THE STANDARD FIREWORKS RAJARATNAM COLLEGE FOR WOMEN (AUTONOMOUS),
SIVAKASI – 626 123.

(Affiliated to Madurai Kamaraj University, Re-accredited with A+ Grade by NAAC,
College with Potential for Excellence by UGC and Mentor Institution under UGC PARAMARSH)

DEPARTMENT OF MATHEMATICS
UG DEGREE PROGRAMME IN MATHEMATICS

PROGRAMME EDUCATIONAL OBJECTIVES The Graduates will be prepared to	
PEO1.	be proficient in core knowledge and excellent in statistical & computational skills, help them to shine in Govt./Private Sectors and pursuing higher education.
PEO2.	be excellent in computing ability to comprehend, analyze and design solutions for real life problems and perform social, professional and ethical responsibilities
PEO3.	attend confidently the competitive and entrance exams like TNPSC, UPSC, SSC, RRB and TANCET/GATE etc.,

PROGRAMME LEARNING OUTCOMES By the Completion B.Sc programme, the learners will be able to	
PLO1.	**Disciplinary knowledge** Apply the knowledge of Arts, Science and Humanities to address fundamental and complex questions appropriate to their programmes.
PLO2.	**Critical thinking, Problem solving and Analytical reasoning** Make use of appropriate knowledge and skills to identify, formulate, analyze and solve problems in order to reach substantiated conclusions.
PLO3.	**Research related skills and scientific reasoning** Critically analyze research processes, products and practices with a view of strategic use of data in their field.
PLO4.	**Communication skills and Digital literacy** Demonstrate skills in oral and written communication and make use of ICT in various learning ambience.
PLO5.	**Team work and Leadership quality** Interact productively with people from diverse backgrounds as both leaders/mentors and team members with integrity and professionalism
PLO6.	**Multicultural competence with Moral and ethical awareness** Defend the society against gender and environmental issues with moral and ethical awareness.
PLO7.	**Self-directed and Life-long learning** Formulate their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge.

COURSE LEARNING OUTCOME

CORE COURSE	
Course Code: 23GMC11	**Course Title:** ALGEBRA AND TRIGONOMETRY
On successful completion of the course, the learners should be able to	
CLO1[K2]	discuss fundamental ideas of solving equations and series expansion.
CLO2 [K3]	apply computational techniques for finding the sum of the series, eigen values and eigen vectors of a matrix.
CLO3 [K4]	analyze the diagonalizability of matrix and the relation between circular and hyperbolic functions.
CLO4 [K5]	evaluate powers, inverse of matrix and roots of the equations.
CLO5 [K6]	predict appropriate methods for solving equations, problems involving matrix and series.

CORE COURSE	
Course Code: 23GMC12	**Course Title:** DIFFERENTIAL CALCULUS
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the fundamental concepts of differentiation.
CLO2 [K3]	solve problems in envelope and curvature.
CLO3 [K4]	analyze various methods to determine maxima and minima of functions.
CLO4 [K5]	evaluate problems on successive and partial differentiation.
CLO5 [K6]	develop knowledge in solving problems on partial derivative.

FOUNDATION COURSES	
Course Code: 23GMFC11	**Course Title:** BRIDGE MATHEMATICS
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts of binomial theorem, sequences/series, permutation / combination, trigonometric functions and rules of derivatives and integration.
CLO2 [K3]	solve various problems related to basics of Mathematics.
CLO3 [K4]	simplify binomial expansion, trigonometric ratios.
CLO4 [K5]	evaluate problems through the methods of differentiation and integration.
CLO5 [K6]	develop knowledge on counting principles and limits.

CORE COURSE	
Course Code: 23GMC21	**Course Title:** ANALYTICAL GEOMETRY (2D & 3D)
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts of analytical geometry.
CLO2 [K3]	solve problems in straight line, plane and sphere.
CLO3 [K4]	analyze the system of planes, straight lines and spheres.
CLO4 [K5]	evaluating the length, angle and shortest distance between the surfaces.
CLO5 [K6]	construct the equation of a given surface.

CORE COURSE	
Course Code: 23GMC22	**Course Title:** INTEGRAL CALCULUS
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts of integration.
CLO2 [K3]	solve problems in multiple integrals.
CLO3 [K4]	analyze the properties of Beta and Gamma functions.
CLO4 [K5]	evaluate the integrals of algebraic, trigonometric and logarithmic functions.
CLO5 [K6]	develop knowledge on physical applications of integral.

CORE COURSE	
Course Code: 23GMC31	**Course Title:** VECTOR CALCULUS AND APPLICATIONS
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts of scalar, vector point functions and its operators.
CLO2 [K3]	apply computational techniques to solve problems in vector calculus.
CLO3 [K4]	analyze the properties of vector field operators.
CLO4 [K5]	evaluate problems related to Gauss's, Stoke's and Green's Theorem.
CLO5 [K6]	develop knowledge on applications to real life situations.

CORE COURSE	
Course Code: 23GMC32	**Course Title:** DIFFERENTIAL EQUATIONS AND APPLICATIONS
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts of Differential Equations.
CLO2 [K3]	apply the computational techniques in solving different types DE.
CLO3 [K4]	examine the different forms of ODE / PDE for finding their solutions.
CLO4 [K5]	evaluate problems of ODE and PDE.
CLO5 [K6]	formulate differential equation model for any real life problems.

GENERIC ELECTIVE COURSE	
Course Code: 23GMEG31	**Course Title:** MATHEMATICAL STATISTICS
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the concepts and properties of statistics.
CLO2 [K3]	apply statistical tools to solve various problems.
CLO3 [K4]	analyze bivariate data, association of data and its behavior.
CLO4 [K5]	estimate Interpolation and index numbers.
CLO5 [K6]	propose appropriate method to solve real life problems.

SKILL ENHANCEMENT COURSE	
Course Code: 23GMDS31	**Course Title:** STATISTICS WITH R PROGRAMMING
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts of R language.
CLO2 [K3]	apply data handling functions.
CLO3 [K4]	analyze data using R language.
CLO4 [K5]	evaluate correlation, regression coefficient for any bivariate data.
CLO5 [K6]	create vectors, lists, matrices, arrays and data frames using R.

SKILL ENHANCEMENT COURSE	
Course Code: 23GMES31	**Course Title:** WEB DESIGNING
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts of HTML.
CLO2 [K3]	develop knowledge on lists and styles in HTML document.
CLO3 [K4]	analyze the characteristics of CSS.
CLO4 [K5]	interpret the importance of frames in HTML.
CLO5 [K6]	create a well-structured web site with appropriate titles and themes.

CORE COURSE	
Course Code: 23GMC41	**Course Title:** INDUSTRIAL MATHEMATICS
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts and results in probability theory, Random Variables and sampling distributions.
CLO2 [K3]	solve problems on various concepts of Mathematical Statistics.
CLO3 [K4]	test hypotheses for small samples through chi-square, Students' t and F distributions.
CLO4 [K5]	prove the properties of Mathematical Expectation, Moment generating function & distribution functions.
CLO5 [K6]	construct Classification table for real world problem and perform ANOVA between classes or within classes.

CORE COURSE	
Course Code: 23GMC42	**Course Title:** ELEMENTS OF MATHEMATICAL ANALYSIS
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts of Real number system, properties of metric space and sequence and series.
CLO2 [K3]	apply logical argument for proving characterization, equivalence criterions on various concepts of mathematical analysis..
CLO3 [K4]	analyze the behaviour of sequences and series.
CLO4 [K5]	evaluate problems related to the convergence of sequence and series and limits of functions.
CLO5 [K6]	develop the knowledge on metric spaces.

GENERIC ELECTIVE COURSE	
Course Code: 23GMEG41	**Course Title:** TRANSFORMATION TECHNIQUES
On successful completion of the course, the learners should be able to	
CLO1[K2]	discuss Laplace and Fourier transform for the given function.
CLO2 [K3]	solve problems using Laplace and Fourier transformations
CLO3 [K4]	analyze the behavior of Laplace transform and Fourier integral.
CLO4 [K5]	evaluate problem related to the Parsavel's identity for the given function.
CLO5 [K6]	develop knowledge on Laplace transform to solve ODE.

CORE COURSE	
Course Code: 23GMC51	**Course Title:** ABSTRACT ALGEBRA
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the concepts and properties of groups, subgroups, cyclic groups, rings and fields.
CLO2 [K3]	apply the logical argument for proving the characterizations/equivalent conditions of algebraic structure.
CLO3 [K4]	analyze the nature of groups, rings and ideals.
CLO4 [K5]	justify the results in groups / rings.
CLO5 [K6]	develop knowledge on isomorphism between groups/rings.

CORE COURSE	
Course Code: 23GMC52	**Course Title:** REAL ANALYSIS
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the concept of continuous, differentiable, Riemann integrable of real valued functions.
CLO2 [K3]	make use of logical argument to prove theorems and results in context of real line.
CLO3 [K4]	analyze the properties of Riemann integral.
CLO4 [K5]	justify the results related to power series in R.
CLO5 [K6]	develop the knowledge on uniform and point wise convergence of the sequence.

CORE COURSE	
Course Code: 23GMC53	**Course Title:** MATHEMATICAL MODELLING
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the characteristics of mathematical models.
CLO2 [K3]	apply differential equation models to solve scientific problems.
CLO3 [K4]	classify models through various mathematical concepts.
CLO4 [K5]	evaluate problems in difference equations.
CLO5 [K6]	construct mathematical models for solving real life problems.

CORE COURSE	
Course Code: 23GMC5P	**Course Title:** PROJECT WITH VIVA-VOCE
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the concept in their area of specialization
CLO2 [K3]	develop analytic and research skills.
CLO3 [K4]	analyze the strength and weakness of team work.
CLO4 [K5]	develop presentation skills and leadership qualities.
CLO5 [K6]	create new ideas in emerging trends of Mathematics.

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Course Code: 23GMDE51	**Course Title:** PROGRAMMING IN C
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts in C language.
CLO2 [K3]	use control loops, arrays, structures and pointers to write code in C language.
CLO3 [K4]	analyze the characteristics of structures and pointers.
CLO4 [K5]	estimate solution for problems on arrays
CLO5 [K6]	design C language code for real life problems with appropriate test cases.

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Course Code: 23GMDE52	**Course Title:** INTRODUCTION TO MACHINE LEARNING
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts of machine learning, decision tree learning, clustering and its metrics.
CLO2 [K3]	use Machine learning algorithm to classify data.
CLO3 [K4]	analyze the data by clustering.
CLO4 [K5]	evaluate the metric through principal component.
CLO5 [K6]	develop machine learning algorithm to solve statistical problems.

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Course Code: 23GMDE5L1	**Course Title:** PROGRAMMING IN C LAB
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the concepts of C language.
CLO2 [K3]	use C codes to solve mathematical problems.
CLO3 [K4]	analyze the data by using array.
CLO4 [K5]	deduct and rectify errors in programs.
CLO5 [K6]	create C programs for real life situation.

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Course Code: 23GMDE5L2	**Course Title:** INTRODUCTION TO MACHINE LEARNING LAB
On successful completion of the course, the learners should be able to	
CLO1[K2]	describe the basic concepts of Machine Learning and R.
CLO2 [K3]	use algorithms to solve problems involving retail online dataset and heart disease.
CLO3 [K4]	classify a dataset on your own and compare its performance.
CLO4 [K5]	evaluate data by decision tree algorithm.
CLO5 [K6]	build a classification model using scikit.

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Course Code: 23GMDE53	**Course Title:** OPTIMIZATION TECHNIQUES
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts of LPP and inventory control Problems.
CLO2 [K3]	apply efficient computational techniques and algorithms to solve optimization problems.
CLO3 [K4]	analyze the balanced / unbalanced problems in sub/special classes of LPP
CLO4 [K5]	examine feasible, infeasible, IBFS, unbounded, degenerate/non degenerate solutions to a LPP, TP and AP
CLO5 [K6]	construct mathematical formulation for real life problems.

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Course Code: 23GMDE54	**Course Title:** DISCRETE MATHEMATICS
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic principles of discrete Mathematical structures.
CLO2 [K3]	write truth table for any logical statement.
CLO3 [K4]	analyze the concept of formal languages.
CLO4 [K5]	justify the results on lattices.
CLO5 [K6]	develop knowledge on permutation and combinations.

PART-IV COURSE	
Course Code: 23GMIN51	**Course Title:** INTERNSHIP
On successful completion of the course, the learners should be able to	
CLO1[K2]	relate the class room theory with work place practice.
CLO2 [K3]	apply the practices / procedures observed in real time working environment
CLO3 [K4]	analyse the workflow and communication flow prevailing in the institution/industr
CLO4 [K5]	assess interests and abilities in their field of study
CLO5 [K6]	propose strategies, policies and guidelines for enhancing efficiency of industrial/

CORE COURSE	
Course Code: 23GMC62	**Course Title:** COMPLEX ANALYSIS
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the fundamental concepts of complex numbers systems.
CLO2 [K3]	solve problems in transformation and complex integration.
CLO3 [K4]	analyze the characteristics and equivalence criterions of various concepts of complex numbers system..
CLO4 [K5]	evaluate improper integrals .
CLO5 [K6]	develop knowledge in concept of residue and poles

CORE COURSE	
Course Code: 23GMC61	**Course Title:** LINEAR ALGEBRA
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the fundamental concepts & results of vector space, inner product space and theory of matrices.
CLO2 [K3]	solve problems in linear space, inner product space & matrices.
CLO3 [K4]	analyse the characterizations & criterions of algebraic structure & matrices by logical argument.
CLO4 [K5]	justify the results and theorems on linear algebra.
CLO5 [K6]	create a matrix for practical situation & diagonalize it.

CORE COURSE		
Course Code: 23GMC63		**Course Title:** MECHANICS
On successful completion of the course, the learners should be able to		
CLO1[K2]	explain the basic concepts & principles of statics and dynamics.	
CLO2 [K3]	solve problems in forces acting at a point, moments, simple harmonic motion, projectiles and central orbit using the laws and theorems.	
CLO3 [K4]	analyze the mechanism of physical problems.	
CLO4 [K5]	estimate resultant of any number of forces acting on a particle.	
CLO5 [K6]	propose solutions for problemsrelated to central orbits.	

DISCIPLINE SPECIFIC ELECTIVE COURSE		
Course Code: 23GMDE61		**ourse Title:** PROGRAMMING IN C ++
On successful completion of the course, the learners should be able to		
CLO1[K2]	explain the concepts of OOPs.	
CLO2 [K3]	using constructors, destructors, classes and objects write C++ program .	
CLO3 [K4]	analyze characteristics of an object-oriented programming language.	
CLO4 [K5]	compare and classify the types of inheritance.	
CLO5 [K6]	create program using the concepts of files.	

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Course Code: 23GMDE62	**Course Title:** PROGRAMMING IN PYTHON
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the principles of Python.
CLO2 [K3]	use loops, functions and data types to write simple programs.
CLO3 [K4]	analyze the process of structuring the data using Lists, Tuples and Dictionaries.
CLO4 [K5]	choose the appropriate user defined function to write a Python program.
CLO5 [K6]	create program using concept of files.

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Course Code: 23GMDE6L1	**Course Title**: PROGRAMMING IN C ++ LAB
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain conditional, control making statements in OOPs.
CLO2 [K3]	write OOPs programs to demonstrate overloading.
CLO3 [K4]	analyze characteristics of an object-oriented programming language.
CLO4 [K5]	deduct and rectify errors in programs.
CLO5 [K6]	create programs for real life situation

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Course Code: 23GMDE6L2	**Course Title:** PROGRAMMING IN PYTHON LAB
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the structures and syntax of Python.
CLO2 [K3]	write programs using data types, tuples and dictionaries.
CLO3 [K4]	analyze the mathematical concepts using Python code.
CLO4 [K5]	deduct and rectify the errors in programs.
CLO5 [K6]	develop programming skills in Python.

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Course Code: 23GMDE63	**Course Title:** GRAPH THEORY AND APPLICATIONS
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts of graph theory.
CLO2 [K3]	apply logical argument / algorithm for proving characterization, equivalent conditions in graph theory.
CLO3 [K4]	analyze the properties of vertex and edge colouring in graphs.
CLO4 [K5]	justify algorithms/theorems in graphs.
CLO5 [K6]	develop the knowledge of colouring in graphs.

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Course Code: 23GMDE64	**Course Title:** FUZZY SETS AND ITS APPLICATIONS
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts and different types of Fuzzy Sets.
CLO2 [K3]	apply fuzzy concept to make decision in fuzzy environment.
CLO3 [K4]	analyze various properties and characterization of fuzzy sets and fuzzy relations.
CLO4 [K5]	prove the properties of fuzzy relations and compositions.
CLO5 [K6]	construct fuzzy relation and fuzzy graph for a given environment.

SKILL ENHANCEMENT COURSE	
Course Code: 23GMNE11	**Course Title:** MATHEMATICS FOR COMPETITIVE EXAMINATIONS
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the mathematical concepts applicable to a given problem.
CLO2 [K3]	apply logical concepts to solve time and work, profit and loss problems.
CLO3 [K4]	examine the appropriate methods and shortcuts to do problems related to competitive examinations.
CLO4 [K5]	evaluate the solution of problems on averages, numbers.
CLO5 [K6]	improve their problem solving skills to do mathematical aptitude in a simple way.

SKILL ENHANCEMENT COURSE	
Course Code: 23GMNE21	**Course Title:** DATA ANALYSIS USING EXCEL
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the fundamental concepts of Excel and data analysis.
CLO2 [K3]	apply data handling functions to visualize the data.
CLO3 [K4]	analyse the given data through various formulas, tables and charts.
CLO4 [K5]	evaluate mathematical problems using Excel.
CLO5 [K6]	create chart, pivot table in Excel for the given data.

GENERIC ELECTIVE COURSE	
Course Code: 23GMEG32	**Course Title:** ALLIED MATHEMATICS-I
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the fundamentals of ODE, PDE and Laplace transforms.
CLO2 [K3]	identify the methods for solving PDE.
CLO3 [K4]	examine the different forms of ODE for finding the solutions.
CLO4 [K5]	estimate the solution for scientific problems through differential equations.
CLO5 [K6]	develop knowledge on solving differential equations by using Laplace transforms.

GENERIC ELECTIVE COURSE	
Course Code: 23GMEG42	**Course Title:** ALLIED MATHEMATICS-II
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts of vector calculus, matrices and algebraic structure.
CLO2 [K3]	solve problems on vector differentiation, line/surface/volume integrals and matrices.
CLO3 [K4]	examine the characterization and equivalence criterion of group structures and vector differentiation.
CLO4 [K5]	evaluate problems related to Green's, Gauss's and Stoke's theorems.
CLO5 [K6]	develop knowledge on finding eigen values and eigen vectors problems.

JOB ORIENTED COURSE / SELF EMPLOYMENT COURSE	
Course Code: 23GJO44	**Course Title:** MATHEMATICS FOR CAREER BUIDING
On successful completion of the course, the learners should be able to	
CLO1[K2]	discuss basic formulae in Mathematics.
CLO2 [K3]	solve arithmetic problems
CLO3 [K4]	analyze analytical and logical problems.
CLO4 [K5]	evaluate various verbal and non-verbal reasoning problems.
CLO5 [K6]	develop knowledge on aptitude/reasoning.

JOB ORIENTED COURSE / SELF EMPLOYMENT COURSE	
Course Code: 23GJO44L	**Course Title:** MATHEMATICS FOR CAREER BUIDING LAB
On successful completion of the course, the learners should be able to	
CLO1[K2]	discuss basic formulae in Mathematics.
CLO2 [K3]	solve arithmetic problems
CLO3 [K4]	analyze analytical, logical problems.
CLO4 [K5]	evaluate various verbal and non-verbal reasoning problems.
CLO5 [K6]	develop knowledge on aptitude/reasoning.

THE STANDARD FIREWORKS RAJARATNAM COLLEGE FOR WOMEN (AUTONOMOUS),
SIVAKASI – 626 123.

(Affiliated to Madurai Kamaraj University, Re-accredited with A+ Grade by NAAC,
College with Potential for Excellence by UGC and Mentor Institution under UGC PARAMARSH)

DEPARTMENT OF MATHEMATICS

PG DEGREE PROGRAMME IN MATHEMATICS

PROGRAMME EDUCATIONAL OBJECTIVES The Graduates will be prepared to	
PEO1.	have the caliber to work in various colleges, universities and shine in higher level administrations like UPSC,TNPSC, IBPS, etc.,
PEO2.	have the ability to pursue Research, complying to ethical values and provide optimistic solutions to real life problems.
PEO3.	develop relevant knowledge and skills appropriate to professional activities.

PROGRAMME LEARNING OUTCOMES By the Completion M.Sc programme, the learners will be able to	
PLO1.	**Disciplinary knowledge** Apply the knowledge of Arts, Science and Humanities to address fundamental and complex questions appropriate to their programmes
PLO2.	**Critical thinking, Problem solving and Analytical reasoning** Make use of appropriate knowledge and skills to identify, formulate, analyze and solve problems in order to reach substantiated conclusions.
PLO3.	**Research related skills and scientific reasoning** Critically analyze research processes, products and practices with a view of strategic use of data in their field.
PLO4.	**Communication skills and Digital literacy** Demonstrate skills in oral and written communication and make use of ICT in various learning ambience.
PLO5.	**Team work and Leadership quality** Interact productively with people from diverse backgrounds as both leaders/mentors and team members with integrity and professionalism
PLO6.	**Multicultural competence with Moral and ethical awareness** Defend the society against gender and environmental issues with moral and ethical awareness.
PLO7.	**Self-directed and Life-long learning** Formulate their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge.

COURSE LEARNING OUTCOME

CORE COURSE	
Course Code: 23PMC11	**Course Title:** ALGEBRAIC STRUCTURES
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts and its properties of groups and linear transformations.
CLO2 [K3]	apply the properties of algebraic structure to solve the problems.
CLO3 [K4]	analyze the characteristics and equivalence criterions of various concepts of algebraic structures through logical arguments.
CLO4 [K5]	prove various theorems, results of Group and linear transformations.
CLO5 [K6]	reduce the matrices/transformations to Jordan form and Rational canonical form.

CORE COURSE	
Course Code: 23PMC12	**Course Title:** REAL ANALYSIS I
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts of the Riemann -Stieltjes integral, sequences and series of functions
CLO2 [K3]	determine the behaviour of sequences and series.
CLO3 [K4]	analyze the characteristics and equivalence criterions of various concepts of Real Analysis.
CLO4 [K5]	prove various theorems, results in Riemann-Stieltjes Integral.
CLO5 [K6]	construct mathematical arguments to prove results on power series.

CORE COURSE		
Course Code: 23PMC13		**Course Title:** ORDINARY DIFFERENTIAL EQUATIONS
On successful completion of the course, the learners should be able to		
CLO1[K2]	explain the fundamental concepts of differential equations.	
CLO2 [K3]	solve problems in ODE.	
CLO3 [K4]	analyze the properties of Legender, Euler and Bessel equations.	
CLO4 [K5]	select appropriate method to solve problems on ordinary differential equations.	
CLO5 [K6]	prepare logical arguments to find the Existence and uniqueness of solutions to first order equations.	

DISCIPLINE SPECIFIC ELECTIVE COURSE		
Course Code: 23PMDE11		**Course Title:** GRAPH THEORY AND APPLICATIONS
On successful completion of the course, the learners should be able to		
CLO1[K2]	explain the fundamental concepts of graph theory and the properties of Trees, connectivity& Blocks.	
CLO2 [K3]	apply logical / mathematical argument for proving characterization, criterions on various concepts of graph theory.	
CLO3 [K4]	analyse the behavior of different types of graphs and its applications.	
CLO4 [K5]	select any suitable application for discussing Euler Tour, Hamiltonian cycle and Matchings.	
CLO5 [K6]	prepare a graph theoretical model for any real life problem.	

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Course Code: 23PMDE12	**Course Title:** NUMBER THEORY AND CRYPTOGRAPHY
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain and illustrate the basic concepts and results in number theory & cryptography.
CLO2 [K3]	solve various problems in context of theory of numbers using mathematical calculations/ various familiar theorems.
CLO3 [K4]	examine the properties of prime numbers & number theoretic functions.
CLO4 [K5]	justify how number theory is related and applied in cryptography.
CLO5 [K6]	develop knowledge of encryption, decryptionand its application indiverse areas.

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Course Code: 23PMDE13	**Course Title:** FUZZY SETS AND THEIR APPLICATIONS
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the fundamental concepts of crisp sets fuzzy sets, operations and relations.
CLO2 [K3]	apply fuzzy concepts in various fields like Medicine, Economics etc.
CLO3 [K4]	analyze various properties and characterization of fuzzy sets and fuzzy relations.
CLO4 [K5]	evaluate the problems on fuzzy environment
CLO5 [K6]	formulate LP model to real life problems using fuzzy concepts.

DISCIPLINE SPECIFIC ELECTIVE COURSE		
Course Code: 23PMDE14		**Course Title:** MATHEMATICAL PROGRAMMING
On successful completion of the course, the learners should be able to		
CLO1[K2]	explain the fundamental concepts of integer linear programming, dynamic programming, games and simulation.	
CLO2 [K3]	use algorithms of various techniques to solve mathematical programming problems.	
CLO3 [K4]	analyze decisions under uncertainty.	
CLO4 [K5]	evaluate problems in simulation and non-linear programming.	
CLO5 [K6]	formulate a model to real life problems using simulation.	

CORE COURSE		
Course Code: 23PMC21		**Course Title:** ADVANCED ALGEBRA
On successful completion of the course, the learners should be able to		
CLO1[K2]	explain the basic concepts and properties of theory of fields.	
CLO2 [K3]	apply mathematical / logical argument for proving characterizations& criterions in context of field theory and Galoi's theory.	
CLO3 [K4]	examine the nature of finite field.	
CLO4 [K5]	justify the properties and theorems related to division ring D, subring of D over real quaternions and solvability by radicals of a polynomial.	
CLO5 [K6]	develop mathematical argument for proving simple results / solving problems on extension field & splitting field.	

CORE COURSE	
Course Code: 23PMC22	**Course Title:** REAL ANALYSIS II
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts of Riemann, Lebesgue integral and measurable sets.
CLO2 [K3]	apply the logical arguments to prove the properties of measure theory and Multivariable Differential Calculus
CLO3 [K4]	analyze the concepts of Fourier series
CLO4 [K5]	justify the properties and theorems related toLebesgue and Fourier integral series.
CLO5 [K6]	combine the properties of implicit functions with extremum

CORE COURSE	
Course Code: 23PMC23	**Course Title:** PARTIAL DIFFERENTIAL EQUATIONS
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the fundamental concepts of PDE.
CLO2 [K3]	apply maximum and minimum principle to solve Dirichlet, Neumann problems for various boundary conditions.
CLO3 [K4]	classify second order equations and find general solutions.
CLO4 [K5]	prove various theorems, results and corollaries in Cauchy's problem.
CLO5 [K6]	prepare logical arguments to find the solution of boundary value Problems.

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Course Code: 23PMDE21	**Course Title:** MATHEMATICAL STATISTICS
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the fundamental concepts of statistics.
CLO2 [K3]	apply computational techniques for solving problems.
CLO3 [K4]	analyze the behavior of limiting distributions of sample moments and quantiles.
CLO4 [K5]	evaluate the problems on distribution functions and theory of runs.
CLO5 [K6]	propose solution for sampling problems by tests of significance.

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Course Code: 23PMDE22	**Course Title:** DATA ANALYSIS USING R
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts of R language.
CLO2 [K3]	identify the suitable statistical tests to manipulate datasets in R.
CLO3 [K4]	analyze data using hypotheses .
CLO4 [K5]	choose the appropriate statistical tests for solving problems.
CLO5 [K6]	create and edit visualizations with R.

PROFESSIONAL COMMUNICATION SKILL ENHANCEMENT COURSE	
Course Code: 23PMSE21	**Course Title:** COMPUTATION BY SAGEMATH
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the technical codings for efficient usage of sagemath.
CLO2 [K3]	apply the suitable syntax and semantics to solve mathematical problems.
CLO3 [K4]	analyse the concepts of algebra and analysis.
CLO4 [K5]	develop their programming skills.
CLO5 [K6]	construct the graph for the given data using Sagemath.

CORE COURSE	
Course Code: 23PMC31	**Course Title:** COMPLEX ANALYSIS
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain local properties of analytical functions its canonical products.
CLO2 [K3]	apply winding numbers for proving Cauchy integral formula, General form of Cauchy's theorem, Residue theorem.
CLO3 [K4]	analyze the properties of harmonic functions, Gamma functions and classification of singularities, zeroes of analytical function.
CLO4 [K5]	evaluate definite integral, line integral, higher derivatives and series expansion of analytic function
CLO5 [K6]	improve new ideas in complex integration theory and behaviour of analytic functions.

CORE COURSE	
Course Code: 23PMC32	**Course Title:** PROBABILITY THEORY
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the fundamentals and properties of probability.
CLO2 [K3]	solve problems in various distributions.
CLO3 [K4]	analyze the computational techniques for solving problems in characteristic functions.
CLO4 [K5]	interpret the behavior of limiting distributions.
CLO5 [K6]	predict the results in probability distributions.

CORE COURSE	
Course Code: 23PMC33	**Course Title:** TOPOLOGY
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the fundamental concepts of topological spaces.
CLO2 [K3]	apply the logical arguments to prove the characteristics of topological spaces.
CLO3 [K4]	classify the topological spaces by countability and separation axioms.
CLO4 [K5]	prove the properties of topological spaces.
CLO5 [K6]	develop knowledge in metric spaces.

CORE COURSE	
Course Code: 23PMCI31	**Course Title:** INDUSTRIAL STATISTICS
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts of statistics and probability applicable to industry.
CLO2 [K3]	solve problems in statistical interference such as estimators.
CLO3 [K4]	analyse various techniques in random variables, generating functions.
CLO4 [K5]	evaluate the estimators and expected values of random variables.
CLO5 [K6]	combine the theories to solve real life problems.

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Course Code: 23PMDE31	**Course Title:** MATHEMATICAL PYTHON
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the principles of Python.
CLO2 [K3]	apply loops, functions and data types to write simple programs.
CLO3 [K4]	analyze various features of Python programming.
CLO4 [K5]	deduct and rectify the errors in programs.
CLO5 [K6]	create program using concept Python .

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Course Code: 23PMDE32	**Course Title:** STOCHASTIC PROCESSES
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts of stochastic process.
CLO2 [K3]	compute problems in Poisson and Markov Process.
CLO3 [K4]	analyze characteristics of stochastic process.
CLO4 [K5]	prove various theorems, results Branching Processes and Stochastic Processes in Queuing Systems.
CLO5 [K6]	develop a model in birth death and non birth death in queuing process.

PART-B COURSES	
Course Code: 23PMIN31	**Course Title:** INTERNSHIP
On successful completion of the course, the learners should be able to	
CLO1[K2]	relate the class room theory with work place practice.
CLO2 [K3]	apply the practices / procedures observed in real time working environment.
CLO3 [K4]	analyse the workflow and communication flow prevailing in the institution/industry.
CLO4 [K5]	assess interests and abilities in their field of study.
CLO5 [K6]	propose strategies, policies and guidelines for enhancing efficiency of industrial/ institutional operations.

PROFESSIONAL COMMUNICATION SKILL ENHANCEMENT COURSE	
Course Code: 23PMSE31	**Course Title:** RESEARCH TOOLS AND TECHNIQUES
On successful completion of the course, the learners should be able to	
CLO1[K2]	discuss the basic skills needed for research.
CLO2 [K3]	apply tools and techniques to identify and solve research problems.
CLO3 [K4]	analyse the ethics in publications different types of journals and difference between dissertation and thesis writing.
CLO4 [K5]	evaluate the characterization and significance of Good Research.
CLO5 [K6]	improve the writing skills in research and publications.

ADDITONAL SKILL SUPPORTIVE COURSE-III	
Course Code: 23PMSS31	**Course Title:** ICT TOOLS
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts of MS Word ,Excel and Power point.
CLO2 [K3]	apply ICT tools for the formatting paragraphs, tables, lists, and pages settings.
CLO3 [K4]	analyse data in excel spreadsheets.
CLO4 [K5]	choose the appropriate tools for data modifications.
CLO5 [K6]	build presentations using power point tools.

CORE COURSE	
Course Code: 23PMC41	**Course Title:** FUNCTIONAL ANALYSIS
On successful completion of the course, the learners should be able to	
CLO1[K2]	describe operators and basic theorems.
CLO2 [K3]	identify the characteristics of Hilbert space, spectrum of a bounded linear operator and Banach algebra.
CLO3 [K4]	analyze the equivalence criterions on various concepts of functional analysis.
CLO4 [K5]	prove the properties of Normed , Banach and Hilbert spaces.
CLO5 [K6]	develop knowledge in establish regular and singular elements.

CORE COURSE	
Course Code: 23PMC42	**Course Title:** DIFFERENTIAL GEOMETRY
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain fundamental concepts and results of surfaces and Geodesics.
CLO2 [K3]	apply logical argument / algorithm for proving characterization, equivalent conditions in differential geometry.
CLO3 [K4]	analyze the properties of surfaces.
CLO4 [K5]	justify the nature of developable, ruled and minimal surfaces.
CLO5 [K6]	develop indepth knowledge in solving problems on curvature and minimal surfaces.

CORE COURSE	
Course Code: 23PMC43	**Course Title:** MECHANICS
On successful completion of the course, the learners should be able to	
CLO1[K2]	demonstrate the fundamental concepts and properties of Mechanics.
CLO2 [K3]	apply the variation principle to solve problems.
CLO3 [K4]	analyze the concept of Angular momentum, Kinetic energy and
CLO4 [K5]	interpret the different applications of the mechanical and electromagnetic fields.
CLO5 [K6]	develop knowledge on Hamilton-Jacobi Theory for solving problems /results.

CORE COURSE	
Course Code: 23PMC4P	**Course Title:** PROJECT WITH VIVA-VOCE
On successful completion of the course, the learners should be able to	
CLO1[K2]	illustrate the mathematical concepts in the area of specialization.
CLO2 [K3]	develop analytic and research skills.
CLO3 [K4]	analyze and extend any research ideas in various branches of Mathematics.
CLO4 [K5]	choose the area of interest for pursuing research.
CLO5 [K6]	create new ideas in emerging trends of Mathematics.

CORE COURSE		
Course Code: 23PMDE41		**Course Title:** RESOURCE MANAGEMENT TECHNIQUES
On successful completion of the course, the learners should be able to		
CLO1[K2]	describe the simplex method and networking models.	
CLO2 [K3]	apply various algorithms to solve problems in network , game theory and classical optimization.	
CLO3 [K4]	analyze linear and non-linear problems through optimization techniques.	
CLO4 [K5]	estimate time schedule, shortest duration, floating time and optimum strategy.	
CLO5 [K6]	construct network diagrams for real world problems.	

DISCIPLINE SPECIFIC ELECTIVE COURSE		
Course Code: 23PMDE42		**Course Title:** FINANCIAL MATHEMATICS
On successful completion of the course, the learners should be able to		
CLO1[K2]	describe the financial markets by efficient allocation of investment.	
CLO2 [K3]	use underlying mathematical ideas for innovations in financial derivatives.	
CLO3 [K4]	analyze Brownian motion and financial models.	
CLO4 [K5]	evaluate the financial market model and incomplete markets.	
CLO5 [K6]	formulate the Black-Scholes models for real world problems.	

SKILL ENHANCEMENT COURSE	
Course Code: 23PMSE41	**Course Title:** TRAINING FOR COMPETITIVE EXAMINATIONS
On successful completion of the course, the learners should be able to	
CLO1[K2]	recall the basic concepts of algebraic structures.
CLO2 [K3]	apply cognitive abilities to solve quantitative and qualitative problems.
CLO3 [K4]	compare and conclude the solution to the applied mathematical problems.
CLO4 [K5]	Select appropriate methods for solving various types of problems.
CLO5 [K6]	improve the mathematical and the computation skills in Algebra.

ADDITIONAL SKILL SUPPORTIVE COURSE	
Course Code: 23PMSS41	**Course Title:** VERBAL & NON-VERBAL REASONING
On successful completion of the course, the learners should be able to	
CLO1[K2]	recall the basic structure of reasoning.
CLO2 [K3]	develop their numerical and analytical skills.
CLO3 [K4]	analyze and solve analytical, logical, verbal and non-verbal reasoning problems.
CLO4 [K5]	evaluate various arithmetic and reasoning problems.
CLO5 [K6]	improve the analytical and computational skills

GENERIC ELECTIVE COURSE	
Course Code: 23PMEG21	**Course Title:** MODELING AND SIMULATION WITH EXCEL
On successful completion of the course, the learners should be able to	
CLO1[K2]	explain the basic concepts of modelling and simulation and Excel.
CLO2 [K3]	apply Excel tools for quantitative and qualitative data analysis.
CLO3 [K4]	analyze model's structure, its capabilities, and its underlying assumptions.
CLO4 [K5]	determine critical role of Excel in the early or rapid prototyping of problems.
CLO5 [K6]	construct a useful and thoroughly conceived simulation model.