

**NEP CBCS 2023-24**

**F.Y.B.Sc**

**Mathematics**



**M. C. E. Society's**

**Abeda Inamdar Senior College**

Of Arts, Science and Commerce, Camp, Pune-1

(Autonomous) Affiliated to SavitribaiPhule Pune University

NAAC accredited 'A' Grade

**Three Year B.Sc. Major Degree Program in  
Mathematics (Faculty of Science & Technology)**

**Syllabus of**

**F.Y. B.Sc. Mathematics**

**Choice Based Credit System Syllabus**

**To be implemented from the academic year 2023-2024**

**Title of the Program: B. Sc (Mathematics)****Preamble:**

Department of Mathematics, Abeda Inamdar Senior College is implementing the first syllabus of B.Sc. under NEP from June 2023. Taking into consideration the rapid changes in Science and Technology and new approaches in different areas of Mathematics and related subjects, the Board of studies in Mathematics has prepared the syllabus of B.Sc Semester-I and Semester-II (w.e.f. 2023-24) Mathematics course under the Choice Based Credit System (CBCS).

The model curriculum developed by U.G.C. is used as a guideline for the present syllabus.

**Aims:**

Sr. No.	Aims
1.	Give the students a sufficient knowledge of fundamental principles, methods, and a clear perception of innumerable powers of mathematical ideas and tools and know-how to use them by modeling, solving, and interpreting.
2.	Reflecting the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science and technology.
3.	Enhancing student's overall development and to equip them with mathematical modeling abilities, problem solving skills, creative talent, and power of communication necessary for various kinds of employment.
4.	Enabling students to develop a positive attitude towards mathematics as an interesting and valuable subject of study.

**Objectives:**

<b>Sr. No.</b>	<b>Objectives</b>
1.	A student should be able to recall basic facts about mathematics and should be able to display knowledge of conventions such as notations and terminology, recognize basic geometrical figures and graphical displays and state important facts resulting from their studies.
2.	A student should get a relational understanding of mathematical concepts and concerned structures and should be able to follow the patterns involved in mathematical reasoning.
3.	A student should get adequate exposure to global and local concerns that explore many aspects of Mathematical Sciences.
4.	A student should get adequate exposure to global and local concerns that explore many aspects of Mathematical Sciences.
5.	A student should be able to apply their skills and knowledge that is, translate information presented verbally into mathematical form, select and use appropriate mathematical formulae or techniques to process the information and draw the relevant conclusion.
6.	A student should be made aware of the history of mathematics and hence of its past, present, and future role as part of our culture.

**Programme Outcome:**

<b>Sr. No.</b>	<b>Outcome</b>
1.	The mathematical maturity of students in their current and future courses shall develop.
2.	The student develops theoretical, applied, and computational skills.
3.	The student gains confidence in proving theorems and solving problems.

<b>Offered as</b>	Major
<b>Course/ Paper Title</b>	Foundation of Mathematics
<b>Course Code</b>	23SBMT11MM
<b>Semester</b>	I
<b>No. of Credits</b>	2

<b>Unit No</b>	<b>Title with Contents</b>	<b>No. of Lectures</b>
<b>Unit I</b>	<b>Sets Relations and Functions</b>	<b>08</b>
	1. Basic terminologies of sets, Operations on sets, Family of sets, Power sets, Cartesian product of sets.	2
	2. Basic definitions of functions, One-one, onto functions and bijections, Composition of functions, Inverse of a function, Image of subsets under functions, Inverse image of subsets under functions. (Excluding theorem only examples)	3
	3. Relations on sets, Types of relations, Equivalence relations, Equivalence classes, and partitions of sets.	3
<b>Unit II</b>	<b>Divisibility Theory in the Integers</b>	<b>07</b>
	1. Basic terminologies of sets, Operations on sets, Family of sets, Power sets, Cartesian product of sets.	3
	2. The Division Algorithm, The Greatest Common Divisor, The Euclidean Algorithm.	4
<b>Unit III</b>	<b>Primes and the theory of Congruence</b>	<b>08</b>
	1. The Fundamental Theorem of Arithmetic: Prime Numbers, Euclid's Lemma.	3
	2. Basic Properties of Congruence.	2
	3. Fermat's Theorem.	2
<b>Unit IV</b>	<b>Complex Numbers</b>	<b>07</b>
	1. Sums and Products, Basic Algebraic Properties, Moduli, Complex Conjugates, Exponential Form, Products and	4

	Quotients, De- Moivre's theorem	
	2. Roots of Complex Numbers: The $n^{\text{th}}$ roots of unity.	2
	3. Regions in Complex Plane	1

**Textbooks:**

1. A Foundation Course in Mathematics, Ajit Kumar, S. Kumaresan and Bhaba KumarSarma, Narosa Publication House.  
Unit I: Chapter 2: Sec. 2.1 to 2.5, Chapter 3: Sec. 3.1 to 3.6, Chapter 4: Sec. 4.1 to 4.4.
2. Elementary Number Theory, David M. Burton, Tata McGraw Hill, Sixth Edition Unit II: Chapter 1: Sec. 1. 1 Chapter 2: Sec. 2.2 to 2.4.  
Unit III: Chapter 3: Sec. 3.1, Chapter 4: Sec. 4.1, 4.2, Chapter 5: Sec. 5.2.
3. Complex Variables and Applications, James Ward Brown and Ruel V. Churchill, Mc-GrawHill, Seventh Edition.  
Unit IV: Chapter 1: Sec 1 to 10.

**Reference Books:**

1. Textbook of Algebra, S. K. Shah and S. C. Garg, Vikas Publishing House Pvt. Ltd. Edition 2017.
2. Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert, John Wiley and Sons Inc, Fourth Ed.

**Website:**

1. <https://www.youtube.com/watch?v=md5UCR7mcIY>

<b>Offered as</b>	Major
<b>Course/ Paper Title</b>	Calculus-I
<b>Course Code</b>	23SBMT12MM
<b>Semester</b>	I
<b>No. of Credits</b>	2

<b>Unit No</b>	<b>Title with Contents</b>	<b>No. of Lectures</b>
<b>Unit I</b>	<b>Real Numbers</b>	<b>08</b>
	1. The Algebraic and Order properties of $\mathbb{R}$ : Algebraic properties of $\mathbb{R}$ , Order properties of $\mathbb{R}$ , Well-Ordering Property of $\mathbb{N}$ . Arithmetic mean- Geometric mean inequality, Bernoulli's inequality. (Revision: essential properties should be revised with illustrative examples)	2
	2. Absolute Value and the Real Line: Absolute value function and its properties, triangle inequality and its consequences, a neighborhood of a point on a real line.	2
	3. The Completeness Property of $\mathbb{R}$ : Definitions of Upper bound, Lower bound, supremum, infimum of subsets of $\mathbb{R}$ , completeness property of $\mathbb{R}$ .	2
	4. Applications of the Supremum Property: property and its consequences, The density theorem (without proof).	2
<b>Unit II</b>	<b>Sequences</b>	<b>07</b>
	1. Sequences and Their Limits: Definition and examples of sequences of real numbers, Definition of the limit of sequence and uniqueness of limit, Examples on the limit of a sequence.	2
	2. Limits Theorems: Definition of bounded sequence, Every convergent sequence is bounded, Algebra of limits.	2
	3. Monotone Sequences: Definition and examples of monotone sequences, Monotone convergence theorem, and examples	1
	4. Subsequences and Bolzano -Weierstrass Theorem: Definition	

	of subsequence and examples, Divergence criteria, Monotone Subsequence theorem (without proof), Bolzano –Weierstrass theorem (first proof).	1
	5. Cauchy Criterion: Definition and examples.	1
<b>Unit III</b>	<b>Limits</b>	<b>08</b>
	1. Functions and their Graphs: Functions, domain and range, graphs of functions, representing a function numerically, and Vertical line test, Piecewise defined functions, increasing and decreasing functions, even and odd functions symmetry, common functions.	2
	2. Limits of Functions: Definition of cluster point and examples, the definition of the limit of a function, the sequential criterion for limits, divergence criteria.	2
	3. Limit Theorems: Algebra of limits (proofs using sequential criterion), Squeeze theorem.	2
	4. Some extension of limit concepts: One-sided limits, infinite limits (without proof).	2
<b>Unit IV</b>	<b>Continuity</b>	<b>07</b>
	1. Continuous Functions: Definition of continuous function at a point, the sequential criterion for continuity, Divergence criterion, combination of continuous functions.	4
	2. Continuous Functions on Intervals: Properties of continuous functions on an interval, Boundedness theorem (without proof), The minimum-maximum theorem (without proof), Location of root theorem (Without proof), Bolzano's intermediate value theorem. Continuous function maps closed bounded interval to closed bounded interval, Preservation of interval theorem.	3

### Textbooks:

1. Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert, John Wiley and Sons Inc, Fourth Edition.

Unit I: Chapter 2: Sec 2.1 (2.1.1 to 2.1.13), Sec. 2.2 (2.2.1 to 2.2.9), Sec. 2.3,

Sec. 2.4 (2.4.1, 2.4.3 to 2.4.6, 2.4.8, 2.4.9).

Unit II: Chapter 3: Sec. 3.1 (3.1.1 to 3.1.7, 3.1.10, 3.1.11), Sec. 3.2 (3.2.1 to 3.2.11), Sec. 3.3 (3.3.1, 3.3.4), Sec. 3.4 (3.4.1 to 3.4.3, 3.4.5 to 3.4.8), Sec. 3.5.

Unit III: Chapter 4: Sec. 4.1 (4.1.1, 4.1.3 to 4.1.9), Sec. 4.2 (4.2.1 to 4.2.8), Sec. 4.3 (4.3.1 to 4.3.9).

Unit IV: Chapter 5: Sec. 5.1, Sec. 5.2, Sec 5.3 (5.3.1 to 5.3.5, 5.3.7 to 5.3.10).

2. Thomas' Calculus, Fourteenth edition, Pearson Publication.

Unit III: Chapter 1: Sec. 1.1.

### **Reference Books:**

1. Introduction to Real analysis, William F.Trench, Free edition, 2010.

2. Calculus of a single variable Ron Larson, Bruce Edwards, tenth edition.

Brooke Cole. Cengage Learning

3. Elementary Analysis, The Theory of Calculus, Kenneth A. Ross, Springer Publication, second edition.

4. Calculus and its Applications, Marvin L. Bittinger, David J. Ellenbogen and Scott A. Sargent, Addison Wesley, tenth edition

**Website:** 1. <https://www.youtube.com/watch?v=fCzS8y4SBtE>

2. <https://www.youtube.com/watch?v=wzFc9us78sM>



<b>Offered as</b>	Major
<b>Course/ Paper Title</b>	Practical Course based on 23SBMT11MM and 23SBMT12MM
<b>Course Code</b>	23SBMT13MM
<b>Semester</b>	I
<b>No. of Credits</b>	2

<b>Practical number</b>	<b>Title</b>	<b>No. of Practical</b>
<b>Practicals based on 23SBMT11MM</b>		
I	Sets Relations and Functions-I	1
II	Sets Relations and Functions-II	1
III	Divisibility	1
IV	Congruence	1
V	Divisibility and congruence	1
VI	Complex Numbers	1
<b>Practicals based on 23SBMT12MM</b>		
I	Real Numbers	1
II	Sequences-I	1
III	Sequences-II	1
IV	Limits	1
V	Continuity	1
VI	Limits and Continuity	1

<b>Offered as</b>	Major
<b>Course/ Paper Title</b>	Co-ordinate Geometry
<b>Course Code</b>	23SBMT21MM
<b>Semester</b>	II
<b>No. of Credits</b>	2

<b>Unit No</b>	<b>Title with Contents</b>	<b>No. of Lectures</b>
<b>Unit I</b>	<b>Analytical Geometry of Two Dimension</b>	<b>06</b>
	1. Change of axes: translation and rotation.	2
	2. Conic Sections: General equation of second degree in two variables	2
	3. Reduction to standard form, the center of conic, nature of conic.	2
<b>Unit II</b>	<b>Planes</b>	<b>10</b>
	1. Direction cosines and direction ratios, Equation of plane, Normal form, Transform to the normal form, Plane passing through three non-collinear points, Intercept form, Angle between two planes.	5
	2. Distance of a point from a plane, Distance between parallel planes, Systems of planes, two sides of planes, Bisector planes.	5
<b>Unit III</b>	<b>Lines in three dimension</b>	<b>08</b>
	1. Equations of a line in Symmetric and unsymmetrical forms, Line passing through two points, Angle between a line and a plane.	4
	2. Perpendicular distance of a point from a plane, Condition for two lines to be coplanar (without proof).	4
<b>Unit IV</b>	<b>Sphere</b>	<b>06</b>
	1. Equation of a sphere in different forms, plane section of a sphere.	2
	2. Equation of a circle, sphere through a given circle	2
	3. Intersection of a sphere and a line, Equation of tangent plane to a sphere.	2

**Textbooks:**

1. Analytic Geometry in Two and Three Dimensions: Von Steuben.

Unit I: Chapter 8: Sec, 8.4.

2. Analytical Solid Geometry: Shantinakaran; S. Chand and Company Ltd, New Delhi, 1998.

Unit II: Chapter 1: Sec. 1.6, 1.7, Chapter 2: Sec. 2.1 to 2.7.

Unit III: Chapter 3: Sec. 3.1 to 3.4, 3.7. Unit IV: Chapter 6: Sec. 6.1 to 6.6.

**Reference Book:**

1. P.K.Jain and Khalil Ahmad, A Text Book of Analytical Geometry of Three Dimensions, Wiley Eastern Ltd. 1999.

**Website:**

1. [https://www.youtube.com/watch?v=HyWagR\\_](https://www.youtube.com/watch?v=HyWagR_)

<b>Offered as</b>	Major
<b>Course/ Paper Title</b>	Calculus-II
<b>Course Code</b>	23SBMT22MM
<b>Semester</b>	II
<b>No. of Credits</b>	2

<b>Unit No</b>	<b>Title with Contents</b>	<b>No. of Lectures</b>
<b>Unit I</b>	<b>Differentiation</b>	<b>07</b>
	1. The Derivatives: Definition of the derivative of a function at a point, every differentiable function is continuous, Rules of differentiation, Cauchy's theorem (without proof), The chain rule, Derivative of inverse function (without proof, only examples).	4
	2. The Mean Value Theorems: Interior extremum theorem, Mean Value theorems, and their Consequences, Intervals of increasing and decreasing of a function, first derivative test for extrema	3
<b>Unit II</b>	<b>L'Hospital Rule and Successive Differentiation</b>	<b>07</b>
	1. L'Hospital Rule: Indeterminate forms, L'Hospital Rules (without proof).	3
	2. Taylor's theorem: Taylor's theorem and Maclaurin's theorem with Lagrange's form of the remainder (Without proof).	3
	3. Successive Differentiation: The nth derivative and Leibnitz theorem for Successive differentiation.	1
<b>Unit III</b>	<b>Ordinary Differential Equations</b>	<b>08</b>
	1. Linear first order equations.	3
	2. Separable equations.	3
	3. Existence and Uniqueness of solutions of nonlinear equations.	2
<b>Unit IV</b>	<b>Exact Differential Equations</b>	<b>08</b>

	1. Transformation of nonlinear equations to separable equations.	2
	2. Exact differential equations.	2
	3. Integrating factors	4

**Textbooks:**

1. Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert, John Wiley and Sons, Inc., Fourth Edition.

Unit I: Chapter 6: Sec. 6.1(6.1.1 to 6.1.8), Sec 6.2(6.2.1 to 6.2.8).

Unit II: Chapter 6: Sec 6.3(6.3.1 to 6.3.7), Sec 6.4(6.4.1 to 6.4.3).

2. Differential Calculus by Shanti Narayan, Tenth Revised Edition.

Unit II: Chapter 5: Sec. 5.1 to 5.6.

3. Elementary Differential equations, William F. Trench, E-book (Free download)

Unit III: Chapter 2: Sec 2.1 to 2.3.

Unit IV: Chapter 2: Sec 2.4 to 2.6.

**Reference Books:**

1. Introduction to Real analysis, William F. Trench, Free edition, 2010.

2. Calculus of a single variable Ron Larson , Bruce Edwards, tenth edition.

3. Elementary Analysis, The Theory of Calculus, Kenneth A. Ross, Springer Publication, second edition.

4. Calculus and its Applications, Marvin L. Bittinger, David J. Ellenbogen and Scott A. Sargent, Addison Wesley, tenth edition.

5. Ordinary and Partial Differential Equations, M.D. Raisingania, S.Chand And Company, 2009.

**Website:**

1. <https://www.youtube.com/watch?v=FvYC5gB89Kc>

2. <https://www.youtube.com/watch?v=Im242eBqaxw>

<b>Offered as</b>	Major
<b>Course/ Paper Title</b>	Practical Course based on 23SBMT21MM and 23SBMT22MM
<b>Course Code</b>	23SBMT23MM
<b>Semester</b>	II
<b>No. of Credits</b>	2

<b>Practical number</b>	<b>Title</b>	<b>No. of Practical</b>
<b>Practicals based on 23SBMT21MM</b>		
I	Analytical Geometry of Two Dimension	1
II	Planes	1
III	Analytical Geometry of Two Dimension and Planes	1
IV	Lines in three dimension	1
V	Sphere	1
VI	Line in three dimensions and Sphere	1
<b>Practicals based on 23SBMT22MM</b>		
I	Differentiation	1
II	L'Hospital Rule and Successive and Differentiation	1
III	Differentiation, L'Hospital Rule and Successive and Differentiation	1
IV	Ordinary Differential Equations	1
V	Exact Differential Equations	1
VI	Ordinary Differential Equations and Exact Differential Equations	1

<b>Offered as</b>	Vocational Skill Course
<b>Course/ Paper Title</b>	LaTeX for Scientific Writing
<b>Course Code</b>	23SBMT11VS
<b>Semester</b>	I
<b>No. of Credits</b>	2

<b>Unit No</b>	<b>Title with Contents</b>	<b>No. of Lectures</b>
<b>Unit I</b>	<b>Introduction to LaTeX</b>	<b>6</b>
	1. Definition and application of LaTeX.	1
	2. Preparation and Compilation of LaTeX input file.	2
	3. LaTeX Syntax.	2
	4. Keyboard Characters in LaTeX.	1
<b>Unit II</b>	<b>Formatting Words, Lines and Paragraphs</b>	<b>8</b>
	1. Text and Math mode fonts.	1
	2. Emphasized and colored font.	1
	3. Sectional unit.	1
	4. Labeling and referring numbered item.	1
	5. Text alignment and quoted text.	1
	6. New lines and paragraphs.	1
	7. Creating and filling blank spaces.	1
	8. Producing dashes with text.	1
<b>Unit III</b>	<b>Listing and Tabbing Text</b>	<b>8</b>
	1. Listing text.	4
	2. Tabbing text through the tabbing environment.	4
<b>Unit IV</b>	<b>Table Preparation</b>	<b>14</b>
	1. Table through the tabular environment.	2
	2. Table through the tabularx environment.	2
	3. Vertical positioning of tables.	2
	4 Sideways (rotated) text in table.	2
	5 Adjusting column width in table.	2
	6 Additional provision for customizing text in table.	2
	7 Merging rows and columns in table.	2

**Text book:**

1. LaTeX in 24 Hours, A practical guide for scientific writing, Dilip Datta, Springer International Publishing, 2017.

Unit I: Chapter 1: Sec. 1.1 to 1.6.

Unit II: Chapter 2: Sec. 2.1 to 2.4, Chapter 3; 3.1 to 3.7.

Unit III: Chapter 6: Sec. 6.1, 6.2.

Unit IV: Chapter 7: Sec. 7.1 to 7.7

**Reference books:**

1. LaTeX, A Document Preparation System, User's Guide and Reference Manual, Leslie Lamport, Addison-Wesley Publishing Company, Inc., 1994.
2. LaTeX Beginner's Guide, Stefan Kottwitz, Packt Publishing Ltd, 2011.
3. LaTeX and Friends, M.R.C. van Dongen, Springer-Verlag Berlin Heidelberg ,2012.

**Website:**

1. [www.overleaf.com](http://www.overleaf.com)

<b>Practical number</b>	<b>Title</b>	<b>No. of Practical</b>
<b>Practicals based on 23SBMT11VS</b>		
I	Introduction to LaTeX (Unit I)	1
II	Syntax and Keyboard characters in LaTeX (Unit I)	1
III	Fonts in LaTeX (Unit II)	1
IV	Sections, labelling and text alignment in LaTeX (Unit II)	1
V	New lines, paragraphs, blank space and dashes in LaTeX (Unit II)	1
VI	Listing text –I (Unit III)	1
VII	Listing text –II (Unit III)	1
VIII	Tabbing text (Unit III)	1
IX	Table through tabular environment (Unit IV)	1
X	Table through the tabularx environment (Unit IV)	1
XI	Positioning text in table (Unit IV)	1
XII	Customizing text in LaTeX (Unit IV)	1

<b>Offered as</b>	Skill Enhancement Course
<b>Course/ Paper Title</b>	Discrete Mathematics
<b>Course Code</b>	23SBMT11SE
<b>Semester</b>	I



<b>No. of Credits</b>	2
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<b>Unit No</b>	<b>Title with Contents</b>	<b>No. of Lectures</b>
<b>Unit I</b>	<b>Set Theory, Logic and functions</b>	<b>10</b>
	1. Propositional Logic.	2
	2. Propositional Equivalences.	2
	3. Sets.	2
	4. Set Operations.	2
	5. Functions.	2
<b>Unit II</b>	<b>Induction and Counting</b>	<b>10</b>
	1. Mathematical Induction	2
	2. Strong Mathematical Induction.	2
	3. The Basics of counting.	2
	4. The Pigeonhole Principle.	2
	5. Permutations and Combinations.	2
<b>Unit III</b>	<b>Relations and Graphs</b>	<b>10</b>
	1. Relations and their properties.	1
	2. n- ary Relations and their applications.	1
	3. Representing Relations.	1
	4. Closure of Relations	1
	5. Equivalence Relations.	1
	6. Partial Orderings.	1
	7. Graphs and Graph Models.	1
	8. Graph Terminology and Special Graphs.	1
	9. Representing Graphs.	1
	10. Connectivity.	1

**Text book:**

1. KENNETH H ROSEN (Indian Adaptation by Kamala Krithivasan), Discrete Mathematics and Its Application with Combinatorics and Graph Theory, Seventh Edition, Special Indian Edition, McGraw Hill Education (India) Private Limited

Unit I: Chapter 1: Sec. 1.1, 1.2.,

Chapter 2: Sec. 2.1, 2.2, 2.3.

Unit II: Chapter 7: Sec. 7.1, 7.2, 7.3, 7.4, 7.5, 7.6.

Chapter 8: Sec. 8.1, 8.2, 8.3 (Only Representing Graphs), 8.4.

**Reference books:**

1. Bernard Kolman, Robert C. Busy, Sharon Cutler Ross, Discrete Mathematical Structures, Sixth Edition, PHI Learning Private Limited.

**Website:**

1. [https://onlinecourses.nptel.ac.in/noc20\\_cs82/preview](https://onlinecourses.nptel.ac.in/noc20_cs82/preview).

<b>Offered as</b>	Indian Knowledge System
<b>Course/ Paper Title</b>	History and Development of Mathematics in India-I
<b>Course Code</b>	23SBMT11IK
<b>Semester</b>	I
<b>No. of Credits</b>	2

<b>Unit No</b>	<b>Title with Contents</b>	<b>No. of Lectures</b>
<b>Unit I</b>	<b>Vedic Geometry</b>	<b>07</b>
	1. The Sulbhsutra.	1
	2. The Theorem of the Diagonal.	1
	3. Rectilinear Figures and their Transformations.	1
	4. Circle from square: The direct construction.	2
	5. The inverse formula: Square from Circle.	2
<b>Unit II</b>	<b>Decimal Numbers</b>	<b>06</b>
	1. Numbers and Based Numbers	2
	2. The Place –value Principle and its Realizations.	2
	3. The Choice of a Base.	2
<b>Unit III</b>	<b>The Mathematics of the Ganitapada</b>	<b>9</b>

	1. General survey.	1
	2. The linear Diophantine Equation- Kuttaka method.	2
	3. The Invention of Trigonometry.	2
	4. The making of Sine Table.	2
	5. Aryabhata's Legacy.	2
<b>Unit IV</b>	<b>From Bramhagupta to Bhaskara -II</b>	<b>08</b>
	1. The Quadratic Diophantine Problem – Bhavana.	2
	2. Methods of Solution: Cakravala.	2
	3. Roots of Complex Numbers: The $n^{\text{th}}$ roots of unity.	2
	4. A Different Circle Geometry: Cyclic Quadrilaterals.	1
	5. The Kerala School and its impact	1

#### Reference Books:

1. Ganitpada Of Aryabhata I
2. Lilavati of Bhaskaracharya A Treatise of Mathematics of Vedic Tradition Translated by Krishnaji Shankara Patwardhan, Somashekhara Amrita Naimpally, Shyam Lal Singh
3. Indian Mathematics Engaging the World from Ancient to Modern Times, George Gheverghese Joseph

#### Website:

<https://vigyanprasar.gov.in/digital-repository/posters/maths-indian-heritage/>

<b>Offered as</b>	Minor
<b>Course/ Paper Title</b>	Foundation of Mathematics
<b>Course Code</b>	23SBMT21MN
<b>Semester</b>	II
<b>No. of Credits</b>	2

<b>Unit No</b>	<b>Title with Contents</b>	<b>No. of Lectures</b>
<b>Unit I</b>	<b>Sets Relations and Functions</b>	<b>08</b>

	1. Basic terminologies of sets, Operations on sets, Family of sets, Power sets , Cartesian product of sets.	2
	2. Basic definitions of functions, One-one, onto functions and bijections, Composition of functions, Inverse of a function, Image of subsets under functions, Inverse image of subsets under functions. (Excluding theorem only examples).	3
	3. Relations on sets, Types of relations, Equivalence relations, Equivalence classes, and partitions of sets.	3
<b>Unit II</b>	<b>Divisibility Theory in the Integers</b>	<b>07</b>
	1. Basic terminologies of sets, Operations on sets, Family of sets, Power sets, Cartesian product of sets.	3
	2. The Division Algorithm, The Greatest Common Divisor, The Euclidean Algorithm.	4
<b>Unit III</b>	<b>Primes and the theory of Congruence</b>	<b>08</b>
	1. The Fundamental Theorem of Arithmetic: Prime Numbers, Euclid's Lemma.	3
	2. Basic Properties of Congruence.	2
	3. Fermat's Theorem.	2
<b>Unit IV</b>	<b>Complex Numbers</b>	<b>07</b>
	1. Sums and Products, Basic Algebraic Properties, Moduli, Complex Conjugates, Exponential Form, Products and Quotients, De- Moivre's theorem	4
	2. Roots of Complex Numbers: The $n^{\text{th}}$ roots of unity.	2
	3. Regions in Complex Plane	1

### Textbooks:

1. A Foundation Course in Mathematics, Ajit Kumar, S. Kumaresan and Bhaba KumarSarma, Narosa Publication House.

Unit I: Chapter 2: Sec. 2.1 to 2.5, Chapter 3: Sec. 3.1 to 3.6, Chapter 4: Sec. 4.1 to 4.4.

2. Elementary Number Theory, David M. Burton, Tata McGraw Hill, Sixth Edition

Unit II: Chapter 1: Sec. 1. 1 , Chapter 2: Sec. 2.2 to 2.4.

Unit III: Chapter 3: Sec. 3.1, Chapter 4: Sec. 4.1, 4.2, Chapter 5: Sec. 5.2.

- Complex Variables and Applications, James Ward Brown and Ruel V. Churchill, McGraw Hill, Seventh Edition.

Unit IV: Chapter 1: Sec 1 to 10.

**Reference Books:**

- Textbook of Algebra, S. K. Shah and S. C. Garg, Vikas Publishing House Pvt. Ltd. Edition 2017.
- Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert, John Wiley and Sons Inc, Fourth Ed.

**Website:**

- <https://www.youtube.com/watch?v=md5UCR7mcIY>
- [https://www.youtube.com/watch?v=C2qIoHkhEuM&list=PLOzRYVm0a5cpVtcdj\\_5SBEh6VQvC](https://www.youtube.com/watch?v=C2qIoHkhEuM&list=PLOzRYVm0a5cpVtcdj_5SBEh6VQvC)

<b>Offered as</b>	Minor
<b>Course/ Paper Title</b>	Calculus-I
<b>Course Code</b>	23SBMT22MN
<b>Semester</b>	II
<b>No. of Credits</b>	2

<b>Unit No</b>	<b>Title with Contents</b>	<b>No. of Lectures</b>
<b>Unit I</b>	<b>Real Numbers</b>	<b>08</b>
	1. The Algebraic and Order properties of R: Algebraic properties of R, Order properties of R, Well-Ordering Property of N .Arithmetic mean- Geometric mean inequality, Bernoulli's inequality. (Revision: essential properties should be revised with illustrative examples)	2
	2. Absolute Value and the Real Line: Absolute value function and its properties, triangle inequality and its consequences, a neighborhood of a point on a real line.	2
	3. The Completeness Property of R: Definitions of Upper bound, Lower bound, supremum, infimum of subsets of R,	2

	completeness property of $\mathbb{R}$ . 4. Applications of the Supremum Property: property and its consequences, The density theorem (without proof).	2
<b>Unit II</b>	<b>Sequences</b>	<b>07</b>
	1. Sequences and Their Limits: Definition and examples of sequences of real numbers, Definition of the limit of sequence and uniqueness of limit, Examples on the limit of a sequence.	2
	2. Limits Theorems: Definition of bounded sequence, Every convergent sequence is bounded, Algebra of limits.	2
	3. Monotone Sequences: Definition and examples of monotone sequences, Monotone convergence theorem, and examples	1
	4. Subsequences and Bolzano -Weierstrass Theorem: Definition of subsequence and examples, Divergence criteria, Monotone Subsequence theorem (without proof), Bolzano –Weierstrass theorem (first proof).	1
	5. Cauchy Criterion: Definition and examples.	1
<b>Unit III</b>	<b>Limits</b>	<b>08</b>
	1. Functions and their Graphs: Functions, domain and range, graphs of functions, representing a function numerically, and Vertical line test, Piecewise defined functions, increasing and decreasing functions, even and odd functions symmetry, common functions.	2
	2. Limits of Functions: Definition of cluster point and examples, the definition of the limit of a function, the sequential criterion for limits, divergence criteria.	2
	3. Limit Theorems: Algebra of limits (proofs using sequential criterion), Squeeze theorem.	2
	4. Some extension of limit concepts: One-sided limits, infinite limits (without proof).	2
<b>Unit IV</b>	<b>Continuity</b>	<b>07</b>

	1. Continuous Functions: Definition of continuous function at a point, the sequential criterion for continuity, Divergence criterion, combination of continuous functions.	4
	2. Continuous Functions on Intervals: Properties of continuous functions on an interval, Boundedness theorem (without proof), The minimum-maximum theorem (without proof), Location of root theorem (Without proof), Bolzano's intermediate value theorem. Continuous function maps closed bounded interval to closed bounded interval, Preservation of interval theorem.	3

### Textbooks:

1. Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert, John Wiley and Sons Inc, Fourth Edition.

Unit I: Chapter 2: Sec 2.1 (2.1.1 to 2.1.13), Sec. 2.2 (2.2.1 to 2.2.9), Sec. 2.3, Sec. 2.4 (2.4.1, 2.4.3 to 2.4.6, 2.4.8, 2.4.9).

Unit II: Chapter 3: Sec. 3.1 (3.1.1 to 3.1.7, 3.1.10, 3.1.11), Sec. 3.2 (3.2.1 to 3.2.11), Sec. 3.3 (3.3.1, 3.3.4), Sec. 3.4 (3.4.1 to 3.4.3, 3.4.5 to 3.4.8), Sec. 3.5

Unit III: Chapter 4: Sec. 4.1 (4.1.1, 4.1.3 to 4.1.9), Sec. 4.2 (4.2.1 to 4.2.8), Sec. 4.3 (4.3.1 to 4.3.9).

Unit IV: Chapter 5: Sec. 5.1, Sec. 5.2, Sec 5.3 (5.3.1 to 5.3.5, 5.3.7 to 5.3.10).

2. Thomas' Calculus, Fourteenth edition, Pearson Publication.

Unit III: Chapter 1: Sec. 1.1.

### Reference Books:

1. Introduction to Real analysis, William F.Trench, Free edition, 2010.
2. Calculus of a single variable Ron Larson, Bruce Edwards, tenth edition. Brooke Cole. Cengage Learning
3. Elementary Analysis, The Theory of Calculus, Kenneth A. Ross, Springer Publication, second edition.
4. Calculus and its Applications, Marvin L. Bittinger, David J. Ellenbogen and Scott A. Sargent, Addison Wesley, tenth edition

- Website:** 1. <https://www.youtube.com/watch?v=fCzS8y4SBtE>  
 2. <https://www.youtube.com/watch?v=wzFc9us78sM>

<b>Course/ Paper Title</b>	Programming in Python-I
<b>Course Code</b>	23SBMT21VS
<b>Semester</b>	II
<b>No. of Credits</b>	2

<b>Unit No</b>	<b>Title with Contents</b>	<b>No. of Lectures</b>
<b>Unit I</b>	<b>Introduction to Python</b>	<b>06</b>
	1. Installation of Python.	1
	2. Values and types: int, float and str, The Print Function: Print basics.	1
	3. Variables: assignment statements, printing variable values, types of variables.	1
	4. Mathematical Operators, operands and precedence: +, -, /, *, **, % PEMDAS (Rules of precedence), String operations: +: Concatenation, *: Repetition.	1
	5. Boolean operator: 5.1 Comparison operators: ==, !=, >, =, <= 5.2 Logical operators: and, or, not.	1
	6. Mathematical functions from math, cmath modules, random module, Keyboard input: input() statement	1
	7. Calculus: Differentiation, Integration, Limit and Series	1
<b>Unit II</b>	<b>Strings, Lists, Tuples</b>	<b>06</b>
	1 Strings: 1.1 Length (Len function). 1.2 String traversal: Using while statement, Using for statement. 1.3 String slice 1.4 Comparison operators (>, <, =)	2
	2 Lists:	2



	<p>2.1 List operations.</p> <p>2.2 Use of range function.</p> <p>2.3 Accessing list elements.</p> <p>2.4 List membership and for loop.</p> <p>2.5 List operations.</p> <p>2.6 Updating list: addition, removal or updating of elements of a list.</p> <p>3 Tuples:</p> <p>3.1 Defining a tuple.</p> <p>3.2 Index operator.</p> <p>3.3 Slice operator.</p> <p>3.4 Tuple assignment.</p> <p>3.5 Tuple as a return value.</p>	2
<b>Unit III</b>	<b>Iterations and Conditional statements</b>	<b>08</b>
	1. Conditional and alternative statements, Chained and Nested Conditionals: if, if-else, if-elif-else, nested if, nested if-else.	3
	2. Looping statements such as while, for etc, Tables using while.	2
	3. Functions:	3
	3.1 Calling functions: type, id.	
	3.2 Type conversion: int, float, str.	
	3.3 Composition of functions, Returning values from functions.	
	3.4 User defined functions, Parameters and arguments.	
<b>Unit VI</b>	<b>2D and 3D Graphs</b>	<b>05</b>
	6.1 Installation of numpy, matplotlib packages.	1
	6.2 Graphs plotting of functions.	1
	6.3 Different formats of graphs, PyDotPlus (Scalable Vector Graphics), PyGraph viz. Decorate Graphs with Plot Styles and Types, Polar charts: Navigation Toolbar with polar plots, Control radial and angular grids.	1
	6.4 Three-dimensional Points and Lines.	1

	6.5 Three-dimensional Contour Plots, Wireframes and Surface Plots.	1
<b>Unit V</b>	<b>Graphics</b>	<b>06</b>
	1. Turtle Graphics: Overview of Turtle graphics, Turtle operations, Object instantiation and the Turtle graphics module.	1
	2. Drawing two-dimensional shapes.	1
	3. Taking a random walk.	1
	4. Colors and the RGB system.	1
	5. Drawing with random colors.	1
	6. Using the str function with objects.	1

#### **Text books:**

1. Think Python, How to Think Like a Computer Scientist, Allen Downey, Green Tea Press Needham, Massachusetts, 2015.  
Unit-I: Chapter-1: Sec. 1.1-1.5, Chapter-2: Sec. 2.1-2.6, Chapter-3: Sec. 3.1-3.6, Chapter-5: Sec. 5.1-5.3.  
Unit-II: Chapter-8: Sec. 8.1-8.5, Chapter-10: Sec. 10.12, Chapter-12: Sec.12.1.- 12.6.  
Unit-III: Chapter 5: Sec. 5.4 -5.7, Chapter 7: Sec. 7.1-7-7.5.
2. Introduction to Scientific Computing in Python, Robert Johansson, 2016.  
Unit-I: Chapter-6: Sec. 6.5-6.8
3. Python for Scientific Engineering, Hans-Petter Halvorsen, 2020.  
Unit-V: Chapter-31
4. Fundamentals of Python: From First Programs to Data Structure, Keneth A Lambert, Martin Osborne, 2010, Course Technology, Cengage Learning.  
Unit-V: Chapter-7: Sec. 7.1.1 to 7.1.8

#### **Reference books:**

1. Fundamentals of Python - First Programs, Lambert K. A. Cengage Learning India, 2015.
2. Introduction to Computing and Programming in Python, Guzdial, M. J., Pearson India.
3. Introduction to Scientific Computing Using Python, Application Development Focus, Ljjobomir Perkovic, Second Edition, Wiley Publication.
4. Python: Notes for Professionals, Goalkicker.com, Free Programming books.

#### **Website:**

1. <https://www.math.purdue.edu/~bradfor3/ProgrammingFundamentals/Python/>

<b>Practical number</b>	<b>Title</b>	<b>No. of Practical</b>
<b>Practicals based on 23SBMT21VS</b>		
I	Introduction to Python, Python Data Types-I	1
II	Python Data Types- II	1
III	Control statements in Python-I	1
IV	Control statements in Python-II	1
V	Application: Divisibility, Primes, Congruence	1
VI	Application: Divisibility, Primes, Congruence	1
VII	Application: Calculus-I	1
VIII	Application: Calculus-II	1
IX	Application: Co-ordinate Geometry-I	1
X	Application: Co-ordinate Geometry-II	1
XI	Graph plotting	1
XII	Turtle Graphics	1

<b>Offered as</b>	Skill Enhancement Course
<b>Course/ Paper Title</b>	Operations Research
<b>Course Code</b>	23SBMT21SE
<b>Semester</b>	II
<b>No. of Credits</b>	2

<b>Unit No</b>	<b>Title with Contents</b>	<b>No. of Lectures</b>
<b>Unit I</b>	<b>The Simplex Method</b>	<b>12</b>
	1. The Simplex Method. 1.1 Iterative Nature of the Simplex Method. 1.2 Computational Details of Simplex Method. 1.3 Summary of the Simplex Method.	3

	2 Artificial Starting Solution. 2.1 M- Method. 2.2 Two Phase Method	5
	3 Special Cases in the Simplex Method 3.1 Degeneracy. 3.2 Alternative Optima 3.3 Unbounded Solution. 3.4 Infeasible Solution.	4
<b>Unit II</b>	<b>Duality and Dual Simplex Algorithm</b>	<b>08</b>
	1 Definition of the Dual Problem.	1
	2 Primal Dual Relationships 2.1 Review of Simple Matrix Operations. 2.2 Simplex Tableau Layout. 2.3 Optimal Dual Solution. 2.4 Simplex Tableau Computations.	2
	3 Economic Interpretation of Duality 3.1 Economic Interpretation of Dual Variables. 3.2 Economic Interpretation of Dual Constraints.	2
	4 Dual Simplex Algorithm.	3
<b>Unit III</b>	<b>The Transportation Model</b>	<b>10</b>
	1 Definition of the Transportation Model	2
	2 The Transportation Algorithm. 2.1 Determination of the Starting Solution.	3
	2.2 Iterative Computations of the Transportation Algorithm.	3
	2.3 Simplex Method Explanation of the Method of Multipliers.	2
<b>Unit IV</b>	<b>The Assignment Model</b>	<b>06</b>
	1 The Assignment Model. 1.1 The Hungarian Method. 1.2 Simplex Explanation of The Hungarian Method	6

**Text book:**

1. Operations Research An Introduction, Hamdy A. Taha, Tenth Edition, Global Edition, Pearson

Unit-I: Chapter-3: Sec. 3.3, 3.4, 3.5.

Unit-II: Chapter-4: Sec. 4.1, 4.2, 4.3, 4.4 (Only 4.4.1).

Unit-III: Chapter-5: Sec. 5.1, 5.3,

Unit-IV: Chapter 5: 5.4.

**Reference books:**

1. Operations Research Theory and Applications, J K Sharma, Sixth Edition, 2016, Trinity Press.
2. Operations Research, Er. Prem Kumar Gupta, Dr. D.S. Hira, Seventh Edition, S. Chand and Company.

**Website:**

1. <https://nptel.ac.in/courses/110106062>

<b>Offered as</b>	Open Elective
<b>Course/ Paper Title</b>	Business Mathematics for Commerce
<b>Course Code</b>	23SBMT10EA
<b>Semester</b>	
<b>No. of Credits</b>	4

<b>Unit No-I</b>	<b>Title with Contents</b>	<b>No. of Lectures</b>
	<b>Matrices and Determinants</b>	<b>11</b>
	1. Definition of matrices.	1
	2. Types of matrices.	1
	3. Algebra of matrices.	1
	4. Determinant of matrices.	2
	5. System of equations.	1
	6. Solution of system of linear equations by adjoint method (upto3 variables only)	2
<b>Unit-II</b>	<b>Arithmetic Progression, Geometric Progression and</b>	<b>09</b>

	<b>Harmonic Progression</b>	
	1. Arithmetic Progression	3
	2. Geometric Progression	3
	3. Harmonic Progression	3
<b>Unit-III</b>	<b>Permutation and Combination</b>	<b>06</b>
	1. Permutation	3
	2. Combination	3
<b>Unit-IV</b>	<b>Interest and Annuity</b>	<b>12</b>
	1. Simple Interest.	1
	2. Compound Interest.	1
	3. Equated Monthly Installment (EMI) by interest of reducing balance and flat interest methods.	2
	4. Ordinary Annuity.	2
	5. Sinking funds.	2
	6. Annuity due.	2
	7. Present value and future value of annuity	2
<b>Unit V</b>	<b>Shares and Mutual Funds</b>	<b>10</b>
	1. Concepts of shares.	1
	2. Facevalue.	1
	3. Marketvalue.	1
	4. Dividend.	1
	5. Equity shares.	1
	6. Preferential shares.	1
	7. Bonus shares.	1
	8. Concept of Mutual funds.	1
	9. Change in Net Asset Value (NAV).	1
	10. Systematic Investment Plan (SIP).	1
<b>Unit VI</b>	<b>Linear Programming Problem (LPP) and Transportation Problem</b>	<b>12</b>
	1. Concept of LPP.	1
	2. Formulation of LPP.	1
	3. Solution of LPP by graphical method	2
	4. Concept of Transportation Problem	1
	5. Initial Basic Feasible Solution	1
	6. North West Corner Method	2
	7. Least Cost Method (LCM)	2

	8.Vogel's Approximation Method	2
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**Text book:**

1. Business Mathematics-Dr. S.M. Shukla, Dr. R.R. Sharma, Sahitya Bhawan Publications, Agra.

Unit I: Chapter 1, Chapter2, Chapter 3.

Unit II: Chapter 4, Chapter5, Chapter 6.

Unit-III: Chapter 7.

Unit-IV: Chapter 10,11,12.

Unit-V: Chapter 13.

2. Operation Research- Prem Kumar Gupta, Dr. D.S. Hira.

Unit II: Chapter 2 (2.1, 2.2, 2.3, 2.6, 2.9, 2.10), Chapter 3 (3.1, 3.2, 3.3 section 3.5 upto Vogel's Approximation Method (VAM).)

**Reference books:**

1. A Textbook of Business Mathematics (for B.Com and BBA courses of all India Universities) – Dr.Padmalochan Hazarika, S Chand and Company Limited.

**Website:**

1. <https://www.classcentral.com/course/swayam-bcoc-134-business-mathematics-and-statistics-59093>.

<b>Offered as</b>	Open Elective
<b>Course/ Paper Title</b>	Quantitative Aptitude
<b>Course Code</b>	23SBMT1OEB
<b>Semester</b>	
<b>No. of Credits</b>	02

<b>Unit I</b>	<b>Ratio and Proportion</b>	<b>08</b>
	1. Concept of Ratio	1
	2. Concept of Proportion	1
	3. Types of ratios	3
	4. Types of proportions	3
<b>Unit II</b>	<b>Average</b>	<b>06</b>
	1. Concept of average	1

	2. Examples	5
<b>Unit III</b>	<b>Time, Distance and Speed</b>	<b>10</b>
	1. Relation of Speed, Time and Distance	1
	2. Units	1
	3. Average Speed	4
	4. Relative Speed	4
<b>Unit IV</b>	<b>Time and Work</b>	<b>06</b>
	1. Concept of Time and Work	1
	2. Examples	5

### References:

1. Quantitative Aptitude for Competitive Examinations by Dr.R.S. Aggarwal , S.Chand Publication
2. Fast Track Objective Arithmetic by Rajesh Verma , Arihant Publication
3. R.V.Praveen,Quantitative Aptitude and Reasoning, 2nd Revised Edition 2013, Prentice-Hall of India Pvt.Ltd.
4. G. K. Ranganath, C. S. Sampangiram and Y. Rajaram, A text Book of business Mathematics, 2008, Himalaya Publishing House.

<b>Offered As</b>	Open Elective
<b>Course/ Paper Title</b>	Enhancement of Mathematical Skills For Competitive Exams
<b>Course Code</b>	23SBMT2OEA
<b>Semester</b>	
<b>No. of Credits</b>	2

<b>Unit No</b>	<b>Title with Contents</b>	<b>No. of Lectures</b>
<b>Unit I</b>	<b>Number System and Algebraic operations</b>	<b>12</b>
	1. Number System.	1
	2. Types of Numbers.	1
	3. Series (AP and GP).	2
	4. Algebraic operations, BODMAS.	2



	5. Divisibility, LCM and HCF.	2
	6. Fraction, Simplification.	2
<b>Unit II</b>	<b>Time, work and Distance</b>	<b>12</b>
	1. Time and work.	2
	2. Time and distance.	2
	3. Boats and steams.	2
	4. Problems on trains.	2
	5. Calendar	2
	6. Clock	2
<b>Unit III</b>	<b>Permutation, Combination and Probability</b>	
	1. Permutations and Combinations.	2
	2. Probability.	2
	3. Heights and Distances	1
	4. Odd Man Out and Series	1

**Text book:**

1. R.S. Aggarwal, “Quantitative Aptitude for Competitive Examinations”, Revised Edition, S. Chand and Co. Ltd, New Delhi, 2017.

Unit I: Chapter 1, Chapter 2, Chapter 3, Chapter 4.

Unit II: Chapter 17, Chapter 18, Chapter 19, Chapter 20.

Unit-III: Chapter 30, Chapter 31, Chapter 34, Chapter 35.

**Reference books:**

1. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
2. Quantitative Aptitude : Numerical Ability (Fully Solved) Objective Questions, Kiran Prakashan, Pratogitaprakasan, Kic X, Kiran Prakasan publishers.
3. Quantitative Aptitude for Competitive Examination by Abhijit Guha, Tata Mc Graw hill publications

<b>Offered As</b>	Open Elective
<b>Course/ Paper Title</b>	Mathematics in real life
<b>Course Code</b>	23SBMT2OEB
<b>Semester</b>	
<b>No. of Credits</b>	2

<b>Unit I</b>	<b>Working with Numbers</b>	<b>08</b>
	1. Whole numbers	1
	2. Rounding	1
	3. Fractions and Decimals	2
	4. Percentage	2
	5. Word Formulas and functions machines	2
<b>Unit II</b>	<b>Units of Measures</b>	<b>04</b>
	1. Using metrics measurement	1
	2. Estimating Measuring and comparing weights	1
	3. Capacity	1
	4. Measuring temperature	1
<b>Unit III</b>	<b>Handling data</b>	<b>10</b>
	1. Collecting data	1
	2. Handling data	1
	3. Pictograms	1
	4. Pie charts	1
	5. Bar Charts	1
	6. Line Graphs	1
	7. Averages	2
	8. Probablity	2
<b>Unit IV</b>	<b>Shape and Space</b>	<b>04</b>
	1. Around the edge	2
	2. Area	2

**Website:**

**<https://www.open.edu/openlearn/science-maths-technology/everyday-maths-1/content-section-overview?active-tab=description-t>**