Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati
Autonomous
Course Structure for B.Sc. Mathematics (w.e.f. 2022-23)

F. Y. B. Sc. Mathematics

Semester	Course Code	Title of Course	No. of Credits	No. of Lectures
I	USMT111	Algebra	2	36
	USMT112	Calculus-I	2	36
	USMT113	Practical based on USMT111 and USMT112	2	48
II	USMT121	Geometry	2	36
	USMT122	Calculus-II	2	36
	USMT123	Practical based on USMT121 and USMT122	2	48

S. Y. B. Sc. Mathematics

Semester	Course Code	Title of Course	No. of Credits	No. of Lectures
III	USMT231	Calculus of Several Variables	3	48
	USMT232	Laplace Transform & Fourier Series	3	48
	USMT233	Practical based on USMT231 and USMT232	2	48
IV	USMT241	Vector Calculus	3	48
	USMT242	Linear Algebra	3	48
	USMT243	Practical based on USMT241 and USMT242	2	48

T.Y.B.Sc Mathematics

Semester	Course Code	Title of Course	No. of Credits	No. of Lectures
V	USMT351	Metric Spaces	3	48
	USMT352	Real Analysis I	3	48
	USMT353	Group Theory	3	48
	USMT354	Ordinary Differential Equation	3	48
	USMT355	Number Theory	3	48
	USMT356(A)	Operation Research	3	48
	USMT356(B)	C Programming	3	48
	USMT357	Practical based on USMT351 and USMT352	2	48
	USMT358	Practical based on USMT353 and USMT354	2	48
	USMT359	Practical based on USMT355 and USMT356	2	48
VI	USMT361	Complex Analysis	3	48
	USMT362	Real Analysis II	3	48
	USMT363	Ring Theory	3	48
	USMT364	Partial Differential Equation	3	48

	USMT365	Lebesgue Integration	3	48
	USMT366(A)	Optimization Techniques	3	48
	USMT366(B)	Python Programming	3	48
	USMT367	Practical based on USMT361, USMT362, and USMT363	2	48
	USMT368	Practical based on USMT364, USMT365, and USMT366	2	48
	USMT369	Mathematics Project	2	48

Equivalence of the old syllabus with the new syllabus

Old Course		New Course	
MAT 1101	Algebra	USMT111	Algebra
MAT 1102	Calculus-I	USMT112	Calculus-I
MAT 1103	Practical based on MAT 1101 and MAT 1102	USMT113	Practical based on USMT111 and USMT112

Academic Year 2022-23

Class: F.Y.B.Sc. (Semester – I)
Course Code: USMT 111
Course: I **Title of the Course:** Algebra
Credit: 2 **No. of Lectures:** 36

A) Learning Objectives:

- To provide sufficient knowledge of fundamental concepts in algebra.
- To introduce and develop Mathematical tools and how to use them for modeling, and solving problems for further studies in different fields of science.
- To develop a positive attitude towards Mathematics as an interesting and valuable subject of study.

B) Learning Outcomes:

- Students will be able to develop mathematical ideas from basic axioms.
- Students will be able to use the Euclidean algorithm and congruences to deal with big numbers and also understand analogies between the cartesian plane and the complex plane.

TOPICS/CONTENTS:

Unit 1: Sets, Relations and Functions [*8 Lectures*]

1.1 Sets and basic operations on sets
1.2 Relations, Equivalence relations, Equivalence classes and Partition of sets.
1.3 Functions, Types of functions, Inverse of a function, Composition of functions.

Unit 2: Divisibility theory in the integers [*10 Lectures*]

2.1 Mathematical induction: Well-Ordering Principle.
2.2 The division algorithm
2.3 The greatest common divisor
2.4 The Euclidean algorithm

Unit 3: Primes and theory of congruences [*8 Lectures*]

3.1 The fundamental theorem of arithmetic
3.2 Basic properties of congruences
3.3 Fermat's theorem.
3.4 Euler's phi-function (Definition and examples only) and Euler's theorem.

Unit 4: Complex Numbers [*10 Lectures*]

4.1 Sum and product

4.2 Basic algebraic properties
4.3 Moduli
4.4 Complex conjugate
4.5 Exponential form
4.6 Product and powers in exponential form
4.7 Arguments of product and quotients
4.8 Roots of complex numbers
4.9 Regions in the complex plane

Text Books:

1. Ajit Kumar, S. Kumaresan and Bhaba Kumar Sarma, *A Foundation Course in Mathematics,* Narosa Publication House, 2018.
   Unit 1 - Sections: 2.1 to 2.5, 3.1 to 3.6, 4.1 to 4.4.
2. David M. Burton, *Elementary Number Theory,* Tata McGraw Hill, 7th Edition, 2012.
   Unit 2 - Sections: 1.1, 2.2 to 2.4; **Unit 3 -** Sections: 3.1, 4.2, 5.2, 7.2 and 7.3.
3. Ruel V. Churchill, James W. Brown, *Complex Variables and Applications,* McGraw-Hill, Eighth Edition.
   Unit 4 - Chapter 1.

Reference Books:

1. S. K. Shah and S. C. Garg, *Textbook of Algebra*, Vikas Publishing House Pvt. Ltd.
2. Kenneth H. Rosen, *Discrete Mathematics and Its Applications*, Tata McGraw Hill.
3. Seymour Lipschutz, *Set Theory and Related Topics*, Schqum's Ountline Series.
4. Robin Wilson, *Number Theory: A very short introduction*, Oxford University Press.
5. Sudarsan Nanda, *Number Theory*, Allied Publishers Pvt. Ltd.
6. Verity Carr, *Complex Numbers: Made Simple*, Made Simple Books.
7. Robert G. Bartle and Donald R. Sherbert, *Introduction to Real Analysis*, John Wiley & Sons.

Class: F.Y. B. Sc. (Semester- I) **Title of Course :** Calculus I
Course Code: USMT112 **Credit:** 2
Course: II **No. of lectures:** 36

A) Learning Objectives:

- To understand the concept of convergence and divergence of a sequence
- To understand the concept of limit and continuity
- To understand the relationship between sequences and continuity

B) Learning Outcome:

- Students will apply these concepts for advanced study in Mathematics (Real Analysis, Complex Analysis, topology)
- Students will apply limit and continuity concepts in physical, chemical, and biological sciences.

Unit 1: Real Numbers **(06 Lectures)**

1.1 The Algebriac 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)

1.2 Absolute Value and the Real Line: Absolute value function and its properties, triangle inequality and its consequences, neighbourhood of a point on real line.

1.3 The Completeness Property of R: Definitions of Upper bound, Lower bound, supermom, infimum of subsets of R, completeness property of R.

1.4 Applications of the Supremum Property: Archimedean property and its consequences, The density theorem (without proof).

Unit 2. Sequences **(10 Lectures)**

2.1 Sequences and Their Limits: Definition and examples of sequences of real numbers, Definition of limit of sequence and uniqueness of limit, Examples on limit of 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.

2.4 Subsequences and Bolzano -Wierstrass Theorem: Definition of subsequence and examples, Divergence criteria, Monotone Subsequence theorem (without proof), Bolzano -Wierstrass theorem (first proof).

Unit 3. Limits **(08 lectures)**

3.1 Functions and their Graphs Functions, domain and range, graphs of functions, representing a function numerically, Vertical line test, Piecewise defined functions, increasing and decreasing functions, even and odd functions symmetry, common functions

3.2 Limits of Functions: Definition of cluster point and examples, definition of limit of a function, sequential criterion for limits, divergence criteria.

3.3 Limit Theorems: Algebra of limits (proofs using sequential criterion) ,Squeeze theoerem.

3.4 Some extension of limit concepts: one-sided limits, infinite limits (without proof) .

Unit 4: Continuity **(12 lectures)**

4.1 Continuous Functions: Definition of continuous function at a point , 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.

Textbooks:

1. R.G. Bartle and D.R. Sherbert, *Introduction to Real Analysis*, John Wiley and Sons Inc, Fourth Edition.
Unit 1: Chapter 2: Sec 2.1 (2.1.1 to 2.1.13), Sec. 2.2(2.2.1 to 2.2.9), 2.3, 2.4(2.4.1, 2.4.3 to 2.4.6, 2.4.8, 2.4.9).
Unit 2: 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).
Unit 3: 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 4: 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. J. Hass, C. Heil, and M. Weir, *Thomas Calculus*, Thirteenth Edition, Pearson Publication.
Unit 3: Text book-2: Chapter 1: Sec. 1.1.

Reference books:

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

Class: F.Y. B. Sc. (Semester- I)

Title of Course: Practical Based on USMT111 & USMT112

Course Code: USMT113

Credit: 2

Course: III

No. of lectures: 48

A) Learning Objectives:

- Improve problem-solving ability in relations, functions, congruence
- Improve problem-solving ability using properties of real numbers, limits, and sequences
- Use of ICT tools to learn Mathematics.

B) Learning Outcome:

- Students will solve problems and learn the logic behind problem-solving methods.
- Students will be able to visualize graphs and do some large calculations using Maxima Software.

Title of Experiments:

Algebra:

1. Problems on Sets, Relations, and Functions
2. Problems on Divisibility theory in the integers
3. Problems on Primes and the theory of congruences
4. Problems on Complex Numbers
5. Problems on Matrices
6. Algebra using Maxima Software

Calculus I:

1. Problems on Real Numbers
2. Problems on Sequences
3. Problems on Limits
4. Problems on Continuity
5. Real numbers and sequences using Maxima Software
6. Limits and continuity using Maxima Software