof 2-hour duration will be conducted at the end of each semester to evaluate students' understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions or fill in the blanks or one line sentence, short answer questions and descriptive type questions, problems.

Question Paper Pattern (60M – 2 hours)

Q. No	Unit	Marks
1	I	12
2	II	12
3	III	12
4	IV	12
5	I II III IV	03 03 03 03

syllabus for M.Sc. Mathematics Autonomous from the year 2023-24

Name of the Course	On job training
Course Code	PSMT207
Class	M.Sc. I
Semester	II
No of Credits	04
Nature	Theory
Type	Practical
Highlight revision specific to employability/ entrepreneurship/ skill development	Now a days it is observed that there is scarcity of good mathematics teachers.so to attract the students towards the teaching field, it is necessary to develop interest and corresponding skills about teaching,amongstudents.students will get hands on experience of teaching mathematics to other students.

Nomenclature: On Job Training

Course Outcomes

CO1: Students will be able to learn about imparting the skills of mathematics teaching.
CO2: Students will understand how to teach mathematics effectively.
CO3: Students will understand various ways of testing the knowledge gained by students.

Unit No.	**stages**	**No. of lectures**
1	methods of teaching,skills to be imparted as a teacher	15
2	demonstration lecture and model making	15
3	preparation and writing of lesson plan	15
4	lecture conductions and topic test	15

Curriculum:

No.	stage	Learning Points	No of Lectures
1	methods of teachingskills to be imparted as a teacher		**60**
2	demonstration lecture and model making		
3	preparation and writing of lesson plan		
4	lecture conductions and topic test ,Assessment		

Learning Resources recommended:

The teachers of the department will guide about the methods of teaching. Also will guide about board writing, model making (if necessary) , writing of lesson plan. One demonstration lecture will be conducted by the teacher. Then student willselect the topic to be taught to F.Y.B.Sc or S.Y. B.Sc or school students and then will prepare for the topic.Also the student will write the lesson plan for these topic and will be corrected by teachers. Students will actullyconduct5 lectures on F.Y.B.Sc or S.Y. B.Sc or school studentsaccording to lesson plan.
Also some lectures for geogebra can be arranged for useful for school teaching part.
These lectures will be delivered by guest faculty.

Evaluation Pattern

A. Continuous Internal Evaluation (40 marks)

Method	Marks
Writing of lesson plan	20
Paper setting for Topic test	10
Attendance and overall performance	10

B.Semester End Evaluation (60 marks)

Students will actually conduct the lectures of F.Y.B.Sc and S.Y.B.Scstudents and will conduct the topic test and assess the test. Teachers will observe and assess their conduction of lectures.

Syllabus for M.Sc. Mathematics Autonomous from the year 2023-24

Name of the Course	Field project
Course Code	PSMT208
Class	M.Sc. I
Semester	II
No of Credits	04
Nature	field project
Type	Practical
Highlight revision specific to employability/ entrepreneurship/ skill development	When Student studies a project course, he learns all the specific techniques, skills and programs which are useful to manage working schedules effectively against a deadline. When you plan your projects well, he can foresee challenges to manage risks, prioritize accordingly and keep his eyes on the end goal. When students study project management, he learn how each project can be broken down into a clear process of assigned tasks, milestones, and deadlines. The skills that student get to learn and practise are Analytical thinking and innovation, Active learning , Problem solving,Critical thinking ,Leadership and social influence,Reasoning, problem solving and ideation, Resilience, stress tolerance and flexibility Project managers are needed across all industries, but they are particularly in the following industry areas: Engineering and Construction, Community Services and Healthcare,Banking and Financial Services,Infrastructure,Manufacturing ,Law , Information Technology,Government and Defense ,Education and Training ,Oil and Gas Retail ,Professional services and consulting

Nomenclature: Field Project

Course Outcomes

CO1 : Student will be able to decide the problem accurately.
CO2 : Student will learn various methods of collection of the data .
CO3 : Student will learn various methods to analysis the data.
CO4 : Student will be able to draw the conclusion from analysis.
CO5 : Student will be able to suggest the solution for the current problem.
CO6 : Students will be able to present their project through powerpoint presentations

Curriculum:

No.	Stage	Learning Points	No of Lectures
1	Deciding project problem		**60**
2	Data collection		
3	analysis		

4	conclusion, powerpoint presentation		

Learning Resources recommended:

Teachers of the department will guide the group of at most 3 students about the field project.

Field projects can be done through Educational field visits to the mathematics related Institutions or colleges. In this case students write field project report after the visit.

Evaluation Pattern

A. Continuous Internal Evaluation (40 marks)

Method	**Marks**
Attendance	10
Efforts, consistency, sincerity towards project	10
Skills adopted	20

B. Semester End Evaluation (60 marks)

The Project is to be presented bya group of at most 6 students. The evaluation of project is to be done by the committee of 2 members on following criteria-

Criteria	**Marks**
Contents Of The Project	30
Presentation Of The Project	20
Viva onThe Project	10

Name and Signature: Dr. Diwakar P. Karwanje
Chairman of BoS of Mathematics