Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Autonomous)

Two Year Degree Program in Mathematics

(Faculty of Science & Technology)

CBCS Syllabus

M.Sc. (Mathematics) Part-I Semester -I

For Department of Mathematics

Tuljaram Chaturchand College, Baramati

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

To be implemented from Academic Year 2023-2024

(Eligibility: B.Sc. (Mathematics))

Title of the Programme: M.Sc. (Mathematics)

Preamble

AES's Tuljaram Chaturchand College has made the decision to change the syllabus of across various faculties from June, 2023 by incorporating the guidelines and provisions outlined in the National Education Policy (NEP), 2020. The NEP envisions making education more holistic and effective and to lay emphasis on the integration of general (academic) education, vocational education and experiential learning. The NEP introduces holistic and multidisciplinary education that would help to develop intellectual, scientific, social, physical, emotional, ethical and moral capacities of the students. The NEP 2020 envisages flexible curricular structures and learning based outcome approach for the development of the students. By establishing a nationally accepted and internationally comparable credit structure and courses framework, the NEP 2020 aims to promote educational excellence, facilitate seamless academic mobility, and enhance the global competitiveness of Indian students. It fosters a system where educational achievements can be recognized and valued not only within the country but also in the international arena, expanding opportunities and opening doors for students to pursue their aspirations on a global scale.

In response to the rapid advancements in science and technology and the evolving approaches in various domains of Mathematics and related subjects, the Board of Studies in Mathematics at Tuljaram Chaturchand College, Baramati - Pune, has developed the curriculum for the first semester of M.Sc. Part-IMathematics, which goes beyond traditional academic boundaries. The syllabus is aligned with the NEP 2020 guidelines to ensure that students receive an education that prepares them for the challenges and opportunities of the 21st century. This syllabus has been designed under the framework of the Choice Based Credit System (CBCS), taking into consideration the guidelines set forth by the National Education Policy (NEP) 2020, LOCF (UGC), NCrF, NHEQF, Prof. R.D. Kulkarni's Report, Government of Maharashtra's General Resolution dated 20th April and 16th May 2023, and the Circular issued by SPPU, Pune on 31st May 2023.

A Mathematics degree equips students with the knowledge and skills necessary for a diverse range of fulfilling career paths. Graduates in Mathematics find opportunities in various fields, including Financial Planner, Market Research Analyst, Data Scientist, teaching, Insurance underwriter, operations research analyst, software developer, and many

other domains. After graduating with a degree in mathematics, students can embark on a multitude of rewarding and diverse career paths. The analytical and problem-solving skills honed during their studies equip them with a strong foundation for success in various fields. Many graduates choose to pursue careers in academia and research, where they can contribute to the advancement of mathematical knowledge through teaching, publishing papers, and conducting groundbreaking research. Others may opt for careers in the financial sector, such as investment banking or actuarial science, utilizing their expertise in mathematical modelling and statistical analysis to make informed decisions and manage risks. Additionally, the field of data science offers abundant opportunities for mathematics graduates, as they possess the ability to extract meaningful insights from complex data sets and develop algorithms that drive innovation in industries like technology, healthcare, and marketing. Moreover, mathematics graduates can find fulfilling careers in engineering, cryptography, software development, and operations research, to name just a few areas where their mathematical skills are highly sought after. Overall, a degree in mathematics opens doors to a wide range of intellectually stimulating and financially rewarding professions, allowing graduates to make significant contributions to society and thrive in a rapidly evolving world.

Overall, revising the Mathematics syllabus in accordance with the NEP 2020 ensures that students receive an education that is relevant, comprehensive, and prepares them to navigate the dynamic and interconnected world of today. It equips them with the knowledge, skills, and competencies needed to contribute meaningfully to society and pursue their academic and professional goals in a rapidly changing global landscape.

Programme Specific Outcomes (PSOs)

PSO 1-Proficiency in Mathematical Concepts: Graduates will have a deep understanding of fundamental mathematical concepts and theories across various branches of mathematics, including calculus, algebra, geometry, probability, and statistics.

PSO 2-Problem-Solving Skills: Graduates will possess strong problem-solving skills and the ability to apply mathematical principles to real-world situations. They can analyze complex problems, develop logical reasoning, and devise creative strategies to find solutions.

PSO 3-Mathematical Modeling: Graduates will be proficient in mathematical modeling, which involves using mathematical techniques to describe and analyze real-world phenomena. They can formulate and solve mathematical models to address problems in diverse fields, including physics, economics, engineering, and social sciences.

PSO4-Computational and Analytical Skills: Graduates will be skilled in using computational tools and software, such as programming languages, statistical software, and mathematical modeling software. They can leverage these tools to perform numerical analysis, data visualization, and simulations**.**

PSO 5-Communication and Presentation: Graduates will possess effective communication skills, both written and oral, to convey complex mathematical ideas and results to both technical and non-technical audiences. They can present mathematical arguments, proofs, and findings in a clear and concise manner.

PSO 6-Research and Inquiry: Graduates will have the ability to engage in mathematical research and inquiry. They can critically evaluate existing mathematical theories, develop new mathematical models, and contribute to the advancement of mathematical knowledge through independent research or collaborative projects.

PSO 7-Interdisciplinary Collaboration: Graduates will be adept at collaborating with professionals from other disciplines, such as scientists, engineers, economists, and

computer scientists. They can effectively communicate and work in multidisciplinary teams to solve complex problems that require mathematical expertise.

PSO 8-Lifelong Learning: Graduates will have developed a strong foundation for lifelong learning in mathematics. They will have the skills to stay abreast of new developments in the field, adapt to emerging technologies and methodologies, and continue their professional growth through self-directed study or advanced academic pursuits.

PSO 9-Advanced Mathematical Techniques: Graduates will have a command of advanced mathematical techniques, such as differential equations, mathematical analysis, linear algebra, number theory, and optimization. They can apply these advanced mathematical tools to solve complex problems and contribute to specialized areas of research.

PSO 10-Mathematical Software Development: Graduates will possess programming skills and the ability to develop mathematical software or algorithms. They can design, implement, and optimize software applications that facilitate mathematical calculations, simulations, data analysis, and modeling.

PSO 11-Mathematical Education and Teaching: Graduates interested in pursuing a career in education will have the necessary skills to teach mathematics at various levels. They can design and deliver effective lessons, develop curriculum materials, and assess student progress in mathematics. They can also inspire and motivate students to develop an appreciation for the subject.

PSO 12-Mathematical Finance and Risk Analysis: Graduates with an interest in finance and economics will have specialized knowledge in mathematical finance and risk analysis. They can apply mathematical models, stochastic calculus, and statistical methods to analyze financial markets, manage investment portfolios, assess risk, and make informed financial decisions.

Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Autonomous)

Board of Studies (BOS) in Mathematics

From 2022-23 to 2024-25

Sr.No.	Name	Designation
1.	Mr. Sadashiv R. Puranik,	Chairman
2.	Ms. Varsha H. Shinde	Member
3.	Dr. Prakash B. Fulari	Member
4.	Ms. Shaila S. Jadhav	Member
5.	Ms. Nikita R. Shinde	Member
6.	Ms. Sonali V. Kate	Member
7.	Dr. Anil S. Khairnar	Vice-Chancellor Nominee
8.	Dr. Nitin S. Darkunde	Expert from other University
9.	Dr. Kishor D. Kucche	Expert from other University
10.	Mr. Amit Patil	Industry Expert
11	Dr. Haribhau R. Bhapkar	Meritorious Alumni
12.	Ms. Sharwari Markale	Student Representative
13.	Mr. Vishwajeet Nalawade	Student Representative

Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

(Autonomous)

Credit Distribution Structure for (M.Sc. Mathematics) Part-I (2023 Pattern)

Year	Level	Sem.	Major		Research Methodology (RM)	OJT/ FP	RP	Cum. Cr.
			Mandatory	Electives				
I	6.0	Sem-I	MAT-501-MJM: Measure Theory and Integration(**Credit 04**) MAT-502-MJM: Advanced Calculus (**Credit 04**) MAT-503-MJM: Practical in Ordinary Differential Equations(**Credit 02**) MAT-504-MJM: Programming in C (**Credit 02**)	MAT-511-MJE (A): Numerical Analysis (**Credit04**) **OR** MAT-511-MJE (B): Group Theory(**Credit 04**)	MAT-521-RM: Research Methodology in Mathematics (**Credit 04**)	--	--	**20**
		Sem- II	MAT-551-MJM: Complex Analysis (**Credit 04**) MAT-552-MJM:Topology (**Credit 04**) MAT-553-MJM: Practical in Partial Differential Equations (**Credit 02**) MAT-554-MJM: Programming in C++ (**Credit 02**)	MAT-561-MJE(A): Linear Algebra**(Credit04)** **OR** MAT-561-MJE(B): Rings and Modules(**Credit04**)	--	MAT-581-OJT/FP **Credit 04**	--	**20**
Cum. Cr.			**24**	**8**	**4**	**4**	**--**	**40**

*** 1 credit = 15 Hr.**

Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati (Autonomous)

Course Structure for (M.Sc. Mathematics) Part-I (2023 Pattern)

Sem	Course Type	Course Code	Course Title	Theory/ Practical	No. of Credits
I	Major (Mandatory)	MAT-501-MJM	Measure Theory and Integration	Theory	04
	Major (Mandatory)	MAT-502-MJM	Advanced Calculus	Theory	04
	Major (Mandatory)	MAT-503-MJM	Practical in Ordinary Differential Equations	Practical	02
	Major (Mandatory)	MAT-504-MJM	Programming in C	Practical	02
	Major (Elective)	MAT-511-MJE (A)	Numerical Analysis	Theory	04
		MAT-511-MJE (B)	Group Theory	Theory	
	Research Methodology (RM)	MAT-521-RM	Research Methodology	Theory	04
			Total Credits Semester I		**20**
II	Major (Mandatory)	MAT-551-MJM	Complex Analysis	Theory	04
	Major (Mandatory)	MAT-552-MJM	Topology	Theory	04
	Major (Mandatory)	MAT-553-MJM	Practical in Partial Differential Equations	Practical	02
	Major (Mandatory)	MAT-554-MJM	Programming in C++	Practical	02
	Major (Elective)	MAT-561-MJE(A)	Linear Algebra	Theory	04
		MAT-561-MJE(B)	Rings and Modules	Theory	
	On Job Training (OJT)/Field Project (FP)	MAT-581-OJT/FP	On Job Training Filed Project	Training/ Project	04
			Total Credits Semester-II		**20**
			Cumulative Credits Semester I and II		**40**

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 Pattern)

Name of the Programme : M.Sc (Mathematics)

Program Code :PSMAT

Class :M.Sc.I

Semester : I

Course Type : Major (Mandatory)

Course Name : Measure Theory and Integration

Course Code :MAT-501-MJM

No. of Lectures : 60

No. of Credits : 4

Course Objectives:

1. Toacquireknowledgeofbasicandadvancedconceptsin MeasureTheorywhichareusefu lin Fourieranalysisand FunctionalAnalysis.
2. Togetfamiliarwithconceptsofmeasurablefunctions,Differentiation,and,Integration.
3. Todeveloptheabilitytosolvesimple andcomplexproblems.
4. Be able to describe at least one approach to the construction of Lebesgue measure, the Lebesgue integral of a function and measure spaces.
5. To gain understanding of the abstract measure theory and main properties of the integral.
6. To construct Lebesgue's measure on the real line and in n-dimensional Euclidean space.
7. Know the principal theorems as treated and their proofs and be able to use them in the investigation of examples.

Course Outcomes:

By the end of the course, students will be able to:

CO1-Understandtheconceptof Differentiation,FunctionsofBoundedVariation, andAbsolutely Continuous Functions.

CO2-Students willbeabletoapplythetheoryinthe coursetosolve avarietyofproblemsthanappropriatelevel ofdifficulty.

CO3-Understand σ-algebras, measurable sets, measures, outer measures, Lebesgue measure and its properties.

CO4-Develop an appreciation of the basic concepts of measure theory. Apply measure theory to real world problems.

CO5-Understand Lebesgue integral, Monotone Convergence Theorem, Dominated Convergence Theorem, and Riemann integral for Riemann integrable functions.

CO6-describe the relationship between continuous function and general integrable functions.

CO7-Determine questions related to different types of L^p spaces.

Topics and Learning Points

	Teaching Hours
UNIT1: Measures on real line	**12**
1.1 LebesgueOuterMeasure	
1.2 MeasurableSets	
1.3 MeasurableFunctions	
1.4 BorelandofLebesgueMeasurability	
UNIT2: Integrationoffunctionon realvariables	**14**
2.1 Integrationofnonnegativefunction	
2.2 GeneralIntegral	
2.3 IntegrationofSeries	
2.4 RiemannandLebesgueIntegral	
UNIT3: Differentiation	**14**
3.1 Functions of bounded variation	
3.2 LebesgueDifferentiationTheorem	
3.3 DifferentiationTheorem	
3.4 DifferentiationandIntegration	
UNIT4: Abstract Measure space	**10**
4.1 Measure and outer measure	
4.2 Uniquenessofextension	
4.3 CompletionofMeasure	
4.4 MeasureSpace	
4.5 Integrationwithrespecttomeasure	
UNIT5: Inequalities and L^p space	**10**
5.1 The L^p spaces	
5.1 5.2 Convexfunction	
5.2 Jensen'sInequality	
5.3 TheInequalitiesofHolderandMinkowski	
5.4 Completenessof$L^P(\boldsymbol{\mu})$	

Text Book:

G.deBarra,MeasureTheory andIntegration,NewAge InternationalLimitedPublishers,2000.
Unit 1-Sections2.1, 2.2,2.4,2.5,**Unit 2-**Sections3.1 to 3.4,**Unit 3-** Sections 4.3to4.6,**Unit 4-**Section5.1 to5.6,**Unit 5-**Section6.1 to6.5.

References:

1. Elias M. Stein and Rami Shakarchi, *Real Analysis*, Princeton University press.
2. Karen Saxe, *Beginning Functional Analysis*, Springer International Edition.
3. W. Rudin, *Principles of Mathematical Analysis*, Mc. Graw Hill.
4. H. L. Royden, P. M. Fitzpatrick, *Real Analysis* (Fourth Edition), Pearson publication Asia Ltd.

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 Pattern)

Name of the Programme : M.Sc (Mathematics)

Program Code :PSMAT

Class :M.Sc.I

Semester : I

Course Type : Major (Mandatory)

Course Name : Advanced Calculus

Course Code :MAT-502-MJM

No. of Lectures : 60

No. of Credits : 4

Course Objectives:

1. To understand theory in Vector calculus.
2. To use important theorems such as Greens Theorem, Divergence, Stokes Theorem for problem-solving.
3. To learn multidimensional Integrals and Surface integrals.
4. Use stokes theorem to give a physical interpretation of the curl of a vector field.
5. Compute the curl and divergence of vector fields.
6. Use the fundamental theorem of line integrals.
7. Use greens theorem to evaluate line integrals along simple closed contours on the plane.

Course Outcomes:

By the end of the course, students will be able to:

CO1-Apply these concepts to solve practical problems that arise in physics and other related areas.
CO2-Understand change of variables by applying change of variable Theorems.
CO3-Use the chain rule by applying necessary rules.
CO4-Differentiate vectors to understand gradient, divergence and curl by using appropriate rules.
CO5-Compute line integrals of vector functions and also solve real world problems by using definition and in differential forms.
CO6-Compute surface integrals of vector fields by developing the notion of integral.
CO7-Use greens and stokes theorems by combining vector differential calculus and vector integral calculus.

Topics and Learning Points

Teaching Hours

UNIT1: DifferentialCalculusofScalarandVectorField **16**

1.1 Derivativeofa scalarfield withrespect toa vector
1.2 Directional derivative,Gradientofascalarfield
1.3 Derivativeofavectorfield
1.4 Matrixformof thechainrule
1.5 Inversefunctiontheorem andImplicitfunctiontheorem.

UNIT2: LineIntegrals **12**

2.1 Path and Line Integrals
2.2 The concept of work as a line integral
2.3 Independence of path
2.4 IntegrationofSeries
2.5 Thefirstandthesecondfundamentaltheoremsof calculus for lineintegral
2.6 Necessaryconditionfora vectorfieldtobegradient

UNIT3: MultipleIntegrals **14**

3.1 Double Integrals
3.2 Applications to area and volume
3.3 Green's Theorem in the plane
3.4 Change of variables in a double integral
3.5 Transformation formula
3.6 Change of variables in an n-fold integral.

UNIT4: SurfaceIntegrals **12**

4.1 The fundamental vector product
4.2 Area of a parametric surface
4.3 Surface integrals
4.4 The theorem of Stokes
4.5 The curl and divergence of a vector field
4.6 Gauss divergence theorem and its applications

UNIT5: ApplicationofDifferentialCalculus **6**

5.1 Partial differential equation
5.2 A first order partial differential equation with constant coefficients
5.3 The one-dimensional wave equation.

Text Book:

T.M.Apostol, *Calculus*,Vol.II(2ndedition),JohnWiley andSons,Inc.
Unit 1-Sections8.1 to 8.22, **Unit 2**-Sections10.1to10.11and10.14to10.16
Unit 3- Sections11.1to11.5 and11.19to11.22and11.26 to11.34,
Unit 4-Sections12.1to12.15,12.18to12.21, **Unit 5**-Sections9.1to9.5

References:

1. T.M.Apostol,*MathematicalAnalysis*,Narosapublishinghouse.
2. W.Rudin,*PrinciplesofMathematicalAnalysis*,McGraw-Hill.

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 Pattern)

Name of the programme : M.Sc (Mathematics)

Programme Code : PSMAT

Class : M.Sc.I

Semester : I

Course Type : Major (Mandatory)

Course Name : Practical in Ordinary Differential Equations

Course Code : MAT-503-MJM

No. of Lectures : 60

No. of Credits : 2

Course Objectives:

1. TointroducethetheoryoflinearandnonlinearODE.
2. Toprovidestudentswithanintroductiontothetheoryofordinarydifferentialequationsthrough applications.
3. Createandanalyze mathematicalmodelsusinghigherorderdifferentialequationsto Solveapplicationproblemssuch asharmonic oscillatorandcircuits.
4. To learn about about linear and non-linear differential equation.
5. Solving differential equation using numerical methods.
6. Solving a system of linear equations and eigen values.
7. Study Picard theorem and solving integral problems using it.

Course Outcomes:

By the end of the course, students will be able to:

CO1-Findthe completesolutionofanonhomogeneousdifferentialequation as a linear combination of the complementary function and a particularsolution.

CO2-Introducedtothecompletesolutionofanonhomogeneous differential equationwithconstantcoefficientsbythemethodofundetermined coefficients.

CO3-Classify the differential equations with respect to their order and linearity.

CO4-Explain the meaning of solutions of Differential equations.

CO5-Solve system of linear equations.

CO6-Use the method of variation of parameter to find the solution of higher order linear differential equations with variable coefficients.

CO7-Solve Cauchy-Euler equation.

Topics and Learning Points	Teaching Hours
Unit 1 Linearequationswithconstantcoefficients	**14**
1.1Secondorderhomogeneousequations.	
1.2 Initialvalueproblemsforsecondorderequations	
1.3 Lineardependence andindependence	
1.4 FormulafortheWronskian	
1.5 Nonhomogeneousequationsofordertwoandorder$n$	
1.6 Homogeneousequationsof order$n$	
1.7 Algebraofconstantcoefficientsequations	
Unit 2 Linearequationswithvariablecoefficients	**14**
2.1 Initialvalueproblemsforthehomogeneousequation	
2.2 Solutionsofthehomogeneousequation	
2.3 Wronskianandlinearindependence	
2.4 Reductionoforderofthehomogeneousequation	
2.5 Nonhomogeneousequationswithanalyticcoefficients	
2.6 Homogeneous equations	
2.7 Legendreequation	
Unit 3 LinearEquationswithregularsingularpoints	**12**
3.1Eulerequation	
3.2 Secondorderequationwithregularsingularpoints	
3.3 Exceptionalcases	
3.4 Bessel'sequation	
3.5 Regularsingularpointatinfinity	
Unit 4 : Existenceanduniquenessofsolutionstofirst orderequations	**10**
4.1Equationswithvariablesseparated	
4.2 Exactequations	
4.3 Methodofsuccessiveapproximations	
4.4 Lipschitzcondition	
4.5 Approximationanduniquenesstosolution	
Unit 5 : Existenceanduniquenessofsolutionstosystems, n^{th}orderequations	**10**
5.1Complexn-dimensionalspace	
5.2 Systemsasvectorequations	
5.3 Existenceanduniquenessofsolutionstosystems	
5.4 Existenceanduniquenessfor linearsystems	

Text Book:

E.A.Coddington,*AnIntroductiontoOrdinaryDifferentialEquations,*Prentice-Hall,1987.
Unit 1-sections2.2to 2.12,**Unit 2**-sections3.1 to 3.8,**Unit 3**–sections 4.1,4.2,4.3, 4.4,4.7,4.8, 4.9,**Unit 4**-section 5.1to5.5 and5.8,**Unit 5**-section 6.4to 6.8.

References:

1. G.F.Simmons, *DifferentialEquationswithapplicationsandHistorical notes,*Tata-McGrawHill.
2. G.Birkhoff andG.C.Rota,*Ordinary differentialequations,*JohnWileyandSons.
3. S.G.Deo,V.Lakshmikantham,V.Raghvendra,*TextbookofOrdinaryDifferentialEquations,*Secondedition,TataMc-GrawHill.
4. G.F.SimmonsandS.G.Krantz,*DifferentialEquations,*Tata-McGraw-Hill.

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 Pattern)

Name of the programme : M.Sc. (Mathematics)
Program Code : PSMAT
Class : M.Sc. -I
Semester : I
Course Type : Major (Mandatory)
Course Name : Practical programming in C
Course Code : MAT-504-MJM
No. of Lectures : 60
No. of Credits : 2

Course Objectives:

1. To understand basic programming in C.
2. To study mathematics using programming.
3. To use programming to make useful software in industry and use of Mathematics in them makes them more reliable and user friendly.
4. Programming basics and the fundamentals of C.
5. Data types in C
6. To understand Mathematical and logical operatory.
7. To study use of if statement and loop.

Course Outcomes:

By the end of the course, students will be able to:

CO1-Understand and visualize the working of computers.
CO2-Use fundamentals of C programming to implementalgorithms in mathematics.
CO3-Develop a C program.
CO4-Exploring C programming.
CO5-Managing input and output operations.
CO6-Understand the basics of file handling mechanisms.
CO7-Solve repetitive work using C programming.

Topics and Learning Points	Teaching Hours
UNIT 1: Introductory concepts in C. 1.1 C Fundamentals. 1.2 The C characters set. 1.3 Constants, variables and keywords 1.4 The first C program, compilation and execution.	**16**
UNIT 2: Operators and Expressions 2.1Associativity of operators 2.2 Hierarchy of operators revisited 2.3 The conditional operators.	**16**
UNIT 3: The decision control structure 3.1The if statement 3.2 The if-else statement 3.3 Nested if-else statement 3.4 Use of logical operator and else if clause	**16**
UNIT 4: Control statements, Functions 4.1 Loops 4.2 While loop, for loop,nesting of loops. 4.3 The odd loop. 4.4 What is function. 4.5 Why use function.	**10**
UNIT 5:Program Structures Preparing and running a program.	**2**

Text Book:

Brian W. Kernighan and Dennis M. Ritchie, *The C Programming Language*, PrenticeHall.

References:

1. ByronsS. Gottfried, Programming with C, Schaum's Outline Series.
2. S.A.Teukolsky**,** *Numerical recipes in C*, W.H.Press.
3. Yeshwant Kanetkar, *Let us C*, BPB Publications.

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 Pattern)

Name of the programme :M.Sc (Mathematics)

Programme Code : PSMAT

Class : M.Sc.I

Semester : I

Course Type : Major (Elective)

Course Name : Numerical Analysis

Course Code :MAT-511-MJE(A)

No. of Lectures : 60

No. of Credits : 4

Course Objectives:

1. Tosolveproblemsnumericallybyvariousapproximationmethods.
2. To find the approximate area of some complex regions using NumericalIntegration.
3. DemonstrateunderstandingofcommonNumericalMethodsandhowtheyareusedtoobtain approximate solutions.
4. Perform an error analysis for various numerical methods.
5. Derive appropriate numerical methods to calculate a definite integral.
6. Analyze the error incumbent in any such numerical approximation.
7. Study different techniques of interpolation.

Course Outcomes:

By the end of the course, students will be able to:

CO1. Student will beabletohandleMachineLearningalgorithmsusingNumericalAnalysis.
CO2. Studentwillbeable toconstructa functionwhichcloselyfits given n-pointsintheplaneby usinginterpolation method.
CO3. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
CO4. Implement numerical methods in Scilab and other mathematical software.
CO5. Solve a linear system of equations using an appropriate numerical method.
CO6. Student will beable solve an algebraic or transcendental equation using an appropriate numerical method.
CO7. Student will beableto approximate a function using an appropriate numerical

Topics and Learning Points

Teaching Hours

Unit 1 :RootofNonlinearEquation **12**

1.1 Introduction
1.2 MethodsofSolution
1.3 Iterativemethods
1.4 EvaluationofPolynomials
1.5 Bisectionmethod
1.6 FalsePositionmethod
1.7 NewtonRaphsonMethodandSecantMethod
1.8 FixedPointMethod,SystemofNonlinearEquationsandRootsofPolynomials.

Unit 2 : DirectandIterativeSolutionofLinearEquation **16**

2.1 ExistenceofSolution
2.2 Solutionbyelimination
2.3 BasicGaussEliminationmethod
2.4 GausseliminationwithpivotingandGauss-JordanMethod
2.5 TriangularFactorizationMethodsandRound-offErrorsandRefinement
2.6 MatrixInversionMethodandJacobiIterativemethod
2.7 Gauss-SeidelMethodandConvergenceofIterationMethods

Unit 3 : CurveFittingInterpolation : **8**

3.1 Polynomialformsandlinearinterpolation
3.2 LagrangeInterpolationPolynomial
3.3 NewtonInterpolationPolynomialandInterpolationwithequidistantpoints

Unit 4 : NumericalDifferentiationandIntegration: **14**

4.1 DifferentiatingContinuousfunctions
4.2 Forwarddifferencequotient
4.3 Centraldifferencequotient
4.4 ErroranalysisandNewton-CotesMethods
4.5 TrapezoidalRule,Simpsons1/3rule,Simpsons3/8rule

Unit 5 : NumericalSolutionofODE andBVP **10**

5.1 TaylorSeriesMethod
5.2 Euler'sMethodandHeun'sMethod
5.3 PolygonMethodandRunge-KuttaMethods
5.4 ShootingMethod
5.5 FiniteDifferenceMethod
5.6 SolvingEigenvalueProblems
5.7 Powermethod

Text Book:

EBalagurusamy,*NumericalMethods*,,McGrawHill.

Unit 1: Section 6.1to 6.3and 6.5to 6.10.
Unit 2: Section 7.1to 7.8,and 7.10.
Unit 3: Section8.1to8.5.
Unit 4:Section9.1to9.7.
Unit 5:Section 11.1,11.2,13.2to13.6,14.1 to14.4.

References:

1. BrianBradie,*AFriendlyIntroductiontoNumericalAnalysis*,PearsonPrenticeHall2007.
2. S.S.Sastry,*IntroductionMethodsofNumericalAnalysis(4thEdition)*,Prentice.
3. John H. Mathews, Kurtis D. Fink, *Numerical Methods using Matlab ,4th Edition*, PearsonEducation(Singapore) Ltd.Indian Branch,Delhi2005.
4. K.E.Atkinson,*AnIntroductiontoNumericalAnalysis*,JohnWileyandsons.
5. J. I.BuchmanandP.R.Turner,*NumericalMethodsandAnalysis*,McGraw-Hill.
6. M. K. Jain, S.R.K. Iyengar, R.K. Jain, *Numerical Methods for scientific & engineeringComputation,5th Edition*,NewAge InternationalPublication.

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 Pattern)

Name of the programme : M.Sc.(Mathematics)

Program Code : PSMAT

Class : M.Sc. -I

Semester : I

Course Type : Major (Elective)

Course Name : Group Theory

Course Code :MAT-511-MJE(B)

No. of Lectures : 60

No. of Credits : 4

Course Objectives:

1. Be able to state the group axioms and to verify whether a given set and binary operation form a group.
2. Define subgroup, identity element, inverse, associativity, order of an element, order of a group, group table, inverse and cyclic groups.
3. Understanding of theoretical part of Groups and how to use them to solve problems.
4. Present concepts of and the relationships between operations satisfying various properties.
5. Be able to define and compute with cyclic groups, the additive group mod n, the multiplicative group mod p, the symmetric group, the dihedral group.
6. Studying and manipulating abstract concepts involving symmetry.
7. Understanding of theoretical part of various Sylow's Theorems.

Course Outcomes:

By the end of the course, students will be able to:

CO1. Apply the Internal Direct Product Theorem in simple cases.
CO2. Analyze the symmetry of a plane figure.
CO3. Decide whether given group is Cyclic and find a generator for a subgroup.
CO4. Express products of elements of a Group define by a generators.
CO5. Recognize the Dihedral group when describe using a standard form.
CO6. Investigate symmetry using group theory.
CO7. Generate groups given specific conditions.

Topics and Learning Points	Teaching Hours
UNIT1: Groups	**10**
1.1 Semi groups and groups.	
1.2 Homomorphism.	
1.3 Subgroups and Cosets.	
1.4 Cyclic groups.	
1.5 Permutation groups.	
1.6 Generators and relations.	
UNIT2: Normal Subgroups	**14**
2.1Normal subgroups and quotient groups.	
2.2 Isomorphism theorem.	
2.3 Automorphism	
2.4 Conjugacy and G-sets.	
UNIT3: Normal Series	**10**
3.1Normal series	
3.2 Solvable groups.	
3.3 Nilpotent groups.	
UNIT4: Permutation Groups	**12**
4.1 Cyclic decomposition.	
4.2 Alternating group A_n.	
4.3 Simplicity of A_n.	
UNIT5: Structure theorems of groups	**14**
5.1Direct products.	
5.2 Finally generated abelian groups.	
5.3 Invariants ofa finite abelian group.	
5.4 Sylow theorems	
5.5 Groups of orders p^2 and pq.	

Text Book:

P.B. Bhattacharya, S. K .Jain and S .R. Nagapaul– *Basic Abstract Algebra*,CambridgeUniversity Press.

Unit 1: Section4.1to4.6
Unit 2: Section5.1to5.4
Unit 3: Section6.1to6.3
Unit 4: Section7.1to7.3
Unit 5: Section8.1to8.5

References:

1. I.S.LutharandI.B.S.Passi:*Algebra(Volume1)Groups*, (NarosaPublishingHouse)
2. I.N.Herstein:*Topicsin Algebra*(Wiley-EasternLtd)
3. N.S.GopalaKrishnan:*University Algebra*(Wiley-EasternLtd)
4. Fraleigh:*A First Course in Abstract Algebra*
5. Dummitand Foote:*Abstract Algebra*(Wiley-EasternLtd).

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 Pattern)

Name of the Programme : M.Sc. (Mathematics)

Program Code :PSMAT

Class :M.Sc.I

Semester : I

Course Type : Research Methodology (RM)

Course Name : Research Methodology in Mathematics

Course Code :MAT-521-RM

No. of Lectures : 60

No. of Credits : 4

Course Objectives:

1. To understand some basic concepts of research and its methodologies.
2. Be able to identify and discuss the complex issues inherent in selecting a research problem, selecting research design, and implementing a research project.
3. Identify and discuss the role and importance of research.
4. Be able to write a research report and thesis.
5. To understand the fundamentals of logical reasoning in pure mathematics.
6. Develop the necessary skill to conduct, review and publish research.
7. To learn and understand the research publication ethics and tools like Latex.

Course Outcomes:

By the end of the course, students will be able to:

CO1-Learn Typesetting of journal articles, technical reports, thesis, books, and slide presentations using Latex.
CO2-Comprehend and explain research articles in their academic discipline.
CO3-Demonstrate the ability to choose methods appropriate to research problems.
CO4-Take up and implement a research project or study.
CO5-Collect the data, edit it properly and analyse it accordingly.
CO6-Develop skills in qualitative and quantitative data analysis and presentation
CO7-Understand fundamentals of logical reasoning in pure and applied mathematics.

Topics and Learning Points

Teaching Hours

UNIT1: Foundation of research **12**

1.1 Meaning and Objectives of research
1.2 Significance of research
1.3 Types of research, Characteristic of mathematical methods
1.4 Research process, Defining Research problem

UNIT2: Mathematical statements **14**

2.1 If then statements, Sufficient and necessary conditions
2.2 Contrapositive, Converse, Negation
2.3 Direct and indirect proof, Principle of induction
2.4 Inductive reasoning, Counter examples

UNIT3: Research design and Method of Data Collection **14**

3.1 Need for research design
3.2 Different research designs
3.3 Collection of data, observation method, Questionnaires
3.4 Numerical and graphical data analysis using software's

UNIT4: Preparation of thesis and Research papers **10**

4.1 Guideline for writing the Abstract
4.2 Layout of the report, methodology, result and discussion
4.3 Style of referencing, Bibliography
4.4 Research Ethics,Software for detection of Plagiarism

UNIT5: Latex for Writing paper, Thesis, and Report **10**

5.1 Introduction to Latex
5.2 Document structure
5.3 Mathematical Concepts
5.4 Inserting Reference, Presentation using Beamer

References:

1. C.R. Kothari, *Research methodology (second revised edition)*, New Age publishers, 2004.
2. James R. Munkres, *Topology*, Second edition, Prentice Hall of India, 2002.
3. Michael P. Marder, *Research methods for science*, Cambridge University press, 2011.
4. Bordens, K.S. and Abbott B.B., *Research Design and Methods*, A process approach, 8 edition, McGraw-Hill, 2011.

Examination Pattern / Evaluation Pattern

Teaching and Evaluation (for Major, Minor, AEC, VEC, IKS courses)

Course Credits	No. of Hours per Semester Theory/Practical	No. of Hours per Week Theory/Practical	Maximum Marks	CE 40 %	ESE 60%
1	15 / 30	1 / 2	25	10	15
2	30 / 60	2 / 4	50	20	30
3	45 / 90	4 / 6	75	30	45
4	60 / 120	4 / 8	100	40	60

Teaching and Evaluation (for VSC, SEC & CC courses)

- Evaluation to be done by Internal & External Experts
- No descriptive end semester written examination
- Evaluation to be done at Department level preferably prior to commencement of Theory /Practical Examinations
- Evaluation to be done on the Skills gained by student