M.S. Ramaiah University of Applied Sciences

New BEL Road, MSR Nagar, Bangalore – 560054

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

PO, PSO, PEO & CO

Programme Name: M.Sc. in Mathematics
Programme Code: 107

Programme Outcome (PO)
Programme Specific Outcome (PSO)
Program Educational Objectives (PEO)
Course Outcomes (CO)

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Bangalore-560058

Registrar
M.S. Ramaiah University of Applied Sciences
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Faculty of Mathematical & Physical Sciences

Programme Name: M.Sc. (Mathematics)

Programme Outcomes (PO's)

M.Sc. Physics post graduates will be able to:

PO-1. Scientific Knowledge: Apply fundamental knowledge of Mathematics to solve real lifeproblems in their chosen domain

PO-2. Dissemination of Knowledge: Disseminate knowledge in educational institutions withrelevant training and prepare students to qualify in various competitive examinations

PO-3. Problem Solving: Understand and solve scientific problems by using analytical techniques

PO-4. Modern Tool Usage: Apply appropriate tools, techniques and understand utilization ofresources appropriately in various laboratories

PO-5. Research: Conduct scientific research and disseminate the knowledge in the chosendomain

PO-6. Individual and teamwork: Work as a member of a team, to plan and to integrate knowledge of various disciplines as individual and to lead teams in multidisciplinarysettings

PO-7. Communication: Make effective oral presentations and communicate technical ideas to abroad audience using written and oral means

PO-8. Life-long learning: Adapt to the changes and advancements in mathematics and engagein independent and life-long learning

Programme Specific Outcomes (PSOs)

At the end of the M.Sc. (Mathematics) programme, the graduate will be able to:

PSO-1. Apply the basic principles of mathematics to solve scientific problems, model,simulate and interpret the results.

PSO-2. Develop abstract mathematical thinking, assimilate complex mathematical ideas an arguments and conduct research in applied mathematics.

PSO-3. Demonstrate communication skills and involvement in lifelong learning for thebetterment of organization.

Program Educational Objectives (PEOs)

The objectives of the M.Sc. (Mathematics) Programme are to:

PEO-1. To provide students knowledge in mathematics to enable them to deliver efficient solutions for complex Scientific problems using analytical and cognitive skills in theirchosen domain

PEO-2. To enable students to apply appropriate tools, techniques and understand utilization of resources in laboratories and computational skills in conducting research in their chosen domains and work as an individual as well as lead team in multidisciplinary settings

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PEO-3. To inculcate communication, soft, and managerial skills for a successful career and to engage in lifelong learning.

Course Outcomes (COs)

Course Title & Code: Linear Algebra (MTC511A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Illustrate the concepts of linear system of equations, vector spaces, linear transformation, diagonalization and inner product spaces
- **CO-2.** State and prove important theorems in linear algebra
- **CO-3.** Solve simple mathematical problems in linear system of equations, matrix theory, vector spaces, linear transformations, diagonalization and inner product spaces
- **CO-4.** Solve complex mathematical problems in linear system of equations, matrix theory, vector spaces, linear transformations, diagonalization and inner product spaces
- **CO-5.** Apply the concepts of linear algebra to model, solve, and analyze real-world situations

Course Outcomes (COs)

Course Title & Code: Theory of Ordinary Differential Equations (MTC512A)

After the successful completion of this course, the student will be able to:'

- **CO-1.** Illustrate the principles of linear and non-linear differential equations, initial and boundary value problems, Sturm-Liouville problems and system of linear differential equations, autonomous systems
- **CO-2.** State and prove theorems on existence and uniqueness of solution, series solutions, of ordinary differential equations and system of differential equations.
- **CO-3.** Solve Sturm-Liouville problems, construct special functions as series solutions of some particular ordinary differential equations
- **CO-4.** Model real world problems using ordinary differential equations and verify the results of the model
- **CO-5.** Solve complex mathematical problems involving linear and non-linear differential equations, initial and boundary value problems, system of linear differential equations, and autonomous systems

Course Outcomes (COs)

Course Title & Code: Real Analysis (MTC513A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Understand and explain the underlying concepts of metric spaces, continuity, differentiability, integrability, uniform convergence
- **CO-2.** Prove statements in the context of real analysis using definitions
- **CO-3.** State and produce rigorous proofs of important theorems that arise in real analysis
- **CO-4.** Solve problems on metric spaces, sequence and series, continuity, differentiability, uniform convergence, integrability and functions of several variables
- **CO-5.** Analyse and apply definitions and theorems of real analysis to problems

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Course Outcomes (COs)

Course Title & Code: Numerical Analysis – 1 (MTC514A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Illustrate various methods of numerical solution to polynomial and transcendental equations, numerical solution to non-linear system, interpolation and numerical integration
- **CO-2.** State and prove theorems on convergence and stability of numerical algorithms
- **CO-3.** Solve simple problems of linear and non-linear root finding methods, system of linear equations, eigenvalues, interpolation methods and quadrature rules
- **CO-4.** Solve complex problems of linear and non-linear root finding methods, system of linear equations, eigenvalues, interpolation methods and quadrature rules
- **CO-5.** Solve complex real world problems associated with nonlinear equations, system of equations, interpolation and numerical integration

Course Outcomes (COs)

Course Title & Code: Abstract Algebra (MTC515A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Understand basic concepts of group theory, ring theory with suitable examples
- **CO-2.** State and prove important theorems in group theory, ring theory
- **CO-3.** Solve algebraic problems using appropriate techniques
- **CO-4.** Demonstrate and understand special groups and rings and their properties
- **CO-5.** Examine the properties implied by the definitions and theorems of groups, rings

Course Outcomes (COs)

Course Title & Code: Numerical Analysis Laboratory - 1 (MTL511A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Illustrate fundamentals of programming in MATLAB
- **CO-2.** Implement algorithms and execute simple programs using MATLAB.
- **CO-3.** Solve mathematical problems associated with linear algebra and compare the results with that of solutions obtained using MATLAB
- **CO-4.** Apply numerical methods to solve nonlinear equations in one variable, system of linear equations, computing eigenvalues, curve fitting, interpolation, integration, and implement the same using MATLAB
- **CO-5.** Solve real world problems associated with system of equations, curve fitting, interpolation and integration using MATLAB.

Course Outcomes (COs)

Course Title & Code: Complex Analysis (MTC521A)

After the successful completion of this course, the student will be able to:

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- **CO-1.** Illustrate the underlying concepts of analyticity, complex integration, power series, residue calculus
- **CO-2.** State and prove important theorems such as Cauchy's theorem, Taylor's and Laurent's theorems, Rouche's theorem, maximum modulus theorem, Phragmen-Lindelof theorem and so on
- **CO-3.** Solve simple problems involving functions of a complex variable, analyticity, complex integration, power series, residue calculus, maximum modulus theorem
- **CO-4.** Apply properties of analytic functions to evaluate improper integrals and definite integrals on the real line using contour integration and key theorems in complex analysis
- **CO-5.** Solve complex mathematical problems arising from complex analysis

Course Outcomes (COs)

Course Title & Code: Theory of Partial Differential Equations (MTC507A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain basic concepts in vector calculus, state and prove important theorems related to vector integration
- **CO-2.** Solve first order, second order linear partial differential equation (PDE).
- **CO-3.** Apply analytical methods to solve the heat equation as an example of Parabolic PDE,
- **CO-4.** Apply analytical methods to solve the wave equation as an example of Hyperbolic PDE,
- **CO-5.** Apply analytical methods to solve the Laplace as an example of elliptic PDE.

Course Outcomes (COs)

Course Title & Code: Topology (MTC523A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Understand basic concepts of topological spaces, open, closed, connected, compact sets and homomorphism with suitable examples.
- **CO-2.** Explain different types of topological spaces with suitable examples.
- **CO-3.** Explain the construction of different quotient topological spaces such as cylinder, Mobius band.
- **CO-4.** Discuss the connected and compact spaces with suitable examples.
- **CO-5.** Explain the concepts of countabillity and separation axioms.

Course Outcomes (COs)

Course Title & Code: Introduction to Statistics and Probability (MTC524A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Define statistics and explain the importance and significance of statistics.
- **CO-2.** Explain the importance of probability in data analysis and in quantification of randomness.
- **CO-3.** State and prove important theorems on probability such as Bayes' theorem and law of large numbers.
- **CO-4.** Explain different types of probability distribution such as Binomial, Poisson and normal distribution
- **CO-5.** Illustrate t-distribution, F-distribution and chi-square distribution with examples and

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explain sampling distribution

CO-6. Explain statistical inference, confidence interval and significance tests about hypothesis

Course Outcomes (COs)

Course Title & Code: Fundamentals of Fluid Dynamics (MTC525A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Illustrate the basic properties of fluids, description of motion and fundamental laws
- **CO-2.** Explain the concept of continuum hypothesis and flow visualization
- **CO-3.** Illustrate the basic theorems and conservation laws of fluid dynamics
- **CO-4.** Analyze the behavior of the fluid based on the fluid properties and conservation laws
- **CO-5.** Apply the conservation laws to analyze the fluid behavior of the real world problem

Course Outcomes (COs)

Course Title & Code: Research Methodology (MPF615A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the value, scope, relevance and mandatory steps of research as well as principles of effective research
- **CO-2.** Discuss and demonstrate the application and utility of the Systematic approach and out of box thinking concepts for research to be effective
- **CO-3.** Explain and apply the procedures outlined for a systematic Literature Review
- **CO-4.** Outline the principles to prepare a well-structured research proposal and research paper
- **CO-5.** Identify and apply the essential skills desirable for an effective technical presentation

Course Outcomes (COs)

Course Title & Code: Measure Theory and Integration (MTC531A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain the basic principles of measure theory, integration and Lp spaces
- **CO-2.** Solve simple problems associated with measure theory, integration and Lp spaces
- **CO-3.** State and prove simple theorems in measure theory, integration and Lp spaces
- **CO-4.** State and prove complex theorems in measure theory, integration and Lp spaces
- **CO-5.** Solve complex problems associated with measure theory, integration and Lp spaces

Course Outcomes (COs)

Course Title & Code: Differential Geometry (MTC532A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Understand basic concepts of covariant vectors, contravariant vectors, tensors and their algebra.
- **CO-2.** Explain the concepts of tangent vector, directional derivatives, and differential forms
- **CO-3.** Calculate the curvature, torsion, normal and bi-normal vectors by using Frenet formulas

CO-4. Compute the Patches of surfaces in $E3$.

CO-5. Explain the Gaussian curvature, the mean curvature, and geodesic of a surface and its importance.

Course Outcomes (COs)

Course Title & Code: Numerical Analysis – 2 (MTC533A)

After the successful completion of this course, the student will be able to:

CO-1. Illustrate various methods of numerical solution to solve ordinary

CO-2. State and prove theorems on convergence and stability of numerical algorithms

CO-3. Solve simple problems using methods such as single step, multi-step, and finite difference methods to solve ordinary differential equations

CO-4. Solve simple problems using finite difference and finite element methods and finite volume methods to solve partial differential equations

CO-5. Solve complex problems arising in real world using numerical solutions to solve partial differential equations

Course Outcomes (COs)

Course Title & Code: Mechanics (MTE531A)

After the successful completion of this course, the student will be able to:

CO-1. Demonstrate the basic theory of classical mechanics.

CO-2. Explain the concept of continuum hypothesis and usage of tensorial notions

CO-3. Illustrate the basic theorems and conservation laws of continuum mechanics

CO-4. Illustrate the concept of two dimensional flows an complex potential

CO-5. Apply the governing equations to interpret the motions of continuum

Course Outcomes (COs)

Course Title & Code: Machine Learning – 1 (MTE631A)

After the successful completion of this course, the student will be able to:

CO-1. Describe the concepts of linear, logistic regression and support vector machines

CO-2. Describe the concepts of artificial neural networks, tree models and unsupervised learning

CO-3. Solve simple problems using machine learning algorithms

CO-4. Analyse the performance of machine learning algorithms

CO-5. Solve complex real world problems using machine learning algorithms

Course Outcomes (COs)

Course Title & Code: Numerical Analysis Laboratory - 2 (MTL532A)

After the successful completion of this course, the student will be able to:

CO-1. Illustrate fundamentals solving differential equations by using build functions of MATLAB.

CO-2. Implement algorithms and solve ordinary differential equations by using MATLAB.

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CO-3. Solve mathematical problems associated with partial differential equations and compare the results with that of solutions obtained using MATLAB.

CO-4. Apply Explicit finite difference method and PDE toolbox to solve partial differential equations and implement the same using MATLAB.

CO-5. Solve real world problems associated partial differential equations by using MATLAB.

Course Outcomes (COs)

Course Title & Code: Seminar - 1 (MTS531A)

After the successful completion of this course, the student will be able to:

CO-1. Make a presentation to a panel of examiners

CO-2. Write a report on the chosen topic

Course Outcomes (COs)

Course Title & Code: Functional Analysis (MTC541A)

After the successful completion of this course, the student will be able to:

CO-1. Illustrate the principles of functional analysis

CO-2. Elucidate the fundamental concept of Banach spaces and their applications

CO-3. Demonstrate the principle concept of Hilbert spaces and their applications

CO-4. Analyze the spectrum of linear and the compact operators in Hilbert space

CO-5. Apply the concept of Fourier transform

CO-6. Demonstrate a reasoned argument to the solution of familiar and unfamiliar complex problems relevant to functional analysis solution to solve ordinary and partial differential equations

Course Outcomes (COs)

Course Title & Code: Fluid Mechanics (MTE541A)

After the successful completion of this course, the student will be able to:

CO-1. Illustrate the principles of classical and fluid mechanics

CO-2. State and prove important theorems in mechanics such as Lagrange's and Hamilton's theorems, conservation laws, Kelvin's circulation theorem, Circle theorem, Blasius theorem

CO-3. Analyze simple motions of solids and multi-body system, small oscillations, motions of inviscid fluids and two dimensional viscous flows

CO-4. Analyze boundary layers encountered in flow past flat plate and perform stability analysis of various fluid flows

CO-5. Solve complex dynamical problems encountered in fluid mechanics

Course Outcomes (COs)

Course Title & Code: Magneto hydrodynamics (MTE542A)

After the successful completion of this course, the student will be able to:

CO-1. Explain the elementary concepts and basic equations of electrodynamics

CO-2. State and prove important theorems of electrodynamics and magnetohydrodynamics

CO-3. Analyzation of the flow problems in magnetohydrodynamics
CO-4. Solve simple applications of magnetohydrodynamics and Alfven waves
CO-5. Solve real world applications encountered in magnetohydrodynamics

Course Outcomes (COs)

Course Title & Code: Machine Learning – 2 (MTE641A)

After the successful completion of this course, the student will be able to:

CO-1. Describe the concepts of deep learning
CO-2. Describe the concepts of natural language processing
CO-3. Solve simple problems using deep learning algorithms
CO-4. Analyse the performance of deep learning algorithms
CO-5. Solve complex real-world problems using deep learning

Course Outcomes (COs)

Course Title & Code: Probability and Stochastic Processes (MTE642A)

After the successful completion of this course, the student will be able to:

CO-1. Describe the concepts of probability theory
CO-2. Describe the concepts of stochastic processes
CO-3. Solve simple problems using probability theory and stochastic processes
CO-4. State and prove theorems related to probability theory and stochastic processes
CO-5. Solve complex real-world problems using probability theory and stochastic processes

Course Outcomes (COs)

Course Title & Code: Dissertation (MTH600A)

After the successful completion of this course, the student will be able to:

CO-1. Recognize the need for developing a new or improving an existing scientific problem through an organized survey of literature
CO-2. Define scientific problem
CO-3. Design and perform the experiments
CO-4. Analyse the results obtained
CO-5. Write a technical Report and give presentation

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