Rayat Shikshan Sanstha's

Karmaveer Bhaurao Patil College Vashi, Navi Mumbai

Autonomous College

[University of Mumbai]

Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of Course	F.Y.B.Sc. Mathematics
2	Eligibility for Admission	12th Science and equivalent [of recognized Boards]
3	Passing Marks	40%
4	Ordinances/Regulations (if any)	
5	No. of Years/Semesters	One year/Two semester
6	Level	U.G.
7	Pattern	Semester
8	Status	New
9	To be implemented from Academic year	2021-2022

Date: _____

Signature: _____

Name of BOS Chairman: _____

AC- 25/10/ 2021

Item No-7.11

Rayat Shikshan Sanstha's
KARMAVEER BHAURAO PATIL COLLEGE, VASHI.
NAVI MUMBAI
Sector-15- A, Vashi, Navi Mumbai - 400 703

(AUTONOMOUS COLLEGE)

Syllabus for Mathematics

Program: B.Sc.

Course: F.Y.B.Sc. Mathematics

(Choice Based Credit System with effect from the academic year 2021-2022)

Preamble of the Syllabus:

Bachelor of Science (B.Sc.) in Mathematics is a under graduation programme of Department of Mathematics, Karmaveer Bhaurao Patil College Vashi, Navi Mumbai [Autonomous College]

The Choice Based Credit and Grading System to be implemented through this curriculum would allow students to develop a strong footing in the fundamentals and specialize in the disciplines of his/her liking and abilities. The students pursuing this course would have to develop understanding of various aspects of the mathematics. The conceptual understanding, development of experimental skills, developing the aptitude for academic and professional skills, acquiring basic concepts and understanding of hyphenated techniques are among such important aspects.

Rayat Shikshan Sanstha's
KARMAVEER BHAURAO PATIL COLLEGE, VASHI.
NAVI MUMBAI
(Autonomous)
Department of Mathematics
B. Sc. Mathematics

Program Outcomes (POs)

Learners are able to–

PO-1	**Disciplinary Knowledge**	Understand the basic concepts, fundamental principles, theoretical formulations and experimental findings and the scientific theories related to Physics, Chemistry, Mathematics, Microbiology, Computer Science, Biotechnology, Information Technology and its other fields related to the program.
PO-2	**Communication Skills**	Develop various communication skills such as reading, listening and speaking skills to express ideas and views clearly and effectively.
PO-3	**Critical Thinking**	Propose novel ideas in explaining the scientific data, facts and figures related to science and technology.
PO-4	**Analytical Reasoning and Problem Solving**	Hypothesize, analyze, formulate and interpret the data systematically and solve theoretical and numerical problems in the diverse areas of science and technology.
PO-5	**Sense of Inquiry**	Curiously ask relevant questions for better understanding of fundamental concepts and principles, scientific theories and applications related to the study.
PO-6	**Use of Modern Tools**	Operate modern tools, equipments, instruments and laboratory techniques to perform the experiments and write the programs in different languages (software).
PO-7	**Research Skills**	Understand to design, collect, analyze, interpret and evaluate information/data that is relevant to science and technology.
PO-8	**Application of Knowledge**	Develop scientific outlook and apply the knowledge with respect to subject.
PO-9	**Ethical Awareness**	Imbibe ethical, moral and social values and exercise it in day to day life.
PO-10	**Teamwork**	Work collectively and participate to take initiative for various field-based situations related to science, technology and society at large.
PO-11	**Environment and Sustainability**	Create social awareness about environment and develop sustainability for betterment of future.
PO-12	**Lifelong Learning**	Ability of self-driven to explore, learn and gain knowledge and new skills to improve the quality of life and sense of self-worth by paying attention to the ideas and goals throughout the life.

Program Specific Outcomes(PSO)

PSO-1	Recalling the concepts of mathematics and applying them to the various courses like algebra, analysis, Differential equations, statistics, etc to form mathematical models.
PSO-2	To apply knowledge of Mathematics for pursuing higher studies at reputed national and international institutes including higher research.
PSO-3	Apply Mathematics to interdisciplinary ways like statistician, mathematical finance, industry expertise and interpret quantitative ideas.

Rayat Shikshan Sanstha's

KARMAVEER BHAURAO PATIL COLLEGE, VASHI.
NAVI MUMBAI (Autonomous)
(w.e.f. academic year 2021-22)

Semester-I

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	CIE	Sem End-Exam	Term work	Practical		Total	Lecture	Practical	Tutorial	Total
UGMT101	Calculus-I	02	01	-	40	60	-	50*	-	150	02	1	-	03
UGMT102	Algebra-I	02	01	-	40	60	-	50*	-	150	02	1	-	03
UGMTP01*	Practical Exam based on UGMT101 & UGMT102													
	Total	**04**	**02**	**-**	**80**	**120**	**-**	**100**	**-**	**300**	**04**	**02**	**-**	**06**
										Total Credit	**04**	**02**	**-**	**06**

Semester-II

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	CIE	Sem End-Exam	Term work	Practical		Total	Lecture	Practical	Tutorial	Total
UGMT201	Calculus-II	02	01	-	40	60	-	50*	-	150	02	1	-	03

UGMT202	Algebra-II	02	01	-	40	60	-	50*	-	150	02	1	-	03
UGMTP01*	Practical Exam based on UGMT101 & UGMT102													
	Total	**04**	**02**	**-**	**80**	**120**	**-**	**100**	**-**	**300**	**04**	**02**	**-**	**06**
										Total Credit	**04**	**02**	**-**	**06**

Syllabus

Note: All topics have to be covered with proof in details (unless mentioned otherwise) and examples.

Semester I

Calculus I				
Course Code	Unit	Topics	Credits	L/Week
UGMT101	I	Real Number System	3	2
	II	Sequences		
	III	Series		
Algebra I				
UGMT102	I	Introduction to logic and functions	3	2
	II	Integers and polynomials		
	III	Prime numbers and Polynomials		
Practical				
UGMTP01		Practical Based on UGMT101 and UGMT102	2hrs/ week per batch	

Semester II

Calculus II				
Course Code	Unit	Topics	Credits	L/Week
UGMT201	I	Limit and continuity of function	2	3
	II	Continuous functions and Differentiation		
	III	Application of Differentiation		
Algebra II				
UGMT202	I	System of linear equations and Matrices	2	3
	II	Determinants		
	III	Introduction to Group theory		
Practical				
UGMTP02		Practical Based on UGMT201 and UGMT202	2hrs/ week per batch	

Teaching Pattern

1. For UGMT101, UGMT102, UGMT201 and UGMT202, two lectures per week per course. Each lecture should be of one hour duration.
2. For practical lecture, 2hr practical per week per batch. Each batch is of 20-25 students.

SEMESTER I
UGMT101: CALCULUS I

Total Marks: 100(Theory 60 and CIE 40)
Workload: 2 Lectures, 2hr Practical (Per week per Batch) **Credit:** 3
Duration: 60 Hrs (45 Theory and 15 Practical) **Examination**: 2 Hrs

Course Outcomes: Upon successful completion of this course, students will be able to:

CO1: State the properties of real numbers.
CO2: Apply properties of real numbers to prove some inequalities.
CO3: Define a sequence and classify different types of sequence.
CO4: State and apply properties of convergence and divergence to sequences and series

Unit I: Real Number System (15 Lectures)
Real number system and order properties of □, Absolute value properties, AM-GM inequality, Triangle inequality, Intervals and neighborhood, Hausdorff property, Bounded sets, Continuum property, l.u.b. and g.l.b axiom statement and its consequences, Density of rational and irrational, Nested interval theorem, Archimedean property and its applications.

Unit II: Sequences (15 Lectures)
Definition of a sequence and examples, Convergence of sequence, every convergent sequence is bounded, uniqueness of limit if exists, Convergence of standard sequences, Algebra of convergent sequences, Sandwich theorem, Cauchy sequence, Bolzano Weierstrass theorem, Monotone sequences, Monotone convergence theorem, Subsequences definition, Subsequence of a convergent sequence is convergent and converges to the same limit, every convergent sequence is a Cauchy sequence and converse.

Unit III: Series (15 Lectures)
Series of real numbers, simple examples of series, series as a sequence of partial sums, convergence of series, convergent and divergent series, Necessary condition for convergence of series, Algebra of convergent series, Cauchy criterion, Comparison test, limit comparison test, Geometric series, Telescopic series Alternating series, Leibnitz theorem (alternating series test), Absolute convergence, conditional convergence, absolute convergence implies convergence but not conversely, Ratio test, root test and examples.

Reference Books:

1. Ajit Kumar-S. Kumaresan, A Basic Course in Real Analysis, CRC Press, 2014
2. R.G. Bartle- D.R. Sherbert, Introduction to Real Analysis, John Wiley & Sons, 1994.

Additional Reference Books:

1. T. M. Apostol, Calculus Volume I, Wiley & Sons (Asia) Pvt. Ltd.
2. Richard Courant-Fritz John, A Introduction to Calculus and Analysis, Volume I, Springer.
3. R. R. Goldberg, Methods of Real Analysis, Oxford and IBH, 1964.

Assignments:
1. Application based examples of Archimedean property, intervals and neighborhood.
2. Consequences of l.u.b. and g.l.b. axiom, infimum and supremum of sets.

3. l.u.b and g.l.b. of different sets.
4. Calculating limits of sequences.
5. Cauchy sequences, monotone sequences.
6. Calculating limit of series, Convergence tests.

UGMT101 Calculus-I

Course Outcomes: After successful completion of this course, students will be able to:

CO-1: State the properties of real numbers.
CO-2: Apply properties of real numbers to prove some inequalities.
CO-3: Define a sequence and classify different types of sequence.
CO-4: State and apply properties of convergence and divergence to sequences and series

ICT Tools Used: Videos, PPT, Pen-Tablet

Students Centric Methods: Problem Solving and Participative
(Experimental, Participative, Problem Solving)

Links: SWAYAM / MOOCS:
1)https://nptel.ac.in/courses/111/106/111106146/
2) https://nptel.ac.in/courses/111/104/111104144/

The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	1	-	-	-	-	-	-	-
CO2	2	2	-	2	-	-	-	-	-	-	-	-
CO3	2	1	2	1	-	-	-	-	-	-	-	-
CO4	2	2	-	2	-	-	-	-	-	-	-	-

***In CO-PO Mapping Matrix:** a correlation is established between COs and POs in the scale of 1 to 3, 1 being the slight (low), 2 being moderate (medium), 3 being substantial (high) and '-' indicate there is no correlation in respective CO and PO.

UGMT102: ALGEBRA I

Total Marks: 100(Theory 60 and CIE 40)
Workload: 2 Lectures, 2hr Practical (Per week per Batch) **Credit:** 3
Duration: 60 Hrs (45 Theory and 15 Practical) **Examination**: 2 Hrs

Course Outcomes: Upon successful completion of this course, students will be able to:

CO1: Define logic statements.
CO2: Identify and apply various properties relating to the integers.
CO3: Apply different methods of proof to verify mathematical assertions.
CO4: Apply Fundamental theorem of algebra for finding roots of given polynomial.

Unit I. Introduction to logic and Functions (15 Lectures)

Statements and logic, Methods of proof, examples, and Basic Set theory: Union, intersection and complement, indexed sets, the algebra of sets, power set, Cartesian product, relations, equivalence relations, partitions, discussion of the example congruence modulo-m relation on the set of integers.
Definition of function, domain, co-domain and range of a function, images and inverse images of sets under function composite functions, graph of the function, Types of functions & their properties, Bijective functions are invertible and conversely, Examples of functions, Binary operation as a function.

Unit II: Integers and polynomials (15 Lectures)

Content of the Unit:

Statement of well-ordering property of non-negative integers, induction principle as a consequence of well-ordering property, Binomial theorem for non-negative exponents, Pascal Triangle. Divisibility in integers, division algorithm, greatest common divisor (g.c.d.) and least common multiple (l.c.m.) of two integers, basic properties of g.c.d. such as existence and uniqueness of g.c.d. of integers. Definition of polynomial, Algebra of polynomials, degree of polynomial, basic properties, Division algorithm in polynomials and g.l.b. of two polynomials and its basic properties, Euclidean algorithm applications.

Unit III: Prime numbers and Polynomials (15 Lectures)

Content of the Unit:

Primes, Euclid's lemma, Fundamental theorem of arithmetic, the set of primes are infinite. Definition and elementary properties of congruence, Euler's phi function, Statements of Euler's theorem, Fermat's little theorem, Wilson theorem and applications.
Roots of a polynomial, relation between roots and coefficients, multiplicity of a root, Remainder theorem, Factor theorem, a polynomial of degree n has at most n roots. Complex roots of a polynomial occur in conjugate pairs, Statement of Fundamental Theorem of Algebra.

Reference Books:

1. David M. Burton, Elementary Number Theory, Seventh Edition, McGraw Hill Education (India) private Ltd.
2. Norman L. Biggs, Discrete Mathematics, Revised Edition, Clarendon Press, Oxford 1989.
3. Foundation Course in Mathematics by Ajit Kumar, S. Kumaresan and Bhaba Sarma Narosa Publication 2017.
4. Robert R. Stoll: Set theory and logic, Freeman & Co.

Additional Reference Books:

1. Kenneth Rosen, Discrete Mathematics and its applications, Mc-Graw Hill International Edition, Mathematics Series.
2. Elementary number theory, Jones and Jones.
3. Number theory and its applications, Thomas Koshy.

Assignments:

1. Mathematical induction (The problems done in F.Y.J.C. may be avoided).
2. Division Algorithm and Euclidean algorithm in Z, primes and the Fundamental Theorem of Arithmetic.
3. Functions (direct image and inverse image), Injective, surjective, bijective functions, finding inverses of bijective functions.
4. Congruences and Euler's-function, Fermat's little theorem, Euler's theorem and Wilson's theorem.
5. Equivalence relation.
6. Factor Theorem, relation between roots and coefficients of polynomials, factorization and reciprocal polynomials.

Practical based on UGMT101:

1. Application based examples of Archimedean property, intervals and neighborhood.
2. Consequences of l.u.b. & g.l.b. axiom, infimum and supremum of sets.
3. Calculating limits of sequences. Cauchy sequences, monotone sequences.
4. Calculating limit of series
5. Convergence tests.

Practical based on UGMT102:

1. Mathematical induction

2. Division Algorithm and Euclidean algorithm in Z, primes and the Fundamental Theorem of Arithmetic.
3. Functions (direct image and inverse image), Injective, surjective, bijective functions, finding inverses of bijective functions.
4. Congruence and Euler's φ-function, Fermat's little theorem, Euler's theorem and Wilson's theorem.
5. Equivalence relation. Factor Theorem, relation between roots and coefficients of polynomials, factorization and reciprocal polynomials.

UGMT102 Algebra-I

Course Outcomes: After successful completion of this course, students will be able to:

CO1: Define logic statements.
CO2: Identify and apply various properties relating to the integers.
CO3: Apply different methods of proof to verify mathematical assertions.
CO4: Apply Fundamental theorem of algebra for finding roots of given polynomial.

ICT Tools Used: Videos, PPT, Pen-Tablet

Students Centric Methods: Problem Solving and Participative
(Experimental, Participative, Problem Solving)

Links: SWAYAM / MOOCS:
1) https://nptel.ac.in/courses/111/105/111105112/
2) https://nptel.ac.in/courses/111/106/111106113/

The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	-	-	-	-	-	-	-
CO2	3	1	1	1	1		-	-	-	-	-	-
CO3	2	1	2	1	1	-	-	-	-	-	-	-
CO4	2	2	1	2	-	-	-	-	-	-	-	-

SEMESTER II
UGMT201: CALCULUS II

Total Marks: 100(Theory 60 and CIE 40)
Workload: 2 Lectures, 2hr Practical (Per week per Batch) **Credit:** 3
Duration: 60 Hrs (45 Theory and 15 Practical) **Examination**: 2 Hrs

Course Learning Outcomes: Upon successful completion of this course, students will be able to:

CO1: Define limit, continuity and differentiability of real valued function
CO2: State and prove algebra of limits, continuous functions and differentiability.
CO3: Construct discontinuous function to continuous function
CO4: Apply continuous function State and prove algebra of limits, continuous functions and differentiability.
CO5: Apply differentiation to graph of function functions, L-Hospital Rule, higher derivative and Taylors Expansion.

Unit I: Limit and continuity of function

Limit of a function, evaluation of limit of simple functions using $\in -\square$ definition, uniqueness of limit if it exists, Algebra of limits Limit of composite function, Sandwich theorem, Left hand, right hand limits, non-existence of limits, limit as t$\to \pm\infty$.
Continuity of a real valued function on a set, $\in -\square$ definition, examples, Continuity of a real valued function at end points of a domain, Sequential continuity, $\in -\square$ if and only if Sequential continuity, Algebra of continuous functions, Discontinuous functions, examples of removable and essential discontinuity. Graphs of some standard functions,

Unit II: Continuous functions and Differentiation (15 Lectures)

Properties of Continuous functions: $f([a,b])$ is closed if f is continuous, Intermediate value theorem and its applications, Bolzano-Weierstrass theorem. A continuous function on a closed and bounded interval is bounded and attains its bounds.
Differentiation of real valued function of one variable: Definition of differentiation at a point and on an open set, examples of differentiable and non differentiable functions, differentiable functions are continuous but not conversely, Algebra of differentiable functions, chain rule, Derivative of inverse functions, Implicit differentiation.

Unit III: Application of differentiation (15 Lectures)

Definition of local maximum and local minimum, necessary conditions, stationary points, second derivative test, examples, Graphing of functions using first and second derivatives, concave, convex functions, points of inflection, Rolle's theorem, Lagrange's and Cauchy's mean value theorems, applications and examples, Higher order derivatives, Leibnitz rule, Taylor's theorem with Lagrange's form of remainder with proof, Taylor polynomial and applications, L-hospital rule without proof, examples of indeterminate forms.

Reference Books:

1. R.G. Bartle- D.R. Sherbert, Introduction to Real Analysis, John Wiley & Sons, 1994.
2. Ajit Kumar- S. Kumaresan, A Basic Course in Real Analysis, CRC Press, 2014.

Additional Reference Books:

1. Richard Courant-Fritz John, A Introduction to Calculus and Analysis, Volume I, Springer.
2. T. M. Apostol, Calculus Volume I, Wiley & Sons (Asia) Private. Ltd.
3. Ghorpade, Sudhir R.- Limaye, Balmohan V., A Course in Calculus and Real Analysis, Springer International Ltd, 2000.

Assignments:
1. Limit of a function and Sandwich theorem.
2. Continuous and discontinuous functions.
3. Properties of continuous functions.
4. Differentiability, Higher order derivatives, Leibnitz theorem.
5. Mean value theorems and its applications.
6. Extreme values, increasing and decreasing functions
7. Applications of Taylor's and Maclaurin's theorems.

UGMT201 Calculus-II

Course Outcomes: After successful completion of this course, students will be able to:

CO1: Define limit, continuity and differentiability of real valued function
CO2: State and prove algebra of limits, continuous functions and differentiability.
CO3: Construct discontinuous function to continuous function
CO4: Apply continuous function State and prove algebra of limits, continuous functions and differentiability.
CO5: Apply differentiation to graph of function functions, L-Hospital Rule, higher derivative and Taylors Expansion.

ICT Tools Used: Videos, PPT, Chalk Board
Students Centric Methods: Problem Solving and Participative (Experimental, Participative, Problem Solving)
Links: SWAYAM / MOOCS: 1) https://nptel.ac.in/courses/111/104/111104144/ 2) https://nptel.ac.in/courses/111/104/111104085/

The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	-	-	-	-	-	-	-
CO2	2	2	3	-	-	-	-	-	-	-	-	-
CO3	2	1	1	2	-	-	-	-	-	-	-	-
CO4	-	2	-	-	-	-	-	1	-	-	-	-
CO5	2	2	-	3	-	-	-	2	-	-	-	-

UGMT202: ALGEBRA II

Course Learning Outcomes: Upon successful completion of this course, students will be able to:

CO1: Solve systems of linear equations and interpret their results.
CO2: Compute and interpret determinants of matrices.
CO3: Use computational techniques and algebraic skills essential for the study of systems of linear equations, matrix algebra.
CO4: Analyze and construct mathematical arguments that relate to the study of introductory group theory. (Proof and Reasoning).

Unit I: System of Linear equations and Matrices (15 Lectures)

Parametric equation of lines and planes, System of homogeneous and non homogeneous linear equations, the solution of system of m homogeneous linear equations in n unknowns by elimination and their geometrical interpretation, Matrices with real entries, addition, scalar multiplication and multiplication of matrices, Transpose of a matrix, Type of matrices, Invertible matrices, identities System of linear equations in matrix form, elementary row operations, row echelon matrix, reduced row echelon form, rank of a matrix, Gaussian elimination method, to deduce that the system of m "homogeneous linear equations in n unknowns has a non-trivial solution if m<n. Procedure to test the consistency of a system of linear equations using rank.

Unit II: Determinants (15 Lectures)

Determinant as area and volume. Existence and uniqueness of determinant function, Computation of determinant of 22, 33 matrices, diagonal matrices. Properties of determinants. Laplace expansion of a determinant, Vandermonde determinant, determinant of upper triangular and lower triangular matrices.

Cofactors and minors, Adjoint of an nn matrix, Basic results such as $A.adj(A) = det(A).I_n$., Determinant and Invertibility, Cramer's rule.

Recommended Books:

1. S Kumaresan, Linear Algebra, A Geometric approach, PHI Learning Private limited, Delhi.

Unit III: Introduction to Group Theory (15 Lectures)

Definition of a group, Abelian group, order of a group, finite and infinite groups. Examples of groups including:
Z, Q, R, C Under addition. Q*(=Q\{0}), R*(=R\{0}),C* (=C\{0}) Q+(= positive rational numbers) under multiplication. Zn; The set of residue classes modulo n under addition.
U (n): the group of prime residue classes modulo n under multiplication.
The symmetric group S_n. The group of symmetries of a plane figure. The Dihedral group D_n is the group of symmetries of a regular polygon of n sides (for n = 3, 4).
Klein 4-group. Matrix groups $M_{nn}(R)$ under addition of matrices, $GL_n(R)$; the set of invertible real matrices, under multiplication of matrices.
Properties such as
perties such as

Properties such as
In a group (G, .) the following indices rules are true for all integers n, m:

1. $a^n a^m = a^{n+m}$ for all a in G
2. $(a^n)^m = a^{nm}$ for all a in G
3. $a.b^n = a^n.b^n$ for all a, b in G whenever a*b = b*a.

In a group (G, .) the following are true:

1. The identity element e of G is unique.
2. The inverse of every element in G is unique.
3. $(a^{-1})^{-1} = a$ for all a in G
4. $a.b^{-1} = b^{-1}.a^{-1}$ for all a, b in G
5. If $a^2 = e$ for every a in G then (G, *) is an abelian group.
6. $aba^{-1n} = ab^n a^{-1}$ for every a, b in G and for every integer n
7. If $a.b^2 = a^2.b^2$ for every a, b in G then (G,.) is an abelian group.
8. Z_n^*, . is a group if and only if n is a prime.

Properties of order of an element such as (m and n are integers)
Properties of order of an element such as: (n and m are integers.)

1. If o(a) = n then $a^m = e$ if and only if n|m.
2. If o(a) = nm then $o(a^n) = m$.
3. If o(a) = n then $o(a^m) = n/(n, m)$, where (n, m) is the GCD of n and m $o(aba^{-1}) = o(b)$ and o(ab) = o(ba).
4. If o(a) = n and o(b) = m, ab = ba, (n, m) = 1 then o(ab) = nm.

Recommended Book:

1. S Kumaresan, Linear Algebra, A Geometric approach, PHI Learning Private limited, Delhi.
2. Kenneth Hoffman & Ray Kunze, Linear Algebra, Pearson Publication.
3. Joseph Gallian, Contemporary abstract algebra, Narosa publication.

Reference Books:

1. Steven H Friedberg, Insel, Spence, Linear Algebra, Pearson Education India.
2. L. Smith: Linear Algebra, Springer Verlag.
3. David C Lay, Linear Algebra and its applications, Pearson Education India.
4. John. B. Fraleigh, A first course in abstract algebra, 6th edition, Narosa Publishing House, New Delhi.
5. I. N. Herstein, Topics in Algebra, second edition, Wiley student edition.

UGMT201 Algebra-II

Course Outcomes: After successful completion of this course, students will be able to:

CO1: Solve systems of linear equations and interpret their results.
CO2: Compute and interpret determinants of matrices.
CO3: Use computational techniques and algebraic skills essential for the study of systems of linear equations, matrix algebra.
CO4: Analyze and construct mathematical arguments that relate to the study of introductory group

theory. (Proof and Reasoning).
ICT Tools Used: Videos, PPT, Chalk Board
Students Centric Methods: Problem Solving and Participative (Experimental, Participative, Problem Solving)
Links: SWAYAM / MOOCS: 1) https://nptel.ac.in/courses/111/105/111105112/ 2) https://nptel.ac.in/courses/111/106/111106113/

The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	-	-	-	-	-	-
CO2	2	1	2	2	-	-	-	-	-	-	-	-
CO3	2	2	2	1	-	2	-	-	-	-	-	-
CO4	2	1	1	3	2	1	-	-	-	-	-	-

If o(a) = n and o(b) = m, ab = ba, (n, m) = 1 then o(ab) = nm.

commended book:

1. Joseph Gallian, Contemporary abstract algebra, Narosa publication.

Reference books:

1. If o(a) = n and o(b) = m, ab = ba, (n, m) = 1 then o(ab) = nm.

Assignments on UGMT202:

1. Solving homogeneous system of m equations in n unknowns by elimination for $(m, n) = (1, 2), (1, 3), (2, 2), (2, 3), (3, 3)$.
2. Solving system $Ax = b$ by Gauss elimination, Solutions of system of linear Equations.
3. Find the determinant of matrices using Vandermonde method.
4. Find the rank of matrix and check the consistency.
5. Prove some basic properties of group.

Practical based on UGMT201:

1. Limit of a function and Sandwich theorem, Continuous and discontinuous functions, Properties of continuous functions.
2. Differentiability, Higher order derivatives, Leibnitz theorem.
3. Mean value theorems and its applications.
4. Extreme values, increasing and decreasing functions
5. Applications of Taylor's theorem and Taylors polynomials.

Practical based on UGMT202:

1. Solving homogeneous system of m equations in n unknowns by elimination for $(m, n) = (1, 2), (1, 3), (2, 2), (2, 3), (3, 3)$.
2. Solving system $Ax = b$ by Gauss elimination, Solutions of system of linear Equations.
3. Verifying whether given $(G, *)$ is a group with respect to operation.
4. Use cramers rule to find the determinant of matrix.
5. Find the order of various groups.

Scheme of Examination

For UGMT101, UGMT102, UGMT201 and UGMT202 (Semester I & II)

A. There will be a **Semester end examination** of 60 marks.

1. Duration: The examinations shall be of 2:30 Hours duration.

2. Theory Question Paper Pattern:

a) There shall be FOUR questions. The questions first three questions shall be of 15 marks each based on the units I, II, III respectively. The fourth question shall be of 15 marks based on the entire syllabus.

b) All the questions shall be compulsory. The questions shall have internal choices within. Including the choices, the marks for each question shall be 30.

c) The questions may be subdivided into sub-questions and the allocation of marks depends on the weightage of the topic.

B. There will be **Continuous Internal Assessment** of 40 marks.

Paper	20 Marks	10 Marks	10 Marks
Paper I (Calculus)	Unit Test	Assignment/Seminar	Class Test on Unit II
Paper II (Algebra)	Unit Test	Assignment/Seminar	Class Test on Unit II

Question paper pattern for Unit Test of 20 marks:

The unit test for 20 marks will be conducted online. There shall be 20 compulsory multiple choice questions with single correct answer, each carrying one mark.

C. Practical Examination

1. There will be semester end practical examination of 100 marks.
2. Duration: The examinations shall be of **3 Hours** duration.

Practical Exam	Viva	Journal	Total
80	10	10	100

Question paper pattern for practical exam of 80 marks:

Part A: Based on Paper I (Total 40 marks)

Section I: Multiple Choice Questions (Total 16 marks, 2 marks each)
Attempt any **8** out of **12**
Section II: Attempt any **THREE** out of **FIVE** (Total 24 marks, 8 marks each)

Part B: Based on Paper II (Total 40 marks)

Section I: Multiple Choice Questions (Total 16 marks, 2 marks each)
Attempt any **8** out of **12.**
Section II: Attempt any **THREE** out of **FIVE** (Total 24 marks, 8 marks each)

Each Practical of every course of Semester-I and II shall contain 10 problems out of which minimum 05 have to be written in the journal. A student must have a certified journal before appearing for the practical examination.