

OBE HANDBOOK

LEARNING OUTCOMES

PO, PSO & CO

PG DEPARTMENT OF MATHEMATICS AND STATISTICS



ST. GEORGE'S COLLEGE ARUVITHURA PG DEPARTMENT OF MTHEMATICS AND STATISTICS

OBE HANDBOOK

LEARNING OUTCOMES PO, PSO &CO



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PROGRAMME OUTCOMES

	Effective Communication :- Speak, read, write and listen clearly in person
	and through electronic media in English and in one Indian language and make
PO1	meaning of the world by connecting people, ideas, books, media and
	technology.
	Self-directed and Lifelong Learning :- Acquire the ability to engage in
PO2	independent and life-long learning in the broadest context socio-technological
	changes.
	Effective Social Interaction :- Elicit views of others, mediate disagreements
PO3	and help reach conclusions in group settings.
	Evaluative Thinking :- Take informed actions after identifying the
	assumptions that frame our thinking and actions, checking out the degree to
PO4	which these assumptions are accurate and valid, looking at our ideas and
	decisions(intellectual, organizational and personal) from different perspectives.
	Ideal Citizenship :- Demonstrate empathetic social concern and equity centred
PO5	national development, and the ability to act with an informed awareness of
	issues and participate in civic life through volunteering.
	Ethics :- Recognize different value systems including your own, understand the
PO6	moral dimensions of your decisions, and accept responsibility for them.
	Environment and Sustainability :- Understand the issues of environmental
PO7	contexts and sustainable development.
	Digital Knowledge System :- Adequate training in the application of digital
PO8	knowledge in higher education and workplace.

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PROGRAMME SPECIFIC OUTCOME

PSO1: Enhance employability through numerical skills, linguistic skills, logical reasoning and statistical ability.

PSO2: Exemplify analytical skills in mathematical analysis, trigonometry, calculus, algebra and differential equations in real life scenarios.

PSO3 : Apply the concepts of analytic geometry and vector calculus in spatial visualization and geometric modelling.

PSO4 : Design inter-connection networks using the concepts in graph theory to solve problems in diverse fields like computer science, artificial intelligence and machine learning.

PSO5 : Apply various optimization techniques in decision-making and statistical tools in data analysis.

COURSE OUTCOMES

SEMESTER 1

MM1CRT01: Foundation of Mathematics

CO1: Understand propositional logic, equivalence, rules of inference and introduction to proofs.

CO2: Understand sets, set operations and functions

CO3: Understand relation and their properties, equivalence relations and partial orderings.

CO4: Understand more about equations and apply different methods for finding roots of equations.

MM1CMT03: Discrete Mathematics(I)

CO1: Understand propositional logic, equivalence and rules of inference.

CO2: Demonstrate sets, set operations and functions and understand its properties.

CO3: Understand number theory and basics of cryptosystems.

CO4: Understand relation and their properties, equivalence relations and partial orderings of various sets.

MM1CMT01: Partial Differentiation, Matrices, Trigonometry and Numerical Methods

CO1: Apply chain rule to find the partial derivatives

CO2: Solve a system of equations using matrices transformation

CO3: Evaluate eigen values and eigen vectors of a matrix

CO4 : Memorize the theory of trigonometry and apply basic trigonometric properties to find expansions

CO5: Understand various numerical methods to solve a function

ST1CMT01: Descriptive Statistics

CO1: Understand the basic steps in the collection, classification and tabulation of data, scaling techniques and construction of diagrams and graphs

CO2: Learn the measures of central tendency and dispersion for data analysis

CO3: Understand the measures of skewness and kurtosis to explain the nature of a data.

CO4: Understand the construction of various index numbers and its uses.

ST1CMT01: Basic Statistics and Introductory Probability Theory

CO1: Understand the properties of data and learn the basic measures for a data analysis

CO2: Explain the nature and extend of the relationship between the values of two numerical variables through correlation and regression

CO3: Recollect the basic concepts and applications of probability.

CO4: Introduce the concept of random variables, probability distributions, moment generating functions and their properties.



MM2CRT01: Analytic Geometry, Trigonometry and Differential Calculus

CO1: Understand tangents and normal of a conic, pole and polar and conjugate diameters of ellipse.

CO2: Understand polar co-ordinates and polar equations

CO3: Apply the method of separation of functions of complex variables into real and imaginary parts, various methods for factorization and the C + iS method for summation.

CO4 : Understand successive differentiation and indeterminate forms and apply L' Hospitals Rule for finding limits of functions.

MM2 CMT03: Discrete Mathematics (II)

CO1: Discuss the concepts of vector valued functions

CO2: Impliment integration in vector fields

CO3 : understand analytic geometry and coordinate system specifically the polar coordinate system.

CO4: Understand the basics of abstract algebra.

MM2CMT01: Integral Calculus and Differential Equations

CO1: Understand differential calculus.

CO2: Describe basic ideas of partial derivatives.

CO3: Apply integration to find volumes of different structures.

CO4: Understand and implement the idea of multiple integrals to find volume of different structures.

ST2CMT02: Probability Theory

CO1: Remember the basic concepts, operations and theorems of probability.

CO2: Discuss the concepts of random variables, probability desnsity functions, cumulative distribution functions of univariate random variable with the help of some problems

CO3 : Understand the joint probability distributions of two discrete/ continuous random variables.

CO4: Apply statistical tools to explain the nature and extend of the relationship between the values of two numerical variables.

MM3CRT01: Calculus

CO1: Expand functions using Taylor's and Maclaurin's series.

CO2: Acquire knowledge on Asymptotes and Envelopes.

CO3: Find the partial derivatives of functions.

CO4: Calculate the volume of solid of revolution and find the length of the curves.

CO5: Demonstrate substitution in multiple integrals for different coordinate systems.

MM3CMT03 : Vector Calculus, Analytic Geometry and Abstract Algebra

CO1: Understand vector valued functions and apply the concept of vector differentiation for finding arc length, curvature and directional derivatives.

CO2: Understand vector integration and apply vector integration work, circulation and flux and apply Green's theorem, Stoke's theorem and divergence theorem.

CO3: Understand polar co-ordinates, conic sections and conics in polar co-ordinates.

CO4: Understand groups, cyclic groups, permutation groups and homomorphism

ST3CMT03: Probability Distributions

CO1: Understand the terms expectation in univariate and bivariate cases, moment generating function, characteristic function and their properties.

CO2: Understand different probability distributions, their properties and uses.

CO3: Learn different laws, inequalities and theorems for large sample cases.

CO4: Learn different sampling distributions, their construction, properties and inter relationship.

ST3CMT02: Advanced Statistical Methods

CO1: Understand important probability distributions, their properties and applications

CO2: Learn different sampling distributions, their construction, properties and inter relationship.

CO3: Explains different methods of estimation of parameters involved in a pdf and the properties of estimators.

CO4 : Apply the statistics learnt in sampling distributions to test different types of statistical hypothesis including population mean, proportion and tests related to attributes.

MM4CRT01: Vector Calculus, Theory of Numbers and Laplace Transforms

CO1 : Memorize vector calculus and understand more on vector calculus.

CO2: Understand vector integration.

CO3: Understand basics of number theory.

CO4 : Understand Laplace transform.

MM4CMT04 : Fourier Series, Laplace Transform and Complex Analysis

CO1: Understand Fourier Series and Legendre polynomials.

CO2: Understand Laplace Transform and apply Laplace Transform to solve differential equations.

CO3: Understand complex numbers and Cauchy – Reimann equations.

CO4 : Understand line integrals in complex plane and apply Cauchy's Integral Theorem and Cauchy's Integral formula.

MM2CMT03 : Operations Research

CO1: Understand the meaning of operations research, nature and models used in operations research

CO2: Learn different methods of solving a linear programming problem like graphical method and simplex method

CO3: Learn to solve transportation and assignment problems

CO4: Understand the concept of game theory and solving different types of games.

ST4CMT04: Statistical Inference

CO1 : Understand the terms involved in inferential statistics and the properties of estimators.

CO2: Understand different methods of estimation of parameters in a population.

CO3: Discuss the terms in a statistical hypothesis testing procedure and apply the normal distribution in large sample tests related to population mean, proportion and tests related to attributes.

CO4: Apply different sampling distributions in testing of hypothesis when sample size is small.



MM6CRT01: Mathematical Analysis

CO1: Understand real numbers thoroughly with the help of various properties like algebraic, order and completeness properties and the concepts supremum and infimum.

CO2: Understand real sequences and their limits and various properties of convergent and divergent sequences and apply the results to check whether a sequence is convergent or divergent.

CO3: Understand series and absolutely convergent series and apply the results to check whether a series is convergent or divergent.

CO4: Understand the concept of limit of functions and find the limit of various functions.

MM5CRT02: Differential Equations

CO1: Understand nature of solutions, types of differential equations, , reduction of orderdependent variable missing-independent variable missing.

CO2: Learn to solve the second order linear equations with constant coefficients and higher order linear equations

CO3: Understand power series solutions and special functions

CO4: Understand partial differential equations, origin of first order partial differential equations, linear equations of the first order and Lagrange's method

MM5CRT03: Abstract Algebra

CO1 : Understand the basic definitions of binary operation, groups and different classification of groups and elementary properties of groups.

CO2: Learn permutations, coset definitions and Cayley's and Lagrange Theorems.

- **CO3**: Understand the concept of homomorphism and factors groups.
- **CO4**: Analyse rings and fields and their basic properties.

Human Rights And Mathematics For Environmental Studies

CO1 : Understand about nature of environment, conservation of various natural resources and use of resources for sustainable life style and structure and conservation of ecosystems.

CO2: Familiarize biodiversity and its conservation, causes effects and control measures of environment pollution and different types of environment protection acts.

CO3: Discuss the presence of fibonacci numbers in nature.

CO4 : Understand golden ratio, geometric interpretation and its construction, golden ratio and human body , golden ratio by origami.

CO5: Understand human rights in India and various organs - UNESCO, UNICEF, WHO, ILO, conservation of natural resources and human rights

MM5OPT02: Applicable Mathematics

CO1: Recollect Types of numbers, HCF & LCM of integers, Fractions, BODMAS rule, squares and square roots, ratio and proportion, percentage, profit & loss.

CO2: Remember solution of quadratic equations with real roots, permutations and combinations, Trigonometry- introduction, values of trigonometric ratios , Heights and distances.

CO3: Remember simple interest, compound interest, time and work, work and wages, time and distance, exponential series and logarithmic series.

CO4: Remember area and perimeter of polygon, factorization of quadratic, cubic polynomials, basics of differentiation including product rule, quotient rule.

MM6CRT01: Real Analysis

CO1: Understand continuous functions and uniformly continuous functions and check the continuity of various functions.

- CO2: Understand the concept differentiability, Mean value Theorem and L' Hospital Rules.
- **CO3:** Understand the concept Riemann integrability and Riemann integrable functions.

CO4: Understand sequences and series of functions and point wise and uniform convergence.

MM6CRT02: Graph Theory and Matric Spaces

CO1: Understand basic definitions and theory of graph

CO2: Discuss theorems and properties related with the theory of graphs and understand Euler's tour and hamiltonian graphs and related problem.

CO3 : Understand definition of metric space with examples, open sets, closed sets and cantor set.

CO4: Understand convergence, completeness and continuous mapping.

MM6CRT03: Complex Analysis

CO1: Understand analycity of a complex function and different types of functions.

CO2: Understand the complex integration and solve using Cauchy's integral formula, fundamental theorem and maximum modulus principle.

CO3: Examine the convergence of Taylor and Laurent's series.

CO4 : Understand residues and poles using Cauchy's residue theorem.

MM6CRT04: Linear Algebra

CO1: Understand more applications of matrices in systems of linear equations.

CO2: Analyse vector space ,its basis and dimension.

CO3: Understand linear mapping, linear isomorphism, ordered basis, transition matrix from a basis to another, nilpotent and index of nilpotency.

CO4: Apply matrix operation to find out eigen values, eigen vectors, geometric multiplicity, eigen apace and diagonalization.

MM6CBT01: Operations Research

CO1: Understand Linear Programming Model Formulation And Solution By The Graphical Method And The Simplex Method

CO2: Understand Formulation Of Dual LPP, Standard Results On Duality, Advantages Of Duality And Theorems Of Duality With Proof.

CO3: Learn To Solve Transportation And Assignment Problems

CO4 : Understand The Basic Concepts Of Game Theory And Solution Of Games With And Without Saddle Point.

MM6PRT01: Project

CO1: Memorize the basics of pure mathematics.

CO2: Learn a new concepts based on their literature survey on their interest.

CO3: Discuss the new concept that acquired from surveys.

CO4 : Organize the literature review.

M. Sc Mathematics

PROGRAMME SPECIFIC OUTCOMES

PSO1: Analyze, execute tasks and solve problems in daily life and at work.

PSO2 : Explain and transform the physical problems using the knowledge of mathematical theories .

PSO3 : Solve problems relating to specialised mathematical topics like Combinatorics and Graph Theory using appropriate tools and techniques.

PSO4: Apply the mathematical skills in objectivity, creativity, independent thinking, analyzing & amp; mathematical problem-solving.

PSO5 : Demonstrate advanced knowledge and fundamental understanding of specialised mathematical topics.

SEMESTER 1

ME010101: Absract Algebra

CO1: Learn to construct and describe groups

- CO2 : Understand the properties of groups and get familiar with important classes of groups
- CO3: Understand the structure of finitely generated abelian groups
- CO4 : Familiar with rings and their arithmetic

ME010102 : Linear Algebra

CO1 : Able to prove and apply the primary decomposition theorem and the criterion for diagonalisability.

- CO2 : Develop a good knowledge of adjoint of linear map.
- CO : Understand the concept of vector space, subspaces, bases and dimension.
- CO4 : Learn representation of transformations by matrices

ME010103 : Basic Topology

CO1 : Understand well the concepts of homeomorphisms and how it preserves a variety of topological properties

CO2: Understand separation axioms and find their differences

CO3 : Know what we mean by connectedness, compactness and Hausdorff property and their general characteristics

CO4 : Understand well the concepts of continuity of functions and quotient spaces

CO5: Understand the use in string theory in physics, and for describing the space-time structure of universe.

ME010104 : Real Analysis

CO1 : Aquaint with the ideas of the total variation and deal with functions of bounded variation

CO2: Learn the theory of Riemann-Stieltjes integrals

CO3 : Illustrate the effect of uniform convergence on the limit function with respect to boundedness, continuity, differentiability and integrability.

CO4 : Gain knowledge of special functions and to study various properties of them.

ME010105 : Graph Theory

CO1 : Studying graphs through a framework provides answers to many arrangements.

CO2 : To understand networking, optimization, matching and operational problem

CO3 : To understand connectivity concept in graph theory, trees, related concepts, graph coloring and its application in real life situations

CO4 : To understand the concept of planarity of graphs, its applications, Four-color theorem and Heawood five color theorem.

ME010201: Advanced Abstract Algebra

- CO1: Understand the concept of extension field
- CO2: Learn geometric constructions
- CO3 : Understand unique factorization theorem
- CO4 : Understand spliting fields

ME010202 : Advanced Topology

- CO1 : Understand well the concepts of homotopy and path homotopy
- CO2: Understand separation axioms and find their differences
- CO3: Know what we mean by net and convergence
- CO4: Understand product topology and productive properties
- CO5: Understand Urysohn characterisation of normality

ME010203 : Numerical Analysis with Python

- CO1 : To understand why Python is a useful scripting languages in mathematics .
- CO2 : To learn how to use lists, tuples and dictionaries in Python programs.
- CO3 : To understand how to represent mathematical symbols in Python language(Sympy).
- CO4 : Understand how to plot graphs using Sympy.
- CO5: Understand to find limits, continuity, derivatives and integration using Python languages.

ME010204 : Complex Analysis

CO1: To understand the spherical representation of complex numbers, theory of power series and related theorems.

CO2: To understand fundamental theorems on complex integration in detail

CO3 : Able to find higher derivatives, able to find singularities and identify the type of singularity.

CO4 : Understand the general form of Cauchy's theorem , calculating residues, prove the Cauchy Residue theorem.

ME010205 : Measure and Integration

CO1 : Introducing measure as generalization of length

- CO2 : Learn the concept of measures and measurable functions
- CO3 : Understand the signed measures and its applications.
- CO4 : To introduce the product measures.

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ME010301 : Advanced Complex Analysis

CO1 : To understand harmonic function in detail, to understand schwarz theorem, geometrical interpretation of Poisson Formula

CO2 : To understand that any analytic function has a power series representation and can express it as an infinite product

CO3 : Able to evaluate integrals along a path, compute the Taylor and Laurent expansion of simple functions

CO4 : Understand the singularities and calculating residues, prove the Cauchy Residue theorem.

ME010302 : Partial Differential Equations

CO1: Understand to solve the PDEs independently.

CO2: Be able to solve linear and non linear PDEs in first order.

CO3: Be able to determine the type of a second order PDE.

CO4: Understand to solve PDEs in higher dimensions.

CO5: Understand to convert partial differential equations to canonical form.

CO6 : Understand what are well posed initial value problem for classical PDEs such as the wave equation, Laplace equation and the diffusion equation

ME010303 : Multivariate Calculus & Integral Transforms

CO1 : To discuss different types of integral transforms.

CO2: Develop an idea of functions of several variables

CO3 : Understand necessary and sufficient condition for differentiability and inverse , implicit function theorem

CO4 : Impart basic knowledge of differentiation and integration in n-dimensional Euclidean space.

ME010304 : Functional Analysis

CO1 : Understand the different distance metrics and normed spaces

CO2 : Understand the general properties of linear operators and their depencies on functional spaces

- CO3: Understand bounded and continuous linear operators
- CO4 : Learn about inner roduct spaces and Hilbert spaces
- CO5: Understand differeent Hahn-Banach theorems

ME010305 : Optimization Techniques

- CO1: Understand to solve linear programming problems in graphical and algebraic methods.
- CO2: Understand the concept of duality.
- CO3: Understand to solve integer programming problems.
- CO4 : Develop concepts of flow and potential in networks.

CO5 : Understand to solve non linear programming problems with constrained and unconstrained extremas



ME010401 : Spectral Theory (Core)

CO1: Learn open mapping theorem and closed graph theorem

CO2: Understand the meaning of eigen values, spectrum, resolvent set of a matrix

CO3.: Understand the concept of spectrom of bounded linear operators on finite dimensional spaces

CO4 : .Understand the concept of spectrom of compact linear operators.

CO5 : Understand positive operators and projection operators

ME010402 : Analytic Number Theory (core)

- CO1: Understand the concept of arithmetic functions
- CO2 : Learn partial sums of Dirichlet products
- CO3 : Understand the concept of conguences and related theorems
- CO4: Understand the concept of primitive roots

ME800401 : Differential Geometry(Elective)

CO1: Understand concepts of graphs and level sets.

- CO2 : Understand to explain vector fields on surfaces.
- CO3 : Analyze geodesics, parallel transport and Weingarten map.
- CO4: Understand properties of surfaces-curvature, local equivalence.
- CO5: Understand to identify different types of surfaces.

ME800402 : Algorithmic Graph Theory(Elective)

CO1: To understand the complexities of algorithms, search and sorting algorithms, and representation of graphs in computer

CO2: Able to find the depth-first and breadth-first search and minimum spanning tree problem

CO3 : To undesrtand the concept of graphs through a framework provides answers many arrangement, networking, optimization, and operational problems

CO4 : To understand the concept of matching and maximum matching in bipartite graphs

ME800403 : Combinatorics(Elective)

- CO1 : To use algebraic concepts to solve basic problems in real life
- CO2 : To introduce Ramsey type problems and Ramsey numbers
- CO3 : Apply combinatorial principles and techniques to solve counting problems
- CO4 : Compute a generating function and apply it to solve combinatorial problems

Project/Dissertation

CO1 : Enhance research skill

CO2 : Apply the knowledge of mathematical concepts in interdisciplinary fields.

CO3 : Students will be able to demonstrate critical understanding at an advanced level with up-to-date knowledge in research methodology of his/her field of interests.

CO4 : Students will be completely prepared to take up PhD and continue his/her research.