



**R.E. Society's
R. P. Gogate College of Arts & Science
and R. V. Jogalekar College of
Commerce, Ratnagiri (Autonomous)**

**Bachelor of Science (B.Sc.) Mathematics
Programme**

**Three Year Integrated Programme
Six Semesters**

Syllabus for Semester : III & IV

Under Choice Based Credit System (CBCS)

**To be implemented from Academic Year-
2023-2024**

Name of Programme	B.Sc. Mathematics
Level	UG
No of Semesters	06
Year of Implementation	2023-24
Programme Specific Outcomes (PSO)	<ol style="list-style-type: none"> 1. Learner shall able to develop positive attitude towards mathematics as an interesting and valuable subject. 2. Enhancing students' overall development and to equip them with mathematical modelling, abilities, problem solving skills, creative talent. 3. Learner should be able to acquire good knowledge and understanding in advanced areas of mathematics. 4. Learner should apply Mathematical models to the problems of society.
Relevance of PSOs to the local, regional, national, and global developmental needs (200 words)	<p>Mathematics is useful at Global, Regional and local level. Better understanding of mathematics helps the student to visualize the solution of the problems in society. The application part is taken care of so that the learner should be able to create mathematical models to the problems in society. The skill set, knowledge acquired during the completion of programme shall make him employable in fields like Teaching, Banking, Research analyst, various IT industries.</p>

Revised Syllabus of Courses of
Bachelor of Science (B.Sc) Mathematics Programme
Under Choice Based Credit System
Course Structure

S.Y.B.Sc.

(To be implemented from Academic Year- 2023-24)

Course Code	Semester III	Credits	Course Code	Semester IV	Credits
USMT301	Calculus III	2	USMT401	Multivariable Calculus I	2
USMT302	Linear Algebra I	2	USMT402	Linear Algebra II	2
USMT303	Ordinary Differential Equations	2	USMT403	Numerical Methods	2
USMT304	Mathematics Pactical-1 Based on USMT301, USMT302 and USMT303	3	USMT404	Mathematics Pactical-2 Based on USMT401, USMT402 and USMT403	3
Total Credits		9	Total Credits		9

Teaching Pattern :

1. Three lectures per week per course (Theory)
2. Two lectures per week per course (Practical) for USMT301, USMT302, USMT401 and USMT402
3. Three lectures per week per course (Practical) for USMT303 and USMT403

**Revised Syllabus of Courses of
Bachelor of Science (B.Sc.) Mathematics Programme at Semester III
with Effect from the Academic Year 2023-2024**

Course Code	Semester III	Credits
USMT301	Calculus III	2
USMT302	Linear Algebra I	2
USMT303	Ordinary Differential Equations	2
USMT304	Mathematics Pactical-1 Based on USMT301, USMT302 and USMT303	3
Total Credits		9

Name of the Course	Calculus III
Course Code	USMT301
Class	S.Y.B.Sc.
Semester	III
No. of Credits	2
Nature	Theory
Type	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	Calculus has importance in real life according to its valuable applications. Many real-life situations can be modelled using sequences and series. The Riemann Integral is used in measuring distances, also it is used in solving many interesting problems in the fields like Economics, Finance etc. This course will improve the required calculation skills among the learners.

Unit No.	Units	No. of Lectures
1	Infinite Series	15
2	Riemann Integration	15
3	Applications of Integration and Improper Integrals	15

Nomenclature : Calculus III

Course Outcomes :

On successful completion of this course, a learner will be able to:

1. Solve the problems on various types of convergence of series.
 2. solve problems on Riemann integrable functions, integration by parts formula, Leibnitz's rule, Gamma and Beta functions, absolute convergence
 3. write proofs of properties of Riemann integrable functions, Riemann integrability of continuous functions, fundamental theorems of calculus, Mean Value Theorem
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Curriculum :

Unit No.	Title and Learning Points	
1	Infinite Series	15 Lectures
	1.1 Infinite Series in R 1.2 Tests for convergence 1.3 Alternating Series, Absolute Convergence	
2	Riemann Integration	15 Lectures
	2.1 Idea of approximating the area under a curve 2.2 Criterion for Riemann integrability 2.3 Algebra of Riemann integrable functions 2.4 Riemann Integrability of a continuous function	
3	Applications of Integrations and Improper Integrals	15 Lectures
	3.1 First and second Fundamental theorem of Calculus, Mean Value Theorem 3.2 Two types of improper integrals 3.3 Gamma and Beta Functions and their properties	

Learning Resources Recommended :

1. Sudhir Ghorpade, Balmohan Limaye; A Course in Calculus and Real Analysis (2nd Edition); Springer
 2. R. R. Goldberg; Methods of Real Analysis; Oxford and IBH Pub. Co., New Delhi, 1970
 3. Calculus and Analytic Geometry (9th Edition); Thomas and Finney; Addison-Wesley, Reading Mass., 1998
 4. T. Apostol; Calculus Vol. 2; John Wiley
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Evaluation Scheme :**A. Continuous Evaluation (40 Marks)**

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 20 marks / 2 Unit tests of 10 marks each / 3 Unit tests of 10 marks each and best two out of three will be considered)	20
Assignments / Seminar / Group discussion	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (60 Marks - 2 Hours)

Comprehensive written examination of 2-hours duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions, short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	I	05
	II	05
	III	05
2	I	15
3	II	15
4	III	15

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Name of the Course	Linear Algebra I
Course Code	USMT302
Class	S.Y.B.Sc.
Semester	III
No. of Credits	2
Nature	Theory
Type	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	This course gives brief introduction of Linear Algebra, considered a basic concept in the modern presentation of Geometry which prepares learners to study further courses related to Algebra.

Unit No.	Units	No. of Lectures
1	System of equations and Matrices	15
2	Vector Space over R	15
3	Determinants, Linear Equations (Revisited)	15

Nomenclature : Linear Algebra I

Course Outcomes :

On successful completion of this course, a learner will be able to:

1. solve system of linear equations using Gaussian elimination and matrix inversion.
 2. demonstrate understanding of the concepts of vector space and subspace, linear independence, span and basis.
 3. solve problems on Determinant and its applications.
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Curriculum :

Unit No.	Title and Learning Points
1	System of equations and Matrices 15 Lectures
	1.1 Systems of homogeneous and non-homogeneous linear equations, Matrix representation of system of homogeneous and non-homogeneous linear equations. Algebra of solutions of systems of homogeneous linear equations 1.2 Elementary row and column operations. Row equivalent, Row Reduction 1.3 Elementary matrices. Relation of elementary row operations with elementary matrices. Invertibility of elementary matrices
2	Vector Space over R 15 Lectures
	2.1 Definition of a vector space over R, Subspaces, examples of vector spaces 2.2 Intersections and sums of subspaces. Direct sums, Quotient space 2.3 Linear combination of vectors, Linear span of a subset of a vector space. Linear dependence and independence of subsets of a vector space. 2.4 Basis of a vector space, dimension of a vector space, examples, Bases of a vector space as a maximal linearly independent sets and as minimal generating sets.
3	Determinants, Linear Equations (Revisited) 15 Lectures
	3.1 Inductive definition of the determinant of a $n \times n$ matrix, Laplace expansions along an arbitrary row or column. Determinant expansions using permutations 3.2 Basic properties of determinants Row space & the column space of a matrix examples 3.3 Relation between the solutions of a system of non-homogeneous linear equations and the associated system of homogeneous linear equations 3.4 Crammers Rule. LU Decomposition

Learning Resources Recommended :

1. Howard Anton, Chris Rorres, Elementary Linear Algebra, Wiley Student Edition.
2. Sege Lang, Introduction to Linear Algebra, Springer
3. S Kumaresan, Linear Algebra- A geometric Approach, PHI Learning

4. Sheldon Axler, Linear Algebra don right, Springer

Evaluation Scheme :

A. Continuous Evaluation (40 Marks)

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 20 marks / 2 Unit tests of 10 marks each / 3 Unit tests of 10 marks each and best two out of three will be considered)	20
Assignments / Seminar / Group discussion	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (60 Marks - 2 Hours)

Comprehensive written examination of 2-hours duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions, short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	I	05
	II	05
	III	05
2	I	15
3	II	15
4	III	15

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Name of the Course	Ordinary Differential Equations
Course Code	USMT303
Class	S.Y.B.Sc.
Semester	III
No. of Credits	2
Nature	Theory
Type	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	ODEs are used in many models to determine how the state of this model is changing (regarding time or another variable). Thus, ODEs are important for many scientific fields because they arise whenever a relation is given for the change of a model/system.

Unit No.	Units	No. of Lectures
1	Higher order Linear Differential Equations	15
2	Systems of First Order Linear Differential Equations	15
3	Numerical Solution of Ordinary Differential Equations	15

Nomenclature : Ordinary Differential Equations

Course Outcomes :

On successful completion of this course, a learner will be able to:

1. solve higher order linear differential equations.
 2. solve systems of first order linear differential equations.
 3. find the numerical solution of ordinary differential equations.
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Curriculum :

Unit No.	Title and Learning Points	
1	Higher order Linear Differential Equations	15 Lectures
	1.1 The general n^{th} order linear differential equations 1.2 Higher order homogeneous linear differential equations with constant coefficients 1.3 Higher order homogeneous linear differential equations with constant coefficients 1.4 The inverse differential operator and particular integral 1.5 Higher order linear differential equations with variable coefficients	
2	Systems of First Order Linear Differential Equations	15 Lectures
	2.1 Existence and Uniqueness theorem for the solutions of initial value problems for system of two first order linear differential equations in two unknown functions 2.2 Homogeneous linear system of two first order differential equations in two unknown functions of independent variable 2.3 Wronskian for a Homogeneous Linear System 2.4 Homogeneous linear systems with constant coefficients 2.5 Non homogeneous linear system	
3	Numerical Solution of Ordinary Differential Equations	15 Lectures
	3.1 Numerical solution of initial value problem of first order ordinary differential equation using six different methods 3.2 Numerical solution of simultaneous and higher order ordinary differential equation	

Learning Resources Recommended :

1. E. D. Rainville and P. E. Bedient; Elementary Differential Equations; Macmillan
 2. M. D. Raisinghania; Ordinary and Partial Differential Equations; S. Chand
 3. G. F. Simmons; Differential Equations with Applications and Historical Notes; Taylor's and Francis
 4. S. S. Sastry; Introductory Methods of Numerical Analysis, PHI
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Evaluation Scheme :**A. Continuous Evaluation (40 Marks)**

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 20 marks / 2 Unit tests of 10 marks each / 3 Unit tests of 10 marks each and best two out of three will be considered)	20
Assignments / Seminar / Group discussion	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (60 Marks - 2 Hours)

Comprehensive written examination of 2-hours duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions, short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	I	05
	II	05
	III	05
2	I	15
3	II	15
4	III	15

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Name of the Course	Mathematics Practical-1
Course Code	USMT304
Class	S.Y.B.Sc.
Semester	III
No. of Credits	3
Nature	Practical
Type	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	A practical approach to teaching Mathematics allows learners to explore the material in a more hands-on manner. This course allows learners to apply problem-solving techniques and gain an understanding of the application of the courses USMT301, USMT302 and USMT303

Unit No.	Units	No. of Lectures
1	Infinite Series	10
2	Riemann Integration	10
3	Applications of Integration and Improper Integrals	10
4	System of equations and Matrices	10
5	Vector Space over R	10
6	Determinants, Linear Equations (Revisited)	10
7	Higher order Linear Differential Equations	15
8	Systems of First Order Linear Differential Equations	15
9	Numerical Solution of Ordinary Differential Equations	15

Nomenclature : Mathematics Practical-1

Course Outcomes :

On successful completion of this course, a learner will be able to:

1. solve problems on concepts from Calculus III
 2. solve problems on concepts from Linear Algebra I
 3. solve problems on concepts from Ordinary Differential Equations
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Curriculum :

Unit No.	Title and Learning Points	
1,2,3	Infinite Series, Riemann Integration, Applications of Integration and Improper Integrals	30 Lectures
	<ol style="list-style-type: none">1. Examples of convergent/divergent series and algebra of convergent series2. Tests for convergence of series3. Calculation of upper sum, lower sum and Riemann integral4. Problems on properties of Riemann integral5. Problems on fundamental theorem of calculus, mean value theorems, integration by parts, Leibnitz Rule6. Convergence of Improper integrals, different tests for convergence. Beta Gamma Functions7. Miscellaneous theoretical questions based on full course USMT301	
4,5,6	System of equations and Matrices, Vector Space over R, Determinants, Linear Equations (Revisited)	30 Lectures
	<ol style="list-style-type: none">1. System of homogeneous and non-homogeneous linear equations2. Elementary row/column operations and Elementary matrices3. Vector spaces, subspaces4. Linear dependence/independence, Basis, Dimension5. Determinant and Rank of a matrix6. Solution to a system of linear equations, LU decomposition7. Miscellaneous theoretical questions based on full course USMT302	
7,8,9	Higher order Linear Differential Equations, Systems of First Order Linear Differential Equations, Numerical Solution of Ordinary Differential Equations	45 Lectures
	<ol style="list-style-type: none">1. Finding the general solution of higher order linear differential equations.2. Solving higher order linear differential equations using method of undetermined coefficients and method of variation of parameters3. Solving a system of first order linear ODEs with auxiliary equations4. Finding the solution of initial value problems- Taylor's series method, Picard's, Modified Euler's, Runge-kutta Method of 4th order & calculating their accuracy5. Finding the solution of simultaneous ODEs using Runge-Kutta Method.6. Finding the numerical solution of two-point linear boundary value problem using Finite Difference method.7. Miscellaneous theoretical questions based on full course USMT303	

Learning Resources Recommended :

1. All resources recommended for USMT301, USMT302 and USMT303
 2. USMT301 Practical Question Bank Designed by Department of Mathematics, GJC
 3. USMT302 Practical Question Bank Designed by Department of Mathematics, GJC
 4. USMT303 Practical Question Bank Designed by Department of Mathematics, GJC
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Evaluation Scheme :**C. Continuous Evaluation (60 Marks : 20+20+20)**

Method	Marks
Journal + Viva	45
Overall Performance (Attendance, Punctuality, Sincerity, Timely Submission)	15

D. Semester End Evaluation (90 Marks : 30+30+30 - 4 Hours)

Comprehensive written examination of 2-hours duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions and descriptive (Problems) type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	Objective on Unit 1,2,3 of USMT301	18
2	Objective on Unit 1,2,3 of USMT302	18
3	Objective on Unit 1,2,3 of USMT303	18
4	Descriptive on Unit 1,2,3 of USMT301	12
5	Descriptive on Unit 1,2,3 of USMT302	12
6	Descriptive on Unit 1,2,3 of USMT303	12

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**Revised Syllabus of Courses of
Bachelor of Science (B.Sc.) Mathematics Programme at Semester IV
with Effect from the Academic Year 2023-2024**

CourseCode	Semester IV	Credits
USMT401	Multivariable Calculus I	2
USMT402	Linear Algebra II	2
USMT403	Numerical Methods	2
USMT404	Mathematics Pactical-2 Based on USMT401, USMT402 and USMT403	3
Total Credits		9

Name of the Course	Multivariable Calculus I
Course Code	USMT401
Class	S.Y.B.Sc.
Semester	IV
No. of Credits	2
Nature	Theory
Type	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	This course is important in many areas of real-life like to calculate the profit and loss in business using graphs, to check the temperature variation, to determine the speed or distance covered such as miles per hour, kilometer per hour etc. This course improves the required calculation skills among the learners.

Unit No.	Units	No. of Lectures
1	Functions of Several Variables	15
2	Differentiation of Scalar Fields	15
3	Applications of Differentiation of Scalar Fields and Differentiation of Vector Fields	15

Nomenclature : Multivariable Calculus I

Course Outcomes :

On successful completion of this course, a learner will be able to:

1. solve problems on limit and continuity of scalar fields, limit and continuity of vector field, partial and directional derivative of scalar fields
 2. write the proofs of theorems related to differentiation of scalar fields, applications of differentiation of scalar fields, differentiability of vector fields
 3. solve problems on applications of differentiation of scalar fields and vector fields
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Curriculum :

Unit No.	Title and Learning Points
1	Functions of Several Variables 15 Lectures
	1.1 Real-Valued functions of several variables (Scalar Fields), Graph of a function 1.2 Limits and Continuity of scalar fields, Limits and continuity of vector fields 1.3 Partial and Directional Derivatives of scalar fields
2	Differentiation of Scalar Fields 15 lectures
	2.1 Differentiability of scalar fields, continuity at a point of differentiability, existence of partial derivatives at a point of differentiability. 2.2 Gradient, Chain Rule 2.3 Euler's theorem, Higher order partial derivatives
3	Applications of Differentiation of Scalar Fields and Differentiation of Vector Fields 15 Lectures
	3.1 Applications of differentiation of scalar fields 3.2 Differentiation of Vector fields

Learning Resources Recommended :

1. T. Apostol; Calculus, Vol.2 (2nd Edition); John Wiley
 2. Sudhir Ghorpade, Balmohan Limaye; A course in Multivariable Calculus and Analysis (2nd Edition); Springer
 3. Walter Rudin; Principles of Mathematical Analysis; McGraw-Hill, Inc
 4. J. E. Marsden, A. J. Tromband A. Weinstein, Basic Multivariable Calculus; Springer
 5. D. Somasundaram and B. Choudhary: A First Course in Mathematical Analysis, Narosa, New Delhi, 1996
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Evaluation Scheme :**A. Continuous Evaluation (40 Marks)**

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 20 marks / 2 Unit tests of 10 marks each / 3 Unit tests of 10 marks each and best two out of three will be considered)	20
Assignments / Seminar / Group discussion	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (60 Marks - 2 Hours)

Comprehensive written examination of 2-hours duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions, short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	I	05
	II	05
	III	05
2	I	15
3	II	15
4	III	15

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Name of the Course	Linear Algebra II
Course Code	USMT402
Class	S.Y.B.Sc.
Semester	IV
No. of Credits	2
Nature	Theory
Type	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	This course gives brief introduction to Linear Algebra, considered as basic concept in the modern presentation of geometry which prepares learners to study further courses related to Algebra.

Unit No.	Units	No. of Lectures
1	Linear Transformation	15
2	Inner Product Spaces and Orthogonality	15
3	Eigen Values, Eigen Vectors and Diagonalizable Matrix	15

Nomenclature : Linear Algebra II

Course Outcomes :

On successful completion of this course, a learner will be able to:

1. explain the concept of linear transformation and their properties
 2. identify inner product spaces and outline properties of inner products
 3. explain the concept of orthogonalization and apply the concepts of eigen values and eigen vectors to geometry
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Curriculum :

Unit No.	Title and Learning Points
1	Linear Transformation 15 Lectures
	1.1 Definition of a Linear Transformation of vector spaces; Elementary Properties, Examples. Sums and scalar multiples of linear transformations. Composites of linear transformations 1.2 Null-Space (kernel) and Image (Rank) of LT, Rank Nullity Theorem 1.3 Matrix associated with LT, Matrix of composite of two LT, Invertible LT
2	Inner Product Spaces and Orthogonality 15 Lectures
	2.1 Inner Product Spaces (Over R), Examples, Cauchy Schwarz Inequality 2.2 Angle between two vectors, Orthogonality of Vectors, Pythagoras theorem and some Geometric Applications, Gram-Schmidt Orthogonalization Process, Orthogonal, Orthonormal Basis for Finite Dimensional Inner Product Space 2.3 Orthogonal Complement, Orthogonal decomposition of an inner product space, Orthogonal Projection of IPS on to its subspaces
3	Eigen Values, Eigen Vectors and Diagonalizable Matrix 15 Lectures
	3.1 Eigenvalues and eigenvectors of a LT of a VS into itself and of square matrices. Algebraic and Geometric Multiplicity 3.2 Characteristic Polynomial, Properties, Cayley-Hamilton Theorem, Applications 3.3 Invariance of the characteristic polynomial and eigen values of similar matrices 3.4 Diagonalizable matrix, Procedure for diagonalizing a matrix. 3.5 Spectral theorem for real symmetric matrices (statement only) Applications to quadratic forms and classification of conic sections.

Learning Resources Recommended :

1. Howard Anton, Chris Rores; Elementary Linear Algebra; Wiley Student Edition
2. Serge Lang; Introduction to Linear Algebra; Springer
3. S. Kumaresan; Linear Algebra-A geometric Approach; PHI Learning
4. David W. Lewis; Matrix Theory

Evaluation Scheme :**A. Continuous Evaluation (40 Marks)**

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 20 marks / 2 Unit tests of 10 marks each / 3 Unit tests of 10 marks each and best two out of three will be considered)	20
Assignments / Seminar / Group discussion	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (60 Marks - 2 Hours)

Comprehensive written examination of 2-hours duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions, short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	I	05
	II	05
	III	05
2	I	15
3	II	15
4	III	15

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Name of the Course	Numerical Methods
Course Code	USMT403
Class	S.Y.B.Sc.
Semester	IV
No. of Credits	2
Nature	Theory
Type	Elective
Highlight revision specific to employability/ entrepreneurship/ skill development	Numerical Methods, area of Mathematics and Computer Science that creates, analyzes and implements algorithms for obtaining numerical solutions to problems involving continuous variables. Such problems arise throughout the natural sciences, social sciences, engineering, medicine and business. Since the mid-20 th century, the growth in power and availability of digital computers has led to an increasing use of realistic mathematical models in Science and Engineering and Numerical analysis of increasing sophistication is needed to solve these more detailed models of the world.

Unit No.	Units	No. of Lectures
1	Solution of Algebraic and Transcendental Equations	15
2	Interpolation, Curve Fitting, Numerical Integration	15
3	Solution of Linear Systems of equations, Eigen Value Problems	15

Nomenclature : Numerical Methods

Course Outcomes :

On successful completion of this course, a learner will be able to:

1. solve Algebraic and Transcendental Equations
 2. solve problems based on Interpolation, curve fitting and Numerical Integration
 3. solve Linear Systems of equations
 4. find Eigen values
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Curriculum :

Unit No.	Title and Learning Points	
1	Solution of Algebraic and Transcendental Equations	15 Lectures
	1.1 Measures of Errors 1.2 Types of Errors 1.3 Iteration methods based on First degree equation	
2	Interpolation, Curve Fitting, Numerical Integration	15 Lectures
	2.1 Interpolation 2.2 Curve Fitting 2.3 Numerical Integration	
3	Solution of Linear Systems of equations, Eigen Value Problems	15 Lectures
	3.1 Linear systems of equation 3.2 Eigen Value Problems	

Learning Resources Recommended :

1. Kendall E. and Atkinson; An Introduction to Numerical Analysis; Wiley
 2. M. K. Jain, S. R. K. Iyengar and R. K. Jain; Numerical Methods for Scientific and Engineering Computation; New Age International Publications
 3. S. Sastry; Introductory Methods of Numerical Analysis; PHI Learning
 4. An Introduction to Scilab-Cse iitb
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Evaluation Scheme :**A. Continuous Evaluation (40 Marks)**

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 20 marks / 2 Unit tests of 10 marks each / 3 Unit tests of 10 marks each and best two out of three will be considered)	20
Assignments / Seminar / Group discussion	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (60 Marks - 2 Hours)

Comprehensive written examination of 2-hours duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions, short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	I	05
	II	05
	III	05
2	I	15
3	II	15
4	III	15

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Name of the Course	Mathematics Practical-2
Course Code	USMT404
Class	S.Y.B.Sc.
Semester	IV
No. of Credits	3
Nature	Practical
Type	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	A practical approach to teaching Mathematics allows learners to explore the material in a more hands-on manner. This course allows learners to apply problem-solving techniques and gain an understanding of the application of the courses USMT401, USMT402 and USMT403

Unit No.	Units	No. of Lectures
1	Functions of Several Variables	10
2	Differentiation of Scalar Fields	10
3	Applications of Differentiation of Scalar Fields and Differentiation of Vector Fields	10
4	Linear Transformation	10
5	Inner Product Spaces and Orthogonality	10
6	Eigen Values, Eigen Vectors and Diagonalizable Matrix	10
7	Solution of Algebraic and Transcendental Equations	15
8	Interpolation, Curve Fitting, Numerical Integration	15
9	Solution of Linear Systems of equations, Eigen Value Problems	15

Nomenclature : Mathematics Practical-1

Course Outcomes :

On successful completion of this course, a learner will be able to:

4. solve problems on concepts from Calculus III
 5. solve problems on concepts from Linear Algebra I
 6. solve problems on concepts from Ordinary Differential Equations
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Curriculum :

Unit No.	Title and Learning Points
1,2,3	Functions of Several Variables, Differentiation of Scalar Fields, Applications of Differentiation of Scalar Fields and Differentiation of Vector Fields 30 Lectures
	<ol style="list-style-type: none">1. Limits and Continuity of scalar and Vector fields, Integral limits2. Computing directional derivatives, partial derivatives and MVT of scalar fields3. Differentiability of Scalar field, Total derivative, Gradient, Level sets,4. Chain Rule, Higher order derivatives and Mixed Partial Derivatives5. Maximum and Minimum rate of change of scalar fields, Taylor's Theorem, Finding Hessian/Jacobian Matrix, Chain Rule of Vector fields6. Finding Maxima, Minima and Saddle Points, Second Derivative Test for Extrema of Functions of two variables and methods of Lagrange multipliers.7. Miscellaneous theoretical questions based on full course USMT401
4,5,6	Linear Transformation, Inner Product Spaces and Orthogonality, Eigen Values, Eigen Vectors and Diagonalizable Matrix 30 Lectures
	<ol style="list-style-type: none">1. Linear Transformation, Kernel, Rank-Nullity theorem2. Linear Isomorphism, Matrix associated with LT3. Inner product and properties, Projection, Orthogonal Complements4. Orthogonal, Orthonormal Sets, Gram-Schmidt Orthogonalisation5. Eigen Values, vectors, Characteristic Polynomial, App. of Cayley-Hamilton T6. Diagonalization of matrix, Orthogonal diagonalization of Symmetric Matrix7. Miscellaneous theoretical questions based on full course USMT402
7,8,9	Solution of Algebraic and Transcendental Equations, Interpolation, Curve Fitting, Numerical Integration, Solution of Linear Systems of equations, Eigen Value Problems 45 Lectures
	<ol style="list-style-type: none">1. Newton-Raphson Method, Secant Method.2. Regula-Falsi Method, Iteration Method3. Interpolation Polynomial by Lagrange's Interpolation, Newton Forward and Backward difference Interpolation4. Curve fitting, Trapezoidal Rule, Simpson's 1/3 rd Rule, Simpson's 3/8th Rule5. LU Decomposition Method, Gauss-Seidel Iterative Method6. Jacobi's Method, Rutishauser Method7. Miscellaneous theoretical questions based on full course USMT403

Learning Resources Recommended :

1. All resources recommended for USMT401, USMT402 and USMT403
2. USMT401 Practical Question Bank Designed by Department of Mathematics, GJC
3. USMT402 Practical Question Bank Designed by Department of Mathematics, GJC
4. USMT403 Practical Question Bank Designed by Department of Mathematics, GJC

Evaluation Scheme :**C. Continuous Evaluation (60 Marks : 20+20+20)**

Method	Marks
Journal + Viva	45
Overall Performance (Attendance, Punctuality, Sincerity, Timely Submission)	15

D. Semester End Evaluation (90 Marks : 30+30+30 - 4 Hours)

Comprehensive written examination of 2-hours duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions and descriptive (Problems) type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	Objective on Unit 1,2,3 of USMT401	18
2	Objective on Unit 1,2,3 of USMT402	18
3	Objective on Unit 1,2,3 of USMT403	18
4	Descriptive on Unit 1,2,3 of USMT401	12
5	Descriptive on Unit 1,2,3 of USMT402	12
6	Descriptive on Unit 1,2,3 of USMT403	12



Name and Signature: Dr. Diwakar P. Karwanje
Chairman of BoS of Mathematics

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