

GDC Memorial College, Bahal (Bhiwani)

NAAC Accredited Grade 'B'

Department of Mathematics

Course Outcomes, Program Outcomes and Program Specific Outcomes

M.Sc. (Maths) 1st Sem.

➤ **Program Outcomes (PO)**

After successful completion of two year degree program in Maths a student should be able to:

PO1: Apply knowledge of mathematics to become competent professionals at global level.

PO2: Identify and solve complex scientific problems using mathematical skills

PO3: Apply the mathematical complex problems based on scientific principles for the analysis and interpretational data.

PO4: Select, design and apply appropriate computational techniques to solve and models physical problems.

PO5: Apply and improve the mathematical modelling to predict the effect of environment changes and contribute to the sustainable development.

PO6: Implement ethical principles and responsibilities of a mathematician to serve the society.

PO7: Communicate effectively through soft skills, report writing, documentation and effective presentations.

PO8: Perform as an individual and as a member or leader in diverse teams in multidisciplinary settings.

PO9: Engage in independent and lifelong learning in the broadest context of science and technological changes.

PO10: Enhance and adopt skills required for higher order employment or jobs through activities such as seminar, dissertation, workshops and conferences.

PO11: Successfully crack the national and international level competitive examinations.

PO12: Apply and implement mathematical/ statistical tools to analyze the data.

➤ **Program Specific Outcomes (PSO)**

Students will be able to

PSO1: Understand the mathematical concepts and applications in the field of algebra, analysis, computational techniques, optimization, differential equations, engineering, finance and actuarial science.

PSO2: Handle the advanced techniques in algebra, analysis, computational techniques, optimization, differential equations, engineering, finance and actuarial science to analyze and design algorithms solving variety of problems related to real life problems.

PSO3: Adopt changing scientific environment in the process of sustainable development by using mathematical tools.

PSO-4: Have necessary skills and expertise in the field of research and developments through seminar and dissertation.

➤ **Course Outcomes (CO):**

I. **Subject:** Mathematical Statistics **Subject Code:** 18MTH-105

After successful completion of the course, the student is expected to:

CO1: Use discrete and continuous probability distributions, including requirements, mean and variance, and making decisions.

CO2: Define binomial outcomes and compute probability of getting X successes in N trials.

CO3: Identify the characteristics of different discrete and continuous distributions.

CO4: Identify the type of statistical situation to which different distributions can be applied.

CO5: Use Poisson, exponential distributions to solve statistical problems.

CO6: Use the normal probability distribution including standard normal curve calculations of appropriate areas.

CO7: Use different distributions to solve simple practical problems.

CO8: To find Expectation (mean and variance), Moment Generating Function of discrete and uniform distributions.

II. **Subject:** Abstract Algebra-I

Subject Code: 18MTH-101

After successful completion of the course, the student is expected to:

CO1: To introduce the concepts Groups, Permutation groups, Direct product of groups, Rings, Euclidean Rings, Polynomial Rings and some related theories and to develop working knowledge of these concepts and also skills for applying them in number theory and construction of certain fields

CO2: The student will be able to Understand the concept of Groups, Normal groups and Quotients groups and permutation Groups.

CO3: The student will be able to Analyse counting principle and Sylow's theorems and apply them for describing structures of finite groups.

CO4: The student will be able to Demonstrate the knowledge of Rings, ideals of Rings and Quotient rings, Field of Quotients of an integral domain

CO5: The student will be able to Describe polynomial Rings and other forms of polynomial rings, base and Dimension of a Vector Space.

III. **Subject:** Ordinary Differential Equations

Subject Code: 18MTH-102

After successful completion of the course, the student is expected to:

CO1: Understand ordinary differential equations of various types, their solutions, and fundamental concepts about their existence.

CO2: Understand the concept and applications of eigen value problems.

CO3: Understand differential equations of Sturm Liouville type.

CO4: Apply various power series methods to obtain series solutions of differential equations.

CO5: Solve problems of ordinary differential equations arising in various fields.

IV. **Subject:** Mechanics

Subject Code: 18MTH-103

After successful completion of the course, the student is expected to:

CO1: Understand the concept of functional and determine stationary paths of a functional to deduce the differential equation for stationary paths.

CO2: Use Euler-Lagrange equation to find stationary paths and its applications in some classical fundamental problems.

CO3: Define and understand basic mechanical concepts related to discrete and continuous mechanical systems.

CO4: describe and understand the motion of a mechanical system using Lagrange Hamilton formalism.

CO5: Connect concepts and mathematical rigor in order to enhance understanding.

V. **Subject:** Measure and Integration

Subject Code: 18MTH-104

After successful completion of the course, the student is expected to:

CO1: To develop skills and to acquire knowledge on basic concepts of Lebesgue Measure, The Lebesgue Integral, Measurable Functions, L^p - spaces, Minkowski inequalities, Holder inequalities, Convergence and completeness.

CO2: the student will be able to: Understand the concept of measure and properties of Lebesgue measure.

CO3: The student will be able to: Study the properties of Lebesgue integral and compare it with Riemann integral.

CO4: The student will be able to: To establish the derivative of the indefinite integral of an integrable function is equal to the integral. To establish the equivalent condition an indefinite integral is absolutely continuous. Jensen inequality becomes a generalization of the inequality between the arithmetic and geometric mean.

CO5: To establish several inequalities involving the $\|\cdot\|_p$ in the L^p spaces. To find a representation for bounded linear functions.

CO6: After completing this course, the student shall realize the need of broader concepts of length and continuity for extending the notion of integral to widen the class of functions for which derivative and integral are inverse process to each other. Further the student gets a taste of duality theory through the classical Banach spaces.

Department of Mathematics

Course Outcomes, Program Outcomes and Program Specific Outcomes

M.Sc. (Maths) 2nd Sem.

➤ Program Outcomes (PO)

After successful completion of two year degree program in maths a student should be able to:

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PO3: Apply the mathematical complex problems based on scientific principles for the analysis and interpretational data.

PO4: Select, design and apply appropriate computational techniques to solve and models physical problems.

PO5: Apply and improve the mathematical modelling to predict the effect of environment changes and contribute to the sustainable development.

PO6: Implement ethical principles and responsibilities of a mathematician to serve the society.

PO7: Communicate effectively through soft skills, report writing, documentation and effective presentations.

PO8: Perform as an individual and as a member or leader in diverse teams in multidisciplinary settings.

PO9: Engage in independent and lifelong learning in the broadest context of science and technological changes.

PO10: Enhance and adopt skills required for higher order employment or jobs through activities such as seminar, dissertation, workshops and conferences.

PO11: Successfully crack the national and international level competitive examinations.

PO12: Apply and implement mathematical/ statistical tools to analyze the data.

➤ **Program Specific Outcomes (PSO)**

Students will be able to

PSO1: Understand the mathematical concepts and applications in the field of algebra, analysis, computational techniques, optimization, differential equations, engineering, finance and actuarial science.

PSO2: Handle the advanced techniques in algebra, analysis, computational techniques, optimization, differential equations, engineering, finance and actuarial science to analyze and design algorithms solving variety of problems related to real life problems.

PSO3: Adopt changing scientific environment in the process of sustainable development by using mathematical tools.

PSO-4: Have necessary skills and expertise in the field of research and developments through seminar and dissertation.

➤ **Course Outcomes (CO):**

I. **Subject:** Abstract Algebra-II

Subject Code: 18MTH-

201 After successful completion of the course, the student is expected to:

CO1: To study Modules and its application to finitely generated abelian groups

CO2: To understand the concept of Noetherian and Artinian Rings.

CO3: To study algebraic extension of a field and the splitting field.

CO4: When one completes an introductory course on Galois theory one will be able to visualize and appreciate the necessity of acquiring deep mathematical thought to be able to solve certain seemingly simple questions such as insolubility of quintic by radicals. The course provides an opportunity to the student to learn highly sophisticated and deep concepts in algebra such as Algebraically closed fields, splitting fields, normal and separable extensions.

CO5: The student will be able to: Demonstrate Field extensions and characterization of finite normal extensions as splitting fields and study prime fields.

Department of Mathematics

Course Outcomes, Program Outcomes and Program Specific Outcomes

M.Sc. (Maths) 3rd Sem.

➤ **Program Outcomes (PO)**

After successful completion of two year degree program in Maths a student should be able to:

PO1: Apply knowledge of mathematics to become competent professionals at global level.

PO2: Identify and solve complex scientific problems using mathematical skills

PO3: Apply the mathematical complex problems based on scientific principles for the analysis and interpretational data.

PO4: Select, design and apply appropriate computational techniques to solve and model physical problems.

PO5: Apply and improve the mathematical modelling to predict the effect of environment changes and contribute to the sustainable development.

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➤ **Program Specific Outcomes (PSO)**

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PSO3: Adopt changing scientific environment in the process of sustainable development by using mathematical tools.

PSO-4: Have necessary skills and expertise in the field of research and developments through seminar and dissertation.

➤ **Course Outcomes (CO):**

I. **Subject:** Partial Differential Equations

Subject Code: 18MTH-301

After successful completion of the course, the student is expected to:

CO1: To introduce first and second order partial differential equations and their classification and methods of finding solutions of these partial equations.

CO2: classify first order partial differential equations and their solution and solve them by various methods.

CO3: Classify second order Partial Differential equations and solve one dimensional wave equations using different analytic methods.

CO4: Solve Laplace equations using various methods and also demonstrate uniqueness of solutions of certain kinds of these equations.

CO5: Compute solutions of wave equations and heat equations.

CO6: To classify elliptic, hyperbolic, parabolic equations.

CO7: Use different Techniques to solve simple practical problems.

II. **Subject:** Differential Geometry

Subject Code: 18MTH-302

After successful completion of the course, the student is expected to:

CO1: Define the equivalence of two curves, find the derivative map of an isometry. analyze the equivalence of two curves by applying some theorems.

CO2: Defines surfaces, their properties and express definition and parametrization of surfaces and tangent spaces.

CO3: Explain differential maps between surfaces and find derivatives of such maps. Also Integrate differential forms on surfaces. To study Involutes and evolutes of space curves with the help of examples.

CO4: List topological aspects of surfaces. Define the concept of manifolds. Give examples of manifolds and investigate their properties

CO5: To be able to compute the curvature and torsion of space curves.

III. **Subject:** Mechanics of solid-1

Subject Code: 18MTH-303

After successful completion of the course, the student is expected to:

CO1: To solve advanced solid mechanics problems using classical methods Outcomes.

CO2: To understand the theory of elasticity including strain/displacement and Hooke's law relationships.

CO3: To analyze solid mechanics problems using classical methods and energy methods.

CO4: To solve torsion problems in bars and elastic moduli isotropic elastic medium.

CO5: To learn about tensors and its properties.

IV. **Subject:** Fluid Dynamics

Subject Code: 18MTH-304

After successful completion of the course, the student is expected to:

CO1: .calculate the pressure distribution for incompressible fluids.

CO2: calculate the hydrostatic pressure and force on plane and curved surfaces.

CO3: demonstrate the application point of hydrostatic forces on plane and curved surfaces.

CO4: formulate the problems on buoyancy and solve them.

CO5: To learn about the 3-dimensional sources and 2-dimensional motion.

CO6: To learn about the kinetic energy of acyclic and cyclic irrotational motion. motion.

V. **Subject:** Discrete Mathematics

Subject Code: 18MTH-305

After successful completion of the course, the student is expected to:

CO1: Students will learn the basic concepts of sets, permutations, relations, graphs, trees and finite state machines. Students will represent discrete objects and relationships using abstract mathematical structures.

CO2: Verify the correctness of an argument using propositional and predicate logic and truth tables

CO3: Construct mathematical arguments using logical connectives and quantifiers. Apply algorithms and use definitions to solve problems to prove statements in elementary number theory.

CO4: Demonstrate the ability to solve problems using counting techniques and combinatorics in the context of discrete probability.

CO5: Solve problems involving recurrence relations and generating functions.

CO6: Construct proofs using direct proof, proof by contraposition, proof by contradiction, proof by cases, and mathematical induction.

CO7: Use graphs and trees as tools to visualize and simplify situations.

CO8: Perform operations on discrete structures such as sets, functions, relations, and sequences.

Department of Mathematics

Course Outcomes, Program Outcomes and Program Specific Outcomes

M.Sc. (Maths) 4th Sem.

➤ **Program Outcomes (PO)**

After successful completion of two year degree program in Maths a student should be able to:

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PSO2: Handle the advanced techniques in algebra, analysis, computational techniques, optimization, differential equations, engineering, finance and actuarial science to analyze and design algorithms solving variety of problems related to real life problems.

PSO3: Adopt changing scientific environment in the process of sustainable development by using mathematical tools.

PSO-4: Have necessary skills and expertise in the field of research and developments through seminar and dissertation.

➤ **Course Outcomes (CO):**

I. **Subject:** Functional Analysis

Subject Code: 18MTH-401

After successful completion of the course, the student is expected to:

CO1: To learn to recognize the fundamental properties of normed spaces and of the

transformations between them.

CO2: To understand Banach Spaces, Dual Spaces.

CO3: Understand the notions of inner product and Hilbert space and apply the spectral theorem to the resolution of integral equations.

CO4: To understand Hahn Banach Theorem and open mapping theorem.

CO5: Correlate Functional Analysis to problems arising in Partial Differential Equations, Measure Theory and other branches of Mathematics.

CO6: To study Spectral theory and Spectral properties of different operators.

II. **Subject:** Integral Equations and Calculus of Variation **Subject Code:** 18MTH-402

After successful completion of the course, the student is expected to:

CO1: To solve Volterra Integral equation of first and second kind with the help of method of successive substitution.

CO2: To study Laplace transform and iterated kernels.

CO3: To study and solve Fredholm Integral equations using method of successive substitution.

CO4: To understand the concept of kernels for both Volterra and Fredholm Integral equation

CO5: To study greens theorem and understand what functionals are, and have some appreciation of their applications

CO6: Apply the formula that determines stationary paths of a functional to deduce the differential equations for stationary paths in simple cases

CO7: Use the Euler-Lagrange equation or its first integral to find differential equations for stationary paths

III. **Subject:** Mechanics of solid - II **Subject Code:** 18MTH-403

After successful completion of the course, the student is expected to:

CO1: To study two dimensional problems of Plane stress and Plane strain. Also, to find the general solution of Biharmonic equation.

CO2: To study the concept of torsion of beams and some simple problems related to circle, ellipse and equilateral triangle cross-section.

CO3: Understanding different variational method and different kinds of deflection.

CO4: To study viscoelasticity and Maxwell and kelvin models.

CO5: Focusing on Simple harmonic progressive waves, plane and spherical waves.

CO6: To understand the concept of Elastic waves.

IV. **Subject:** Advance Fluid Dynamics

Subject Code: 18MTH-404

After successful completion of the course, the student is expected to:

CO1: Knowledge of two-dimensional source, sink and doublets and their images. Irrotational motion in two dimensions.

CO2: Understanding Vortex Motion due to circular and rectilinear vortices.

CO3: Developing the relation between stress and gradient of velocity.

CO4: Flow through tubes of different cross section.

CO5: Deriving the equation of motion in cylindrical and spherical polar co-ordinates.

CO6: Analysis of Inspection and boundary layer thickness.

V. **Subject:** Mathematical Aspects of Seismology

Subject Code: 18MTH-405

After successful completion of the course, the student is expected to:

CO1: Understand the different kind of waves such as harmonic, plane waves. Wave equation and its solution.

CO2: Understand the concept of dispersion, group velocity and relation between phase and group velocity.

CO3: Have knowledge of Spherical waves and the introduction of seismology.

CO4: know about Earthquake, their location, cause, aftershocks and the internal structure of earth.

CO5: be able to reduce the equation of motion into wave equation. Understand the Snell's law of reflection and refraction.

CO6: know the concept of surface waves.

CO7: study two and three dimensional Lamb's problems in isotropic elastic solid.

II. **Subject:** Computational Techniques

Subject Code: 18MTH-205

After successful completion of the course, the student is expected to:

CO1: The objective of this course includes the study of numerical methods for Interpolation of polynomials and Approximation roots of functions and also the study of numerical methods for solving Linear system of equations and Ordinary differential equations with given initial conditions.

CO2: To study about the Error analysis and solution of linear and non-linear equations.

CO3: The study of numerical methods for solving Linear system of equations and Ordinary differential equations with given initial conditions. Apply various Mathematical operations and tasks, such as Interpolation of Polynomials.

CO4: The student will be able to: Ability to solve the Problems based on Numerical Integration.

CO5: To find Numerical solution of ordinary differential equations such as Runge- Kutta methods.

III. **Subject: Complex Analysis**

Subject Code: 18MTH-202

After successful completion of the course, the student is expected to:

CO1: Know the fundamental concepts of complex analysis.

CO2: Evaluate complex integrals and apply Cauchy integral theorem and formula.

CO3: Evaluate limits and checking the continuity of complex function & apply the concept of analyticity and the Cauchy-Riemann equations.

CO4: Solve the problems using complex analysis techniques applied to different situations in engineering and other mathematical contexts.

CO5: Establish the capacity for mathematical reasoning through analysing, proving and explaining concepts from complex analysis

CO6: Extend their knowledge to pursue research in this field.

IV. **Subject:** Topology

Subject Code: 18MTH-203

After successful completion of the course, the student is expected to:

CO1: To generalize the concept of distance, open sets, closed sets and related theorems in real line and to learn basic concepts in Metric Spaces, Topological Spaces, compact spaces and connected spaces.

CO2: To Understand the basic concepts of metric spaces, open sets, closed sets and continuous functions on metric spaces.

CO3: To Define and illustrate the concept of topology and prove a selection of theorems concerning Topological spaces, continuous functions and product topologies.

CO4: To Characterize compact spaces using the Heine-Borel theorem.

CO5: To Define and illustrate the concepts of the separation axioms and appreciate the beauty of deep mathematical results like Urysohn's lemma, Urysohn imbedding

theorem and understand the dynamics of the proof techniques. Characterize connected spaces, components of a space.

V. **Subject:** Operations and Research Techniques

Subject Code: 18MTH-

204 After successful completion of the course, the student is expected to:

CO1: To develop problem solving skills and to acquire knowledge on basic concepts of in linear programming problems, Transportation problems, Assignment problems and Job sequencing.

CO2: The student will be able to: Formulate and solve a linear programming problem.

CO3: The student will be able to: Convert standard business problems into linear programming problems and can solve using simplex algorithm.

CO4: The student will be able to Formulate and solve transportation problems.

CO5: The student will be able to: Formulate and solve the Assignment problem. **CO6:** The student will be able to learn about the queuing system and queuing models. **CO7:** To understand Economic Control Quality

