Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

(Autonomous)

Department of Mathematics

2019 Pattern

F. Y. B. Sc. (Mathematics)

Semester	Course Code	Title of Course	No. of Credits	No. of Lectures
I	MAT 1101	Algebra	2	36
	MAT 1102	Calculus-I	2	36
	MAT 1103	Practical based on MAT 1101 and MAT 1102	2	48
II	MAT 1201	Geometry	2	36
	MAT 1202	Calculus-II	2	36
	MAT 1203	Practical based on MAT 1201 and MAT 1202	2	48

Choice Based Credit System Syllabus (2019 Pattern)

Class: F.Y.B.Sc. (Semester – I)
Course Code: MAT 1101
Course: 1 **Title of the Course:** Algebra
Credit: 2 **No. of Lectures:** 36

A) Course Objectives:

1. Define and comprehend the basic concepts of sets, including set notation, set operations (union, intersection, complement), subsets, power sets, and the cardinality of sets.
2. Analyze and differentiate between relations and functions, exploring various types of relations (equivalence, partial orders) and functions (injective, surjective, bijective).
3. Apply the knowledge of sets, relations, and functions to model real-world problems, emphasizing their significance in computer science, mathematics, social sciences, and other domains.
4. To comprehend the foundational concepts of divisibility within integers, including prime factorization, divisibility rules, and their applications.
5. To enable students to apply the Euclidean Algorithm effectively in finding the greatest common divisor (GCD) of integers and its applications in solving problems related to divisibility.
6. To introduce the theory of congruences, modular arithmetic, and residue classes, enabling students to solve problems involving congruences and understand their applications.
7. To comprehend the fundamental concepts of systems of linear equations, including their representation, solution methods, and applications in various fields.
8. To develop proficiency in performing operations on matrices, including finding inverses, determinants, and applying these operations to solve systems of equations efficiently.
9. To introduce the concept of eigenvalues and eigenvectors, and explore their significance in linear transformations, stability analysis, and applications in diverse areas such as engineering, physics, and data analysis.

B) Course Outcomes:

1. Students will demonstrate proficiency in performing set operations, manipulating sets, understanding set properties, and solving problems involving sets and their elements.
2. Students will be able to analyze various relations and functions, identify their properties, determine their types, and apply this knowledge to solve problems in different contexts, fostering critical thinking and problem-solving skills.
3. Students will be able to analyze and determine divisibility properties of integers, apply prime factorization, and use divisibility rules to solve problems effectively.
4. Students will demonstrate proficiency in applying the Euclidean Algorithm to compute the greatest common divisor of integers, and use it to solve problems involving divisibility, linear Diophantine equations, and related topics.
5. Students will be able to solve problems using congruences, manipulate congruence classes, apply modular arithmetic principles, and use these concepts to solve problems related to divisibility and number theory.
6. Students will be able to solve complex systems of linear equations using appropriate methods, including Gaussian elimination, matrix operations, and techniques for finding inverse matrices.

7. Students will be able to analyze and interpret the properties of eigenvalues and eigenvectors in matrices, apply these concepts to solve problems in various disciplines, and comprehend their significance in real-world scenarios such as stability analysis, principal component analysis (PCA), and differential equations.

TOPICS/CONTENTS:

Unit 01: Induction [*3 Lectures*]

1.1 Well ordering principle for natural numbers
1.2 Principle of Mathematical induction (Strong form)

Unit 02: Sets, Relations and Functions [*8 Lectures*]

2.1 Definition of set, Operation on sets, Power set, Cartesian product of sets.
2.2 Definition of relation, equivalence relation, equivalence classes, partition of a set.
2.3 Definition of function, domain, co-domain, and the range of function, injective, surjective, bijective functions, composite functions, invertible functions.

Unit 03: Integers [*6 Lectures*]

3.1 Divisibility, Division algorithm, Euclidean algorithm, Properties of G.C.D. and L.C.M.
3.2 Primes, Euclid's lemma, Unique factorization theorem (Statement only).
3.3 Congruences: Definition and elementary properties, Fermat's little theorem (Statement only).
3.4 Euler's phi-function.

Unit 04: Complex Numbers [*5 Lectures*]

4.1 Addition and multiplication of complex numbers, Modulus and amplitude of complex numbers, Real and imaginary parts and conjugate of complex numbers.
4.2 Geometric representation of sum, difference, product and quotient of two complex numbers as well as modulus, amplitude and conjugate.
4.3 De'Moivre's theorem, Roots of unity, Euler's formula.

Unit 05: Matrices and system of linear equations [*14 Lectures*]

5.1 Matrices, Row echelon and reduced row echelon form of a matrix, Rank of matrix.
5.2 System of linear equations, Matrix form of system of linear equations, Homogeneous and non-homogeneous system of linear equations, Gauss elimination, Gauss-Jordan methods.
5.3 Consistency of a system of linear equations, condition of consistency (Without proof).
5.4 Eigen values, Eigen vectors, Characteristic equation of a matrix.
5.5 Cayley Hamilton theorem (Statement only), Inverse of matrix.

Textbook:

1. David M. Burton, Elementary Number Theory, Tata McGraw Hill, 7th Edition, 2012. (**Sections:**1.1, 2.1 to 2.4, 4.2, 5.2, 7.2, 7.3)
2. H. Anton, C. Rorres, Elementary linear algebra with applications, Wiley 7th Edition, 1994 (**Sections:**1.1 to 1.6, 6.1,9.1 to 9.3)
3. Kenneth Rosen, Discrete Mathematics and its Applications, Tata McGraw Hill. (**Sections:** 2.1 to 2.3, 7.1, 7.5)

Reference Books:

1. Tom M. Apostol, Calculus Volume – I, Wiley International Edition, 2007.
2. A Foundation Course in Mathematics, Ajit Kumar, S. Kumeareson, Bhaba Sarma
3. Robert G. Bartle, Donald R. Sherbert, Introduction to Real Analysis, John Wiley & Sons, 4th Edition, 2011.
4. Ruel V. Churchill, W. Brown, Complex Variables and Applications, Tata McGraw Hill, 9th Edition

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Mapping of Program Outcomes with Course Outcomes

Class: FYBSc (Sem I) **Subject:** Mathematics
Course: Algebra **Course Code:** MAT1101
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	2	2			1	1			
CO 2	3	2			1				1
CO 3	2	2			1				
CO 4	2	3		1					1
CO 5	3	3		1	1				1
CO 6	2	2							
CO 7	2	2							

Justification for the mapping

PO1: Disciplinary Knowledge
CO1: Understanding sets and set operations fosters logical reasoning and problem-solving skills crucial in various disciplines, enhancing students' capacity to analyze and manipulate data efficiently.
CO2: Studying relations and functions cultivates critical thinking by enabling students to discern properties, types, and applications, empowering them to solve problems across diverse contexts within disciplinary knowledge.
CO3: Understanding divisibility properties of integers, prime factorization, and divisibility rules equips students with essential tools to solve diverse mathematical problems efficiently.

CO4: Mastering the Euclidean Algorithm enables students to efficiently find the greatest common divisor, unlocking solutions for various mathematical problems encompassing divisibility, linear Diophantine equations, and related concepts.
CO5: Understanding congruences and modular arithmetic equips students with powerful tools to solve diverse mathematical problems in divisibility and number theory.
CO6: Students will acquire vital problem-solving skills by mastering diverse methods such as Gaussian elimination, matrix operations, and inverse matrix techniques, crucial for solving intricate systems of linear equations within their disciplinary knowledge.
CO7: Understanding eigenvalues and eigenvectors enables students to unravel matrix properties crucial for problem-solving across disciplines, such as stability analysis, PCA, and differential equations, offering insights into fundamental mathematical principles applied in real-world contexts.

PO2: Critical Thinking and Problem Solving
CO1: Understanding set operations and properties fosters logical reasoning and enhances problem-solving skills essential for critical thinking in various domains.
CO2: Studying relations and functions cultivates critical thinking and problem-solving skills by enabling students to discern properties, types, and applications across diverse contexts.
CO3: Students will develop analytical skills by mastering divisibility properties, prime factorization, and divisibility rules, enabling effective problem-solving in critical thinking scenarios.
CO4: Mastering the Euclidean Algorithm fosters problem-solving skills essential for tackling complex mathematical scenarios involving divisibility, Diophantine equations, and related concepts.
CO5: Understanding congruences and modular arithmetic principles equips students with powerful problem-solving tools to tackle divisibility and number theory, fostering critical thinking through mathematical reasoning and manipulation.
CO6: Understanding diverse methods like Gaussian elimination, matrix operations, and inverse matrix techniques cultivates versatile problem-solving skills essential for tackling intricate systems of linear equations.
CO7: Understanding eigenvalues and eigenvectors enables students to decipher complex systems' stability, perform effective PCA, and solve differential equations, fostering critical thinking by applying these concepts across diverse disciplines for real-world problem-solving.

PO4: Research-related skills and Scientific temper
CO4: The Euclidean Algorithm facilitates efficient determination of greatest common divisors, crucial for solving problems in divisibility, Diophantine equations, and related mathematical concepts, fostering research-related skills and a scientific mindset.
CO5: Understanding congruences and modular arithmetic equips students with problem-solving abilities crucial in research by enabling them to analyze patterns, manipulate classes, and apply these concepts to tackle problems in divisibility and number theory, fostering scientific temper.

PO5: Trans-disciplinary Knowledge
CO1: Students will apply set operations to analyze complex interdisciplinary problems, fostering critical thinking and problem-solving skills across diverse fields.
CO2: Analyzing relations and functions cultivates critical thinking by enabling students to recognize patterns, properties, and types, empowering problem-solving across diverse disciplines.
CO3: Analyzing divisibility properties enhances problem-solving by applying prime factorization and rules, fostering a trans-disciplinary approach to mathematics.

CO5: Understanding congruences and modular arithmetic empowers students to solve diverse problems across disciplines by applying these fundamental principles to address challenges in divisibility, number theory, and problem-solving.

PO6: Personal and Professional Competence

CO1: Proficiency in set operations cultivates analytical thinking essential for problem-solving across various personal and professional domains.

PO9: Self-directed and Life-long Learning

CO2: Studying relations and functions cultivates critical thinking by enabling students to discern properties, classify types, and solve problems across diverse contexts, fostering self-directed learning and lifelong problem-solving skills.

CO4: The Euclidean Algorithm equips students with a versatile problem-solving tool for understanding divisibility, linear Diophantine equations, and related mathematical concepts, fostering self-directed and lifelong learning.

CO5: Understanding congruences and modular arithmetic equips students with problem-solving skills in various mathematical contexts, fostering self-directed and life-long learning through their applicability in problem-solving, divisibility, and number theory.

Choice Based Credit System Syllabus (2019 Pattern)

Class: F.Y.B.Sc. (Semester – I)
Course Code: MAT 1102
Course: 2 **Title of the Course:** Calculus-I
Credit: 2 **No. of Lectures:** 36

A) Course Objectives:

1. To classify of real numbers and recognize different properties that exits with real numbers.
2. To understand the concept of supremum and infimum and their applications.
3. To apply supremum and infimum for advanced study in Mathematics.
4. To understand the definition of limits and convergence in the context of sequences and series of real numbers.
5. To compute limits of sequences involving elementary functions.
6. To prove statements involving convergence arguments.
7. To apply limit of sequence concept in physical, chemical, and biological sciences.

B) Course Outcomes:

1. Students will able to classify real numbers and recognize different properties that exits with real numbers.
2. Students will able to understand the concept of supremum and infimum and their applications.
3. Students will apply these concepts for advanced study in Mathematics (Real Analysis, Complex Analysis, topology).
4. Students will able to understand the definition of limits and convergence in the context of sequences and series of real numbers.
5. Students will able to compute limits of sequences involving elementary functions.
6. Students will able to prove statements involving convergence arguments.
7. Students will apply limit of sequence concept in physical, chemical, and biological sciences.

TOPICS/CONTENTS:

Unit 01: Introduction to Real Numbers: **[15 lectures]**

1.1 The Set $\mathbb{N}$ of Natural Numbers
1.2 The Set $\mathbb{Q}$ of Rational Numbers
1.3 The Set $\mathbb{R}$ of Real Numbers
1.4 The Completeness Axiom
1.5 The symbols $+\infty$ and $-\infty$

Unit 02: Sequences **[18 lectures]**

2.1 Limits of Sequences
2.2 A discussion about Proofs
2.3 Limit theorems for Sequences
2.4 Monotone Sequences and Cauchy Sequences

2.5 Subsequences
2.6 lim sup and limit inf

Unit 03: Series **[3 lectures]**

3.1 Introduction, Definition & examples, Partial Sums
3.2 Ratio Test (without proof)
3.3 Root Test (without proof)

Text Book:

Elementary Analysis (Second Edition), Kenneth A. Ross, Springer

Sections: 1 to 5, 7 to 12 &15

Reference Books:

1. A Course in Calculus and Analysis by Sudhir Ghorpade and Balmohan Limaye, Springer 2006.
2. Principles of Mathematical Analysis, W. Rudin, Third Edition, McGraw Hill, 1976
3. Mathematical Analysis, Tom M. Apostol.
4. Introduction to Real Analysis by Robert G. Bartle and Donald R. Sherbert, Third Edition, John Wiley and Sons,2002

Mapping of Program Outcomes with Course Outcomes

Class: FYBSc (Sem I) **Subject:** Mathematics
Course: Calculus-I **Course Code:** MAT1102
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	2							1
CO 2	3	2		2	2				1
CO 3	3	2		2					1
CO 4	3	2			2				1
CO 5	3	2		2	2				1
CO 6	3	2		2					1
CO 7	3	2		2	2	2			1

Justification for the mapping

PO 1: Disciplinary Knowledge:

All of these course outcomes (COs) contribute to the development of student's disciplinary knowledge in mathematics. For example, CO1, CO2, CO3, CO4, CO5, CO6 requires student to develop deep learning of real number system, sequence, limit of a function and continuity. CO7 requires students to apply the concepts of calculus in many fields like engineering, statistics, biology and computer science.

PO2: Critical Thinking and Problem Solving:

All of these course outcomes (COs) contribute to the development of students critical thinking and problem solving. Strategies For example, CO1, CO2, CO4, CO5 requires students to think critically and apply these to solve complex problems in various filed like engineering and physics. CO3, CO6 and CO7 requires to apply and construct logical proofs to solve real world problems.

PO4: Research-related skills and Scientific temper:

CO2, CO3, CO5, CO6, CO7 contribute to student's research related skills. Student's will able to apply the tools of calculus to various real-world problems in different areas.

PO5: Trans-disciplinary Knowledge:

CO2, CO4, CO5, CO7 requires to students to apply mathematical concept such as convergence of sequence, behaviour of function to solve complex problems. These concepts are useful in many different fields such as Physics, engineering, chemistry and economics.

PO6: Personal and professional competence:

The course outcome CO7contrbute to demonstrate the ability of students to apply mathematical concept such as limit of sequence, convergence in practical manner. This ability is essential for personal and professional development.

PO9: Self-directed and Life-long learning:

All of these COs contribute to demonstrate the ability of students to apply the concept of real numbers, sequences in practical context. This ability will enable them to continue learning and developing skills throughout life.

Choice Based Credit System Syllabus (2019 Pattern)

Class: F.Y.B.Sc. (Semester – I)
Course Code: MAT 1103
Course: 3 **Title of the Course:** Practical based on MAT 1101 & MAT 1102
Credit: 2 **No. of Lectures:** 36

A) Course Objectives:

1. To define and comprehend the basic concepts of sets, including set notation, set operations, subsets, power sets, and the cardinality of sets.
2. To understand the concept of supremum and infimum and their applications.
3. Apply the knowledge of sets, relations, and functions to model real-world problems, emphasizing their significance in computer science, mathematics, social sciences, and other domains.
4. To understand the definition of limits and convergence in the context of sequences and series of real numbers.
5. To enable students to apply the Euclidean Algorithm effectively in finding the greatest common divisor (GCD) of integers and its applications in solving problems related to divisibility.
6. To apply limit of sequence concept in physical, chemical, and biological sciences.
7. To introduce the concept of eigenvalues and eigenvectors, and explore their significance in linear transformations, stability analysis, and applications in diverse areas such as engineering, physics, and data analysis.

B) Course Outcomes:

1. Students will demonstrate proficiency in performing set operations, manipulating sets, understanding set properties, and solving problems involving sets and their elements.
2. Students will able to understand the concept of supremum and infimum and their applications.
3. Students will be able to analyze and determine divisibility properties of integers, apply prime factorization, and use divisibility rules to solve problems effectively.
4. Students will able to compute limits of sequences involving elementary functions.
5. Students will be able to solve problems using congruences, manipulate congruence classes, apply modular arithmetic principles, and use these concepts to solve problems related to divisibility and number theory.
6. Students will apply limit of sequence concept in physical, chemical, and biological sciences.
7. Students will be able to analyze and interpret the properties of eigenvalues and eigenvectors in matrices, apply these concepts to solve problems in various disciplines, and comprehend their significance in real-world scenarios such as stability analysis, principal component analysis (PCA), and differential equations.

Title of Experiments:

Algebra:

1. Induction and complex numbers.
2. Relations and functions.
3. Divisibility and congruences.
4. Matrices: Determinant, rank, Eigen values and Eigen vectors, Cayley Hamilton theorem.
5. System of linear equations
6. Miscellaneous

Calculus I:

1. Real Numbers
2. Graphs and functions with & without using software Maxima
3. Sequence -I
4. Sequence-II
5. Series
6. Miscellaneous

Mapping of Program Outcomes with Course Outcomes

Class: FYBSc (Sem I) **Subject:** Mathematics
Course: Practical based on MAT 1101 & MAT 1102 **Course Code:** MAT1103
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	2							1
CO 2	3	2		2	2				1
CO 3	3	2		2					1
CO 4	3	2			2				1
CO 5	3	2		2	2				1
CO 6	3	2		2					1
CO 7	3	2		2	2	2			1

Justification for the mapping

PO 1: Disciplinary Knowledge:

All of these course outcomes (COs) contribute to the development of student's disciplinary knowledge in mathematics. For example, CO1, CO2, CO3, CO4, CO5, CO6 requires student to develop deep learning of real number system, sequence, limit of a function and continuity.

PO2: Critical Thinking and Problem Solving:

All of these course outcomes (COs) contribute to the development of students critical thinking and problem solving. Strategies For example, CO1, CO2, CO4, CO5 requires students to think

critically and apply these to solve complex problems in various filed like engineering and physics. CO3, CO6 and CO7 requires to apply and construct logical proofs to solve real world problems.

PO4: Research-related skills and Scientific temper:

CO2, CO3, CO5, CO6, CO7 contribute to student's research related skills. Student's will able to apply the tools of calculus to various real-world problems in different areas.

PO5: Trans-disciplinary Knowledge:

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PO6: Personal and professional competence:

The course outcome CO7contrbute to demonstrate the ability of students to apply mathematical concept such as limit of sequence, convergence in practical manner.

PO9: Self-directed and Life-long learning:

All of these COs contribute to demonstrate the ability of students to apply the concept of real numbers, sequences in practical context. This ability will enable them to continue learning and developing skills throughout life.