



# ST FRANCIS DE SALES COLLEGE

Permanently Affiliated to Bangalore University || AICTE Approved Electronic City, Bengaluru - 100

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**A FRANSALIAN INSTITUTE OF HIGHER LEARNING**

## DEPT. OF SCIENCE

### MSc Mathematics

#### PO-PSO-CO

#### **Program Specific Outcome (PSO):**

Program Specific Outcome 1 (PSO1): Prepare and motivate students for research studies in mathematics and related fields. Provide knowledge of a wide range of mathematical techniques and application of mathematical methods/tools in other scientific and engineering domains.

Program Specific Outcome 2 (PSO2): Ability to learn the fundamentals of computational thinking and programming using mathematical tools .

Program Specific Outcome 3 (PSO3): Prepare students for pursuing research or careers in industry in mathematical sciences to take up jobs that require sound knowledge in Mathematics in different private and public sectors Develop soft skills in practicing professional ethics.

Program Specific Outcome 4 (PSO4): Nurture problem solving skills, thinking, creativity through assignments, project work.

Program Specific Outcome 5 (PSO5): Elicit views of others, mediate disagreements and help reach conclusions in group settings.

**COURSE OUTCOME (CO)**

**IV SEMESTER**

**Name of the Course:** Measure and Integration

<b>CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	After studying this course, you will be able to gain an understanding of the concepts of Measurability of continuous functions	PSO- 1, 2	R, U
CO2	After studying this course, you will be able to gain an understanding of the concepts of measurability of a continuous image of measurable function	PSO- 3, 4	U, Ap, An
CO3	Able to identify convergence theorems and Lebesgue integral, bounded convergence theorem	PSO- 3, 4, 5	U, Ap, E
CO4	convergence theorems and Lebesgue integral, bounded convergence theorem, Fatou's lemma	PSO- 1, 3, 4	U, Ap, E

**Name of the Course:** Mathematical Methods

<b>CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	After studying this course, you will be able to solve unseen mathematical problems involving understanding of these concepts and application of these methods	PSO- 1, 2, 3,5	R, U,Ap
CO2	Able to explain how mathematics can be used to solve problems in economics and related subjects	PSO- 1, 4	R, U, Ap

**Name of the Course: Entire and Mesomorphic Functions**

<b>CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	After studying this course, you will be able to gain an understanding of Meromorphic Functions	PSO- 1, 2, 5	R, U,Ap
CO2	Nevanlinna's Characteristic Function, Cartan's Identity and Convexity Theorems,	PSO- 3, 4	U, Ap, E
CO3	Able to understand Order of a Meromorphic Function and its Derivative	PSO- 1, 3	Ap, E, C

**Name of the Course: Magnitohydro dynamics**

<b>CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	After studying this course, you will be able to gain an understanding of Electrodynamics Ampere's law and solenoidal property	PSO- 3, 4	R, U
CO2	Able to understand Electrostatics and electromagnetic units derivation of Gauss law- Faraday's law	PSO- 3, 4	U, E
CO3	Able to understand Alfvén's theorem - Frozen in phenomenon circulation theorem-Bernoulli's equations - Analogue of Helmholtz vorticity equation	PSO- 3, 4,5	U, E, C
CO4	Illustrative examples, Kelvin's circulation theorem-Bernoulli's equations - Analogue of Helmholtz vorticity equation	PSO- 3, 4	Ap, An, E

**Name of the Course:** Graph Theory

<b>CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	After studying this course, you will be able to define the basic concepts of graphs, directed graphs, and weighted graphs, define a graph, identifying edges and vertices, find the degree of a vertex	PSO- 3, 4	R, U
CO2	Able to understand planar graphs and Euler poly hadron formula	PSO- 3, 4	U, E
CO3	Able to understand Vertex and Edge connectivity of graphs	PSO- 3, 4,5	U, E, C
CO4	Able to define the concept of Matching and marriage problem	PSO- 3, 4	Ap, An, E

**Name of the Course:** Latex and Latex Beamer

<b>CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	After studying this course, you will be able to include Mathematical symbols $\Delta, \pi, \varphi, \infty, \mu, \alpha, \eta, \theta, \lambda, \xi, \chi, \tau, \sigma, \beta, \Omega, \Psi, \Upsilon, \vartheta$ ect., write and display Mathematical Equations	PSO- 3, 4	R, U
CO2	Able to understand t how to create a table in different forms, import figures and graphs into latex document	PSO- 3, 4	U, E

### III SEMESTER

**Name of the Course:** Differential Geometry

<b>CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	Learn basic concepts of Geometry and Differential Calculus.	PSO- 1	R, U
CO2	Understand the concepts of Frame Fields.	PSO- 3, 4	U, Ap, An
CO3	Understand the concept Calculus on a Surface	PSO- 3, 4, 5	U, Ap, E
CO4	Learn about shape operators.	PSO- 1, 3, 4	U, Ap, E

**Name of the Course:** Fluid Mechanics

<b>CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	Learn basic concepts of Fluid Mechanics such as Gradient ,Divergence,Curl,Tensors	PSO- 1	R, U
CO2	Understand Fundamental basic physical laws: Conservation of mass ,energy,Momentum.	PSO- 1, 4	R, U, AN
CO3	Understand the Navier Stokes Equation and its consequences.	PSO- 1,4,	An, U, Ap
CO4	Learn about Two dimensional flows of inviscid fluids.	PSO- 1, 3, 5	, U, E

**Name of the Course: Functional Analysis**

<b>CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	Learn Basic Concepts of Functional analysis and linear algebra.	PSO- 1	R, U
CO2	Learn Hahn banach theorem and related concepts	PSO- 3, 4	U, Ap, E
CO3	Understand the concepts of Inner product space and Orthogonality with Gram Schmidt Algorithm	PSO- 1, 3	Ap, E
CO4	Understand the concepts of Hilbert Spaces in detail.	PSO- 1,3	U, R

**Name of the Course: Linear Algebra**

<b>CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	Understand the basic concepts of Linear Algebra.	PSO- 1	R, U
CO2	Understand the relation between Linear transformation and Matrices.	PSO- 1,3, 4	U,Ap, E
CO3	Learn the Canonical forms of Linear transformation and their applications.	PSO-1, 3, 4,5	U, E, Ap
CO4	Learn concepts of applied linear algebra.	PSO- 2,5	Ap, An, E

**Name of the Course:** Numerical Analysis - II

<b>C O</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	Understand the different techniques of solving Ordinary Differential Equations Numerically.	PSO- 1,2, 4	R, U,Ap
CO2	Understand the different techniques of solving Partially Differential Equations Numerically.	PSO- 1,2, 4	R,U,Ap

**Name of the Course:** Scilab Practicals based on M305T

<b>C O</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	Learn How to solve Ordinary differential Equations Computationally using different methods.	PSO- 2, 4	Ap,E
CO2	Learn How to solve Partial differential Equations Computationally using different methods.	PSO- 2, 4	Ap,E

## II SEMESTER

**Name of the Course:** Algebra II

<b>CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	After studying this course, you will be able to recall and be able to use the axioms that define a ring and know the basic properties of rings arising from these axioms. know how to add and multiply polynomials over arbitrary fields. You can also use this to define polynomial rings	PSO – 1,2,3	R, U, Ap

CO2	Solving polynomial equations using formulas for roots	PSO – 1,2,3	U, An, E
CO3	How to test if a polynomial is irreducible Finite Field (Galois Fields)	PSO -1,2,3	U, An, E
CO4	Understanding which equations can be solved using radicals using the conce	PSO -1,2,3	U, An, E
CO5	Ability to understand/obtain the roots of a polynomial equation if the same has (or can be reduced to) degree less than five	PSO -3,4,5	R, U, Ap

**Name of the Course:** Topology II

CO	Course Outcome <i>The learner will be able to</i>	PSOs Addressed	Cognitive Level
CO1	After studying this course, you will be able to gain an understanding of the concepts of metric spaces and topological spaces	PSO- 1, 2	U, R
CO2	Able to identify role in mathematics Metric spaces and have familiarity with a range of examples of these structures	PSO- 3, 4	R, Ap, An, E
CO3	Topological spaces • Connectedness, compactness, separation axioms • Continuity • Metric spaces review • Fundamental groups • Covering spaces • Computation	PSO- 3, 4	R, Ap, An, E
CO4	Generalization of concepts like continuity • G Distinguishing spaces up to homeomorphism	PSO- 1, 2, 4,5	R, Ap, E

**Name of the Course:** Complex Analysis

CO	Course Outcome <i>The learner will be able to</i>	PSOs Addressed	Cognitive Level
CO1	Understanding of topological and geometric properties of the	PSO- 1, 3	R, U



	complex plane		
CO2	Differentiation and integration of functions on $\mathbb{C}$	PSO- 1, 2	U, Ap, An
CO3	applications to problems from real analysis	PSO- 2, 3, 5	U, Ap
CO4	Viewing analytic functions as conformal mappings	PSO- 1, 3	U, Ap, E

**Name of the Course:** Elementary Number Theory

<b>CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	Able to understand definitions of divisibility and related algorithms	PSO- 1, 2, 5	U, Ap
CO2	Basic congruence results	PSO- 2, 3	R, U, E
CO3	Diophantine approximation and transcendental numbers Skills gained: Arithmetical functions	PSO- 2, 3	U, Ap, An
CO4	Solutions of Diophantine equations	PSO- 2, 3, 4	U, Ap, E
CO5	Distribution of primes Competency developed: • Useful tools in cryptography and related applied subjects	PSO- 2, 3	U, Ap, An, E

**Name of the Course:** Partial Differential Equations

<b>CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	The student masters the basic principles and methods for the analysis of partial differential equations	PSO- 1	R, U, Ap
CO2	first-order equations, Cauchy's problems, characteristics, linear second-order equations, classification, boundary value problems for elliptic equations	PSO- 1	U, E
CO3	boundary and initial value problems for hyperbolic and parabolic equations, fundamental solutions, maximum	PSO- 2, 3	Ap, An

	principles		
CO4	maximum principles, weak solutions and functional analytic methods. 2. Skills	PSO- 2, 3	Ap, An
CO5	Skills. The student is able to apply the techniques to study specific examples, understand the proofs and apply central proof techniques of related problems	PSO-2, 3	Ap, An, E

**Name of the Course: Numerical Analysis I**

<b>CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	After studying this course, you will be able to derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, solution of linear and nonlinear equations, and the solution of differential equations	PSO- 1, 4	R, U
CO2	You can analyse and evaluate the accuracy of common numerical methods also	PSO- 1, 3, 5	R, U, Ap
CO3	Familiar with finite precision computation	PSO- 3,4,5	Ap, An, E
CO4	Familiar with calculation and interpretation of errors in numerical methods	PSO- 3, 4	Ap, An, E
CO5	Familiar with numerical solutions of nonlinear equations in a single variable	PSO- 1, 3, 4,5	U, E, C

**Name of the Course: Sci lab Practicals Based on Numerical analysis II**

<b>CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>

CO1	After studying this course, you will be able to find the root of the function using Fixed-point iterative method and Newton-Raphson method	PSO- 1,2, 4	R, U
CO2	You can find the solution of system of equations using Gauss-elimination method with pivoting	PSO- 1, 4	U. Ap, An
CO3	Crout's LU Decomposition method, and Doolittle LU Decomposition method	PSO- 3, 4	Ap, An, E
CO4	You can do numerical integration using Gauss-Legendre method and Gauss- Chebyshev method	PSO- 2, 4	Ap, An, E

### I SEMESTER

**Name of the Course:** Algebra I

CO	Course Outcome <i>The learner will be able to</i>	PSOs Addressed	Cognitive Level
CO1	After studying this course, you will be able to recall and be able to use the axioms that define a Group and a Ring ,will able to know the basic properties of Groups and rings arising from these axioms. Also able to define Ideals, Euclidean Rings,UFD,polynomial rings.	PSO – 1,3	R, U
CO2	Learn different types of Isomorphism Theorems .	PSO – 1,3	U, An
CO3	Understanding the structure of a group using Sylow's theorems.	PSO -1,3,4	U, An, Ap
CO4	Able to understand Irreducible polynomials using Eisenstein Criteria.	PSO -1,3,4	U, An
CO5	Relation between Rings and division algorithm	PSO -2,4,5	R, U, Ap,E

**Name of the Course:** Topology I

<b>CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	Able to understand basic set theory.	PSO- 1, 3	U, R
CO2	Concept of Metric spaces ,Open balls and closed balls are dealt in detail.	PSO- 3, 4	R, Ap, An
CO3	Topological spaces ,Open and Closed Sets.Relative topology.	PSO- 3, 4	R, Ap, An
CO4	Connectedness, compactness, separation axioms of Topological spaces will be understood.	PSO- 1, 4,5	R, Ap

**Name of the Course:** Real Analysis

<b>CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	Understanding The concepts of Riemann Integral and Riemann -Stieltjes Integrals.	PSO- 1, 3	R, U
CO2	Convergence of sequence and series of functions,using different tests.	PSO- 1, 3	U, Ap, An
CO3	Understanding multi dimensional Real space and generalized theorems .	PSO- 1, 3, 4	U,An
CO4	Concepts of Linear transformation ,Directional derivatives ,and understanding Inverse and implicit Function theorems.	PSO- 1, 3,5	U, Ap, E

**Name of the Course:** Mathematical Analysis.

<b>CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	Recap of basic concepts of limits Continuity and differentiability	PSO- 1, 5	U, Ap
CO2	Learn Mean Value theorems and Derivatives of Higher Order, Taylor's Theorem.	PSO- 1, 3	R, U, An
CO3	Understand the Convergence of Sequences and Series ,Cauchy Criteria	PSO- 1 3	U, Ap, An
CO4	Computation with Series, Double series.	PSO- 2, 3, 4	U, Ap

**Name of the Course:** Ordinary Differential Equations

<b>CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	Basic concepts of Linear Differential Equations and their relation with Linear algebra.	PSO- 1,4	R, U
CO2	Existence and uniqueness of solutions, Sturm-Liouville Problems.	PSO- 1	U, An
CO3	Will learn how to Solve Linear Differential Equations using Power Series Methods.	PSO- 2, 3	Ap, E
CO4	Learn Advanced concepts like Critical points, Stability of Linear differential Equations	PSO- 1,5	Ap, E

**Name of the Course:Discrete Mathematics**

<b>Name of the Course Faculty: Padmavathi.V CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	Understanding the basic logics,direct proofs and indirect proofs.	PSO- 1, 3,4	R, U
CO2	Learn Counting techniques and basic algorithms.	PSO- 1, 2, 5	R, U, Ap,E
CO3	Learn techniques of Recurrence relations and how to form generating functions.	PSO- 2,4,5	Ap, An, E
CO4	Basic concepts of graph theory definitions and examples.	PSO- 3, 4	Ap, An
CO5	Learn Advanced algorithms of Graph theory.	PSO- 1,2, 3, 4,5	U, E, C

**Name of the Course:Maxima practicals based on paper M105T**

<b>CO</b>	<b>Course Outcome</b> <i>The learner will be able to</i>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO1	After studying this course, you will be able to understand the concepts of Relations computationally.	PSO- 1,2, 4	Ap,An
CO2	You can Plot graphs using maxima and understand the basic concepts.,	PSO- 1, 2	Ap, An
CO3	Able to solve problems of graph theory using Algorithms computationally.	PSO- 3, 2	Ap, An, E
CO4	Can understand the computational idea of Recurrence relations.	PSO- 2, 4	Ap, An, E