

# **B.Sc. Mathematics**

## **PROGRAM OUTCOMES (PO)**

### **PO1: Effective Communication Skills**

Graduates will demonstrate proficiency in both written and spoken communication, effectively utilizing formal communication techniques necessary for professional environments. They will be adept at conveying ideas clearly and confidently in English and other relevant languages.

### **PO2: Critical Analysis and Interpretation**

Graduates will acquire and apply critical thinking skills to analyze diverse forms of information, including literary texts, financial statements, business operations, and legal frameworks. They will be capable of interpreting and evaluating data to make informed decisions in various contexts.

### **PO3: Technological Proficiency**

Graduates will gain practical knowledge and skills in utilizing modern technology, including software applications, programming languages, and development tools. They will be able to manage and implement technological solutions for business, research, and professional practices.

### **PO4: Quantitative and Analytical Skills**

Graduates will develop strong quantitative and analytical skills through the study of mathematics, statistics, and business mathematics. They will apply these skills to solve complex problems, conduct research, and make data-driven decisions in professional settings.

### **PO5: Research and Problem-Solving**

Graduates will be equipped with comprehensive research skills, including problem definition, research design, data collection, and report formulation. They will be capable of conducting independent research and presenting their findings effectively.

### **PO6: Financial Acumen**

Graduates will have a solid foundation in accounting, financial management, and taxation. They will be proficient in preparing and analyzing financial statements, understanding cost and management accounting, and making informed financial decisions.

**PO7: Management Knowledge and Application**

Graduates will comprehend and apply management principles and methodologies, including decision-making processes, modern management trends, and human resource management practices. They will be prepared to handle organizational leadership and entrepreneurial ventures.

**PO8: Legal and Ethical Awareness**

Graduates will possess a sound understanding of business laws, corporate laws, and intellectual property rights. They will navigate legal frameworks and appreciate ethical considerations in business practices, promoting social responsibility and sustainable practices.

**PO9: Cultural and Social Awareness**

Graduates will develop an appreciation for cultural diversity and social issues through the study of literature, history, and intercultural communication. They will be aware of contemporary issues such as environmental sustainability and human rights, integrating these principles into their professional conduct.

**PO10: Marketing and Entrepreneurship**

Graduates will gain insights into marketing management, brand building, consumer behavior, and entrepreneurial skills. They will be prepared to identify market opportunities, develop marketing strategies, and manage new business ventures.

**PO11: Scientific and Environmental Literacy**

Graduates will understand fundamental scientific principles and their applications, including environmental impacts and sustainability. They will be aware of biodiversity conservation, ecosystem functions, and sustainable agriculture practices.

**PO12: Interdisciplinary Competence**

Graduates will be adept at integrating knowledge from various disciplines, fostering a comprehensive understanding of complex issues. They will be equipped to approach problems from multiple perspectives and propose innovative solutions.

**PO13: Practical and Vocational Skills**

Graduates will acquire practical skills relevant to their field of study, including laboratory techniques, project management, and technical proficiency. They will be prepared for hands-on roles in industry, research, and self-employment opportunities.

**PO14: Socio-Cultural Consciousness and Ethical Responsibility**

Graduates will develop an awareness of major contemporary issues and ethical considerations. They will internalize values that promote social justice, ethical behavior, and global citizenship, responding positively to societal challenges.

## Program Specific Outcomes (PSO)

Program Specific Outcome (PSO)	Students will be able to.....	Mapped Program Outcomes (PO)
PSO 1: Effective Communication in English	develop the ability to communicate confidently and effectively in English, both in written and spoken forms, ensuring they can articulate ideas clearly in a variety of professional and social settings.	PO 1, PO 9
PSO 2: Cultural and Literary Appreciation	gain a deep appreciation for literature and drama, particularly in Hindi and Malayalam, fostering an understanding of moral, social, and environmental issues through literary analysis and creative expression.	PO 9, PO 14
PSO 3: Mathematical Foundations and Logical Reasoning	have a strong foundation in mathematical principles, including propositional logic, set theory, and proof techniques, enabling them to solve complex mathematical problems and apply theoretical knowledge to practical scenarios.	PO 2, PO 4, PO 12

<p>PSO 4: Optimization and Decision-Making Skills</p>	<p>acquire expertise in optimization techniques, particularly linear and nonlinear programming, and will understand their applications in decision-making processes, enhancing their ability to solve real-world problems efficiently.</p>	<p>PO 4, PO 7</p>
<p>PSO 5: Technological Proficiency</p>	<p>develop a thorough understanding of computer fundamentals, web technologies, and database management systems, equipping them with the skills to design, implement, and manage computer-based systems effectively.</p>	<p>PO 3, PO 13</p>
<p>PSO 6: Analytical and Problem-Solving Abilities</p>	<p>enhance their analytical skills through the study of calculus, differential equations, and linear algebra, enabling them to model, analyze, and solve a wide range of mathematical and scientific problems.</p>	<p>PO 2, PO 4, PO 5</p>
<p>PSO 7: Research and Critical Thinking</p>	<p>develop strong research capabilities, critical thinking, and problem-solving skills through seminar assignments and projects, preparing them for advanced studies and professional careers that require innovative and analytical thinking.</p>	<p>PO 2, PO 5, PO 12</p>

# Course Outcomes(CO)

Course	Course Outcome (CO)	Bloom's Taxonomy	Mapped PSO
<b>Fine Tune Your English</b>	CO1: To enable the students to speak English confidently and effectively in a wide variety of situations.	Understanding	PSO1
	CO2: Confidently use English in both written and spoken forms.	Applying	PSO1
	CO3: Use English for formal communication.	Applying	PSO1
	CO4: Helps to improve the basics of grammar.	Understanding	PSO1
	CO5: Develop English language qualitatively.	Understanding	PSO1
	CO6: Develop the skills of letter writing.	Applying	PSO1
<b>Poetry and One Act Play</b>	CO1: Helps to develop interest in Hindi Language and Literature.	Understanding	PSO2
	CO2: Acquainted with the style, dialogue structure, and Language described in One Act Play.	Understanding	PSO2
	CO3: Inculcate moral and human values within students.	Applying	PSO2
	CO4: Familiarize with the social issues and problems of everyday life, changes in moral values through One Act Play and Modern Hindi Poetry.	Understanding	PSO2
	CO5: Develop interest in the Preservation of nature, environment, and natural resources.	Applying	PSO2

	CO6: Helps to develop Students' skill in drama.	Applying	PSO2
<b>Katha, Kavitha</b>	CO1: To discuss the history of Malayalam novel and short stories.	Understanding	PSO2
	CO2: Critically analyze the Renaissance novel in Malayalam.	Analyzing	PSO2
	CO3: To justify modernism and postmodernism in Malayalam short stories.	Evaluating	PSO2
	CO4: Relate Malayalam short stories of different eras.	Analyzing	PSO2
	CO5: To discuss feminism in short stories.	Analyzing	PSO2
<b>Foundation of Mathematics</b>	CO1: Define propositional logic, propositional equivalence, and quantifiers.	Remembering	PSO3
	CO2: Identify appropriate proof techniques in relevant situations.	Applying	PSO3
	CO3: Understand the basic concepts of set operations and functions.	Understanding	PSO3
	CO4: Recall relations and their properties, equivalence relations, and partial orderings.	Remembering	PSO3
	CO5: Apply the theoretical knowledge of methods for finding the roots of a given equation into practical problems.	Applying	PSO3
	CO6: Apply Descartes's rule of signs to solve equations.	Applying	PSO3
<b>Linear Programming</b>	CO1: Learn the principles and concepts of optimization, with a focus on linear programming as a fundamental optimization technique used in Operations Research.	Understanding	PSO4

	CO2: Understand the importance of optimization in decision-making processes.	Understanding	PSO4
	CO3: Acquire the skills to solve linear programming problems using graphical methods, simplex algorithm, and other relevant solution techniques.	Applying	PSO4
	CO4: Understand the step-by-step process of optimization and how to interpret the results.	Understanding	PSO4
	CO5: Gain an understanding of duality theory in linear programming and its practical significance.	Understanding	PSO4
	CO6: To interpret the dual problem in terms of economic interpretations, such as shadow prices and reduced costs.	Applying	PSO4
<b>Computer Fundamentals And Introduction to Web Technologies (Lab)</b>	CO1: Define and explain the basic concepts of computer, its types, and history.	Understanding	PSO5
	CO2: Develop mathematical skill in performing conversions between different number systems.	Applying	PSO5
	CO3: Develop basic knowledge about the hardware components of the computer.	Understanding	PSO5
	CO4: Define and explain the basic concepts about the software components, its programming languages, representation, etc.	Understanding	PSO5
	CO5: Develop basic knowledge about the computer network protocols and concepts.	Understanding	PSO5
<b>Issues that Matter</b>	CO1: Respond rationally and positively to the issues raised.	Applying	PSO1

	CO2: Identify major issues of contemporary significance.	Understanding	PSO1
	CO3: To enhance their linguistic skills in the English language.	Applying	PSO1
	CO4: Internalize the values imparted through the excerpts.	Understanding	PSO1
	CO5: Re-orient themselves as conscious, cautious, and concerned human beings.	Applying	PSO1
	CO6: Articulate these values in error-free English.	Applying	PSO1
<b>Prose and Short Stories</b>	CO1: Get familiar with the genre of short stories.	Understanding	PSO2
	CO2: Helps to develop social responsibilities and to take appropriate decisions.	Applying	PSO2
	CO3: Helps to develop reading skills.	Understanding	PSO2
	CO4: Helps to learn about moral and ethical values and morality in humans through literary works.	Applying	PSO2
	CO5: Discuss modern issues in the field of education and the importance of woman empowerment.	Analyzing	PSO2
	CO6: Familiarize with some masterpieces of modern Hindi Literature.	Understanding	PSO2
<b>Malayalam Gadhyaparichayam</b>	CO1: To inspect poetic images in Malayalam Kavitha.	Understanding	PSO2
	CO2: To evaluate modernism and postmodernism in literature.	Evaluating	PSO2
	CO3: Analyze living pictures in Malayalam dramas.	Analyzing	PSO2



	CO4: To outline feminism in Malayalam language and literature.	Analyzing	PSO2
	CO5: Evaluate Modern poetry and feminized characteristics of modern Malayalam poetry.	Evaluating	PSO2
<b>Analytic Geometry, Trigonometry, and Differential Calculus</b>	CO1: Define propositional logic, propositional equivalence, and quantifiers.	Remembering	PSO3
	CO2: Identify appropriate proof techniques in relevant situations.	Applying	PSO3
	CO3: Understand the basic concepts of set operations and functions.	Understanding	PSO3
	CO4: Recall relations and their properties, equivalence relations, and partial orderings.	Remembering	PSO3
	CO5: Apply the theoretical knowledge of methods for finding the roots of a given equation into practical problems.	Applying	PSO3
	CO6: Apply Descartes's rule of signs to solve equations.	Applying	PSO3
<b>Duality, Transportation, and Assignment Problem</b>	CO1: Understand the concept of duality in linear programming and its practical significance.	Understanding	PSO4
	CO2: Formulate the dual problem and comprehend the relationships between the primal and dual problems.	Applying	PSO4
	CO3: Understand the assignment problem, a special case of linear programming where the objective is to minimize the total cost or maximize the total profit in a bipartite graph.	Understanding	PSO4

	CO4: Apply the Hungarian algorithm and other efficient methods to solve assignment problems.	Applying	PSO4
	CO5: Understand the transportation problem, a classic optimization problem concerned with minimizing the total transportation cost of goods from multiple sources to multiple destinations.	Understanding	PSO4
	CO6: Apply the transportation simplex method and network flow algorithms like the minimum cost flow to solve transportation problems.	Applying	PSO4
<b>Object Oriented Programming with C++ And Software Lab II using C++</b>	CO1: Define and explain the basic concepts of Object-Oriented Programming - its variables, header files and libraries, datatypes, operators, etc.	Understanding	PSO5
	CO2: Develop programming skills in problem solving using the concepts of class, arrays, loops, friend functions, etc.	Applying	PSO5
	CO3: Develop basic knowledge on Constructors and destructors.	Understanding	PSO5
	CO4: Develop programming skills using functions, overloading, etc.	Applying	PSO5
	CO5: Develop basic knowledge and programming skills in pointers, inheritance, polymorphism, and files.	Applying	PSO5
<b>Literature and/as Identity</b>	CO1: To enable students to have a general idea about the relationship between Literature and identity.	Understanding	PSO3
	CO2: To sensitize students to the various ways in which Literature serves as a platform consolidating, critiquing and re-working the issues of identity at various levels.	Analyzing	PSO3

	CO3: The subtle negotiations of indigenous and diasporic identities within literature.	Analyzing	PSO3
	CO4: Aware students about gender equality.	Understanding	PSO3
	CO5: The emergence of life writing and alternate/alternative/marginal identities.	Understanding	PSO3
	CO6: To enable students to adopt different critical strategies to study literature in future.	Creating	PSO3
<b>Calculus</b>	CO1: Recall Maclaurin's and Taylor's theorem in calculus.	Remembering	PSO6
	CO2: Find the double and triple integrals.	Applying	PSO6
	CO3: Understand the concept of partial derivatives and associated rules.	Understanding	PSO6
	CO4: Apply the techniques of double and triple integral to physical problems.	Applying	PSO6
	CO5: Develop competency in using the idea of partial derivatives.	Applying	PSO6
	CO6: Analyze the concepts of higher order derivatives.	Analyzing	PSO6
<b>Queueing Theory</b>	CO1: Gain a solid understanding of the fundamental concepts, principles, and terminologies used in queueing theory.	Understanding	PSO6
	CO2: Learn about the structure and characteristics of queues, arrival processes, service times, and the factors influencing queue behavior.	Understanding	PSO6

	CO3: Able to calculate and analyze important performance measures in queueing systems, such as average queue length, average waiting time, system utilization, and the probability of waiting.	Applying	PSO6
	CO4: Study various queueing models, including single-server and multi-server queues, open and closed systems, finite and infinite queues, and other specialized queueing configurations.	Understanding	PSO6
	CO5: Understand the assumptions and limitations of different queueing models.	Understanding	PSO6
	CO6: Learn about different arrival and service time distributions and how to characterize them using probability distributions.	Applying	PSO6
<b>Database Management Systems And Software Lab III using SQL</b>	CO1: Understand the basics and concepts of database systems.	Understanding	PSO5
	CO2: Design, implement and evaluate a computer-based system, process, component, or program to meet desired needs.	Applying	PSO5
	CO3: An ability to use current techniques, skills, and tools necessary for computing practice.	Applying	PSO5
	CO4: Categories of DBMS (including the benefits) Desktop databases Server database.	Understanding	PSO5
	CO5: Select an appropriate DBMS suitable for a given business requirement.	Analyzing	PSO5
	CO6: Identify the contribution of database technology to society.	Evaluating	PSO5

<b>Illuminations</b>	CO1: To acquaint the learners with different forms of inspiring and motivating literature.	Understanding	PSO2
	CO2: Maintain a positive attitude to life.	Applying	PSO2
	CO3: Evaluate and overcome setbacks based on the insights that these texts provide.	Evaluating	PSO2
	CO4: The text has been designed with an objective of inducing literary sensibility.	Understanding	PSO2
	CO5: Enable the students to develop their linguistic skills.	Applying	PSO2
	CO6: Enable the students to savor the beauty of literature and develop a desire to relish life critically and creatively.	Creating	PSO2
<b>Vector Calculus, Theory of Numbers and Laplace Transforms</b>	CO1: Understand the basic knowledge of vector differentiation and vector integration.	Understanding	PSO6
	CO2: Make use of Green's theorem to find line integrals.	Applying	PSO6
	CO3: Solve differential equations using the technique of Laplace transform.	Applying	PSO6
	CO4: Determine the area of parametric surfaces in 3-dimensional space.	Applying	PSO6
	CO5: Identify the importance of Fermat's and Wilson's theorems.	Evaluating	PSO6
	CO6: Evaluate surface integrals using Stoke's theorem.	Evaluating	PSO6

<b>Non-Linear Programming</b>	CO1: Gain a comprehensive understanding of the basic concepts, principles, and characteristics of nonlinear programming problems.	Understanding	PSO4
	CO2: Learn how nonlinear optimization differs from linear programming and the challenges associated with solving nonlinear problems.	Understanding	PSO4
	CO3: Focus on constrained optimization, where the objective function is subject to inequality and/or equality constraints.	Applying	PSO4
	CO4: Learn about KKT conditions (Karush-Kuhn-Tucker conditions) and other necessary conditions for optimality in constrained nonlinear programming.	Understanding	PSO4
	CO5: Understand the distinction between local and global optima in nonlinear programming.	Understanding	PSO4
	CO6: Learn methods to identify and verify global optimality, including branch-and-bound techniques and convex relaxation approaches.	Applying	PSO4
<b>Operating System And Software Lab IV Project</b>	CO1: It is the heart of a computer system without which the system cannot run.	Understanding	PSO5
	CO2: The OS serves as the point of communication or interface between a user and the computer's hardware.	Applying	PSO5
	CO3: An operating system makes a computer capable of performing multiple tasks simultaneously for multiple users.	Applying	PSO5
<b>Mathematical Analysis</b>	CO1: Understand the difference between injection and surjection with examples.	Understanding	PSO6

	CO2: Recall the limit concepts and theorems of functions.	Remembering	PSO6
	CO3: Illustrate real line as a complete ordered field.	Applying	PSO6
	CO4: Distinguish between countable and uncountable sets.	Analyzing	PSO6
	CO5: Apply Bolzano-Weierstrass theorem for sets and sequences.	Applying	PSO6
	CO6: Determine the absolute convergence of sequences.	Evaluating	PSO6
<b>Differential Equations</b>	CO1: Find the complementary function and particular integrals of linear differential equations.	Applying	PSO6
	CO2: Understand the order, degree, and standard forms of differential equations.	Understanding	PSO6
	CO3: Identify an integrating factor and obtain the solution of a given differential equation.	Applying	PSO6
	CO4: Construct the orthogonal trajectory of the system of curves on a given surface.	Creating	PSO6
	CO5: Create power series solutions to differential equations.	Creating	PSO6
	CO6: Solve the first-order linear partial differential equations using Lagrange's method.	Applying	PSO6
<b>Abstract Algebra</b>	CO1: Illustrate the structure of group, subgroup, and cyclic groups.	Understanding	PSO6
	CO2: Explain the concepts of homomorphism, isomorphism, and automorphism.	Understanding	PSO6

	CO3: Analyze examples of subgroups, normal subgroups, and quotient groups.	Analyzing	PSO6
	CO4: Distinguish between rings, ideals, and quotient rings.	Understanding	PSO6
	CO5: Solve problems from Algebra related to Group Theory and basic Ring Theory.	Applying	PSO6
	CO6: Assess properties implied by the definition of groups, cyclic groups, subgroups, rings, integral domains, and fields.	Evaluating	PSO6
<b>Environmental Mathematics And Human Rights</b>	CO1: Understand the fundamental human rights.	Understanding	PSO3
	CO2: Understand the environment and its resources.	Understanding	PSO3
	CO3: Understand the types of pollution and social issues.	Understanding	PSO3
	CO4: Compare Fibonacci numbers and Lucas numbers and analyze their application in nature.	Analyzing	PSO3
	CO5: Explain Golden Ratio and evaluate its applications.	Evaluating	PSO3
	CO6: Construct figures based on Golden Ratio.	Creating	PSO3
<b>Applicable Mathematics</b>	CO1: Recall basic operations on real numbers.	Remembering	PSO6
	CO2: Find solutions to quadratic equations with real roots.	Applying	PSO6
	CO3: Solve problems using product, quotient, and function of function rules in differential calculus.	Applying	PSO6



	CO4: Explain basic arithmetic involving percentages, averages, time and distance, elementary algebra, and geometry.	Understanding	PSO6
	CO5: Develop Mathematical skills for solving problems.	Applying	PSO6
	CO6: Apply trigonometric ratios in problems involving heights and distances.	Applying	PSO6
<b>Real Analysis</b>	CO1: Understand the concepts of continuity, discontinuity, and uniform continuity of functions.	Understanding	PSO6
	CO2: Analyze the various properties of continuous functions.	Analyzing	PSO6
	CO3: Explain monotone and inverse functions.	Understanding	PSO6
	CO4: Apply theorems on differentiation.	Applying	PSO6
	CO5: Determine the Riemann integrability of a bounded function.	Evaluating	PSO6
	CO6: Distinguish between Pointwise convergence and Uniform Convergence.	Analyzing	PSO6
<b>Graph Theory And Metric Spaces</b>	CO1: Understand the basic concepts of graphs.	Understanding	PSO6
	CO2: Identify cut vertices and bridges.	Remembering	PSO6
	CO3: Make use of the fundamental applications of Graph Theory in different walks of life.	Applying	PSO6
	CO4: Utilize basic problems in graph theory to solve Travelling Salesman Problem, Chinese Postman Problem.	Applying	PSO6

	CO5: Explain the concepts of open sets, closed sets, and Cantor set.	Understanding	PSO6
	CO6: Examine the convergence of sequences and hence the completeness of metric space.	Analyzing	PSO6
<b>Complex Analysis</b>	CO1: Understand the concept of analytic functions and their properties.	Understanding	PSO6
	CO2: Apply the theory and techniques of complex integration.	Applying	PSO6
	CO3: Examine Taylor and Laurent series and classify singularities.	Analyzing	PSO6
	CO4: Evaluate improper integrals and definite integrals involving sines and cosines.	Evaluating	PSO6
	CO5: Interpret the concepts of poles and residues of a complex function.	Understanding	PSO6
	CO6: Solve contour integrals using residue theorem.	Applying	PSO6
<b>Linear Algebra</b>	CO1: Illustrate the basic concepts of vector space and subspaces.	Understanding	PSO6
	CO2: Identify the concepts of spanning set, linear independence, basis, and dimension.	Understanding	PSO6
	CO3: Relate rank and nullity of a linear transformation.	Applying	PSO6
	CO4: Identify a linear transformation by a matrix.	Understanding	PSO6
	CO5: Understand the basic theory of diagonalization.	Understanding	PSO6
	CO6: Construct characteristic polynomial and solve for eigenvalues, eigenvectors, and eigenspaces.	Applying	PSO6

<b>Numerical Analysis</b>	CO1: Describe guidelines on numerical problems.	Understanding	PSO6
	CO2: Explain different methods of numerical analysis.	Understanding	PSO6
	CO3: Discuss interpolation.	Applying	PSO6
	CO4: Formulate Fourier series and Fourier transforms.	Creating	PSO6
	CO5: Explain numerical differentiation and Numerical Integration.	Understanding	PSO6
	CO6: Solve problems in numerical differentiation and integration.	Applying	PSO6
<b>Project</b>	CO1: To develop your ability to design rigorous research studies.	Creating	PSO7
	CO2: To critically evaluate existing research, identify gaps or limitations in the literature, and situate your research within the broader scholarly discourse.	Evaluating	PSO7
	CO3: To apply statistical or qualitative analysis techniques, interpret findings, and draw conclusions based on empirical evidence.	Analyzing	PSO7
	CO4: To apply critical thinking skills to analyze data, interpret results, and propose innovative solutions.	Analyzing	PSO7
	CO5: To develop research timelines, set realistic goals, allocate resources, and meet project milestones.	Applying	PSO7
	CO6: To develop research timelines, set realistic goals, allocate resources, and meet project milestones.	Applying	PSO7

<b>Seminar/Assignment</b>	CO1: To enhance understanding and knowledge of the subject matter covered in the courses.	Understanding	PSO7
	CO2: To encourage the development of critical thinking skills.	Analyzing	PSO7
	CO3: Develop problem-solving skills, including the ability to identify problems, generate alternative solutions, and select the most appropriate approach to solve them.	Applying	PSO7
	CO4: Develop effective communication skills, both written and verbal.	Applying	PSO7
	CO5: Learn how to prioritize tasks, meet deadlines, and manage your workload effectively.	Applying	PSO7