



**Maharashtra Education Society's
Abasaheb Garware College
(Autonomous)**

(Affiliated to Savitribai Phule Pune University)

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

**Syllabi under Autonomy
F.Y.B.Sc. (Mathematics)**

**Choice Based Credit System Syllabus
To be implemented from Academic Year 2022-2023**

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

Taking into consideration the rapid changes in science and technology and new approaches in different areas of Mathematics and related subjects board of studies in Mathematics with concern of teachers of Mathematics and industry has prepared the syllabus of F.Y.B.Sc. Mathematics. To develop the syllabus the U.G.C. Model curriculum is followed.

Program Outcomes:

1. To give knowledge of fundamental principles, methods, Mathematical ideas and tools.
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 students' overall development and to equip them with Mathematical abilities and problem-solving skills.
4. Enabling students to develop a positive attitude towards Mathematics as an interesting and valuable subject of study.

Eligibility:

Passed 12th Science or equivalent course with Mathematics as one of the subjects.

Structure of the course: B.Sc. Mathematics

Year	Semester	Course Type	Course Code	Course Title	Remark	Credit	No. of Lectures /Practical to be conducted
1	I	Core	USMT-111	Algebra - I	Theory	2	36
		Core	USMT-112	Calculus - I	Theory	2	36
		Core	USMTP-113	Mathematics Practical	Practical	1.5	10
	II	Core	USMT-121	Algebra - II	Theory	2	36
		Core	USMT-122	Calculus - II	Theory	2	36
		Core	USMTP-123	Mathematics Practical	Practical	1.5	10
2	III	Core	USMT-231	Several Variable Calculus	Theory	2	36
		Elective	USMTELE-232A OR	Numerical Analysis	Theory	2	36
		Elective	USMTELE -232B	Dynamical Systems	Theory	2	36
		Core	USMTP-233	Mathematics Practical	Practical	2	12
		Core	USLG-231	Language	Theory	2	36
		Core	USEVS-231	Environmental Awareness	Theory	2	36
	IV	Core	USMT-241	Linear Algebra	Theory	2	36
		Elective	USMTELE-242A OR	Vector Calculus	Theory	2	36
		Elective	USMTELE -242B	Integral Transforms	Theory	2	36
		Core	USMTP -243	Mathematics Practical	Practical	2	12
		Core	USLG-241	Language	Theory	2	36
		Core	USEVS-241	Environmental Awareness	Theory	2	36

Year	Semester	Course Type	Course Code	Course Title	Remark	Credit	No. of Lectures /Practical to be conducted
3	V	Core	USMT-351	Metric Spaces	Theory	2	36
		Core	USMT-352	Real Analysis-I	Theory	2	36
		Core	USMT-353	Group Theory	Theory	2	36
		Core	USMT-354	Ordinary Differential Equations	Theory	2	36
		Elective	USMTELE-355A OR	Operations Research	Choose any one	2	36
		Elective	USMTELE-355B	Graph Theory		2	36
		Elective	USMTELE-356A OR	C- Programming	Choose any one	2	36
		Elective	USMTELE-356B	Number Theory		2	36
		Core	USMTP-357	Practical based on USMT-351 and USMT-352	Practical	2	12
		Core	USMTP-358	Practical based on USMT-353 and USMT-354	Practical	2	12
		Core	USMTP-359	Practical based on papers selected from USMT-355 and USMT-356	Practical	2	12
		SEC	USMTSEC-3510	Statistical Techniques using R software	SEC	2	36
		SEC	USMTSEC-3511	Computational Geometry	SEC	2	36
	VI	Core	USMT-361	Complex Analysis	Theory	2	36
		Core	USMT-362	Real Analysis-II	Theory	2	36
		Core	USMT-363	Ring Theory	Theory	2	36
		Core	USMT-364	Partial Differential Equations	Theory	2	36
		Elective	USMTELE-365A OR	Optimization Techniques	Choose any one	2	36
		Elective	USMTELE-365B	Combinatorics		2	36
		Elective	USMTELE-366A OR	Python	Choose any one	2	36
		Elective	USMTELE-366B	Coding Theory		2	36
		Core	USMTP-367	Practical based on USMT-361 and USMT-362	Practical	2	12
		Core	USMTP-368	Practical based on USMT-363 and USMT-364	Practical	2	12
		Core	USMTP-369	Practical based on USMT-365 and USMT-366	Practical	2	12
		SEC	USMTSEC-3610	LaTeX	SEC	2	36
		SEC	USMTSEC-3611	Financial Mathematics	SEC	2	36

SEMESTER-I**Course Code and Title: USMT-111: Algebra - I****Lectures: 36 (Credits- 2)****Course Outcomes:**

1. Students are able to write Mathematical proofs using logical statements.
2. Students are able to understand the general concept of a function, including such notions as range, domain, and function type.
3. Students are able to develop Mathematical ideas from basic axioms.

Unit 1: Statements and Logic**(06 Lectures)**

- 1.1 Statements
- 1.2 Statements with quantifiers
- 1.3 Compound statements
- 1.4 Implications
- 1.5 Proofs in Mathematics

Unit 2: Sets and Relation**(07 Lectures)**

- 2.1 Basic terminologies
- 2.2 Operations on sets
- 2.3 Power sets
- 2.4 Cartesian product of sets
- 2.5 Relations on sets
- 2.6 Types of relations
- 2.7 Equivalence relations
- 2.8 Equivalence classes and partitions of a set

Unit 3: Functions**(08 Lectures)**

- 3.1 Basic definitions
- 3.2 One-one, onto functions and bijections
- 3.3 Composition of functions
- 3.4 Inverse of a function
- 3.5 Image of subsets under functions
- 3.6 Inverse image of subsets under functions
- 3.7 Countable sets and comparing cardinality

Unit 4: Divisibility Theory in the Integers**(15 Lectures)**

- 4.1 The Induction Principle
- 4.2 The Strong Induction Principle
- 4.3 The Well-ordering Principle
- 4.4 Divisibility in Integers
- 4.5 Division Algorithm
- 4.6 Unique Factorization Theorem.
- 4.7 Congruence relation
- 4.8 Chinese Remainder Theorem

Recommended Books:

1. A Foundation Course in Mathematics, Ajit Kumar, S. Kumaresan, Bhaba Kumar Sarma, Narosa Publication.
Unit 1: Chapter 1: 1.1 to 1.5
Unit 2: Chapter 2: 2.1 to 2.5 and Chapter 4: 4.1 to 4.4
Unit 3: Chapter 3: 3.1 to 3.6, 6.2, 6.3
Unit 4: Chapter 5: 5.1 to 5.3
2. An introduction to Number Theory, I. Niven, H. Zukerman.
Unit 4: Chapter 1: 1.2, 1.3(except theorem 1.19), Chapter 2: 2.1, 2.2(Upto Euler's theorem), Chinese Remainder theorem

Reference Books:

1. Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert, John Wiley and Sons Inc, Fourth Edition.
2. Elementary Number Theory, David M. Burton, Tata McGraw Hill, Sixth Edition.

Course Code and Title: USMT-112: CALCULUS – I**Lectures: 36 (Credits- 2)****Course Outcomes:**

1. Students understand the difference between rational and real number system.
2. Students understand the role of supremum and infimum and their applications.
3. Students use the notion of convergence of sequences.

Unit 1: Real Numbers**(10 Lectures)**

- 1.1 The Algebraic and Order Properties of \mathbb{R}
- 1.2 Absolute Value and Real Line
- 1.3 The Completeness Property of \mathbb{R}
- 1.4 Applications of the Supremum Property
- 1.5 Intervals

Unit 2: Sequences**(08 Lectures)**

- 2.1 Sequences and Their Limits
- 2.2 Limit Theorems
- 2.3 Monotone Sequences
- 2.4 Subsequence's and the Bolzano-Weierstrass Theorem

Unit 3: Limits**(08 Lectures)**

- 3.1 Limits of Functions
- 3.2 Limit Theorems
- 3.3 Some Extensions of the Limit Concept

Unit 4: Continuity**(10 lectures)**

- 4.1 Continuous Functions
- 4.2 Combinations of Continuous Functions
- 4.3 Continuous Functions on Intervals
- 4.4 Uniform Continuity

Recommended Book:

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

Unit 1: Chapter 2: 2.1 to 2.5

Unit 2: Chapter 3: 3.1 to 3.4

Unit 3: Chapter: 4.1 to 4.3

Unit 4: Chapter 5: 5.1 to 5.4

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. Thomas Calculus, Thirteenth edition, Pearson Publication

Course Code and Title: USMTP-113: Mathematics Practical**(Credits- 1.5)****Practicals based on USMT-111 and USMT-112.**

Practical 1 to 5 based on USMT-111 and Practical 6 to 10 based on USMT-112.

Practical 1: Problems on Unit 1 from USMT-111

Practical 2: Problems on Unit 2 from USMT-111

Practical 3: Problems on Unit 3 from USMT-111

Practical 4: Problems on Unit 4 from USMT-111

Practical 5: Miscellaneous Problems from USMT-111

Practical 6: Problems on Unit 1 from USMT-112

Practical 7: Problems on Unit 2 from USMT-112

Practical 8: Problems on Unit 3 from USMT-112

Practical 9: Problems on Unit 4 from USMT-112

Practical 10: Miscellaneous Problems from USMT-112

Note:

1. Practicals on Mathematical software can be performed on computer.
2. Practical examination of 50 marks. 15 marks internal continuous assessment and 35 marks external examination including oral.

SEMESTER-II**Course Code and Title: USMT-121: Algebra - II****Lectures: 36 (Credits- 2)****Course Outcomes:**

1. Students are able to solve system of linear equations and understand consistency and geometry of the system of equations.
2. Students are able to apply properties of determinant and its geometric interpretation.
3. Students are able to find gcd and relation between roots and coefficients.

Unit 1: Matrices and Gaussian Elimination**(12 Lectures)**

- 1.1. Introduction.
- 1.2. The Geometry of Linear Equations
- 1.3. Rank of Matrix, Gaussian Elimination Method
- 1.4. Matrix Multiplication, Inverse, Transpose
- 1.5. Triangular Factors and Row Exchanges
- 1.6. Special Matrices and Applications

Unit 2: Determinants**(6 lectures)**

- 2.1. Introduction
- 2.2. Properties of the determinant
- 2.3. Formulas for the determinants
- 2.4. Applications of Determinants

Unit 3: Eigenvalues and Eigenvectors**(6 Lectures)**

- 3.1. Introduction
- 3.2. Diagonalization

Unit 4: Polynomials**(12 Lectures)**

- 4.1. Integral rational functions or polynomials.
- 4.2. Multiplication of polynomials.
- 4.3. Division of polynomials.
- 4.4. The remainder theorem.
- 4.5. Synthetic division.
- 4.6. Highest Common divisor of two polynomials.
- 4.7. The fundamental theorem of Algebra.

4.8. Relations between roots and coefficients.

Recommended Books:

1. Linear Algebra and Its Applications: Gilbert Strang
Unit 1: Chapter 1: 1.1 to 1.7
Unit 2: Chapter 4: 4.1 to 4.4
Unit 3: Chapter 5: 5.1 to 5.2
2. Theory of Equations, J.V. Uspensky, McGraw Hill Book Company
Unit 4: Chapter 2: 1 to 5, 8, Chapter 3: 3, 5

Reference Books:

1. Linear Algebra Geometry and Transformation – Bruce Solomon
2. An introduction to Number Theory, I. Niven, H. Zukerman

Course Code and Title: USMT-122: Calculus- II**Lectures: 36 (Credits - 2)****Course Outcomes:**

1. Students use the notion of differentiability.
2. Students learn some applications of derivatives
3. Students learn to sum some elementary infinite series.
4. Students learn to find area using Riemann integral.

Unit 1: Differentiation**(12 lectures)**

- 1.1. The Derivative
- 1.2 The Mean Value Theorem
- 1.3 L'Hospital Rules
- 1.4 Taylor's Theorem

Unit 2: Riemann Integration**(14 lectures)**

- 2.1 Introduction to Series
- 2.2 The Riemann Integral
- 2.3 Riemann Integrable Functions
- 2.4 The Fundamental Theorem

Unit 3: Exact Differential Equations**(10 lectures)**

- 3.1 Introductory remarks
- 3.2 The nature of solutions
- 3.3 Separable equations
- 3.4 First-order linear equations
- 3.5 Exact equations
- 3.6 Orthogonal trajectories and families of curves

Recommended Books:

1. Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert, John Wiley and Sons, Inc., Fourth Edition.
Unit 1: Chapter 6: 6.1 to 6.4
Unit 2: Chapter 7: 7.1 to 7.3
2. Ordinary Differential Equations by Simmons and Krantz
Unit 3: Chapter 1: 1.1 to 1.6

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 cott A. Surgent, Addison Wesley, tenth edition.
5. Ordinary and partial Differential equations, M.D. Raisingania, S. Chand and Company, 2009.

Course Code and Title: USMTP-123: Mathematics Practical**(Credits - 1.5)****Practicals based on USMT-121 and USMT-122.**

Practical 1 to 5 based on USMT-121 and Practical 6 to 10 based on USMT-122.

Practical 1: Problems on Unit 1 from USMT-121

Practical 2: Problems on Unit 2 from USMT-121

Practical 3: Problems on Unit 3 from USMT-121

Practical 4: Problems on Unit 4 from USMT-121

Practical 5: Miscellaneous Problems from USMT-121

Practical 6: Problems on Unit 1 from USMT-122

Practical 7: Problems on Unit 1 from USMT-122

Practical 8: Problems on Unit 2 from USMT-122

Practical 9: Problems on Unit 2 from USMT-122

Practical 10: Problems on Unit 3 from USMT-122

Note:

Practicals on Mathematical software can be performed on computer.