Parvatibai Chowgule College of Arts & Science
(Autonomous)
Margao – Goa

MINUTES OF MEETING OF THE BOARD OF STUDIES IN MATHEMATICS HELD ON 14th October, 2023 at Parvatibai Chowgule College of Arts & Science (Autonomous) Margao – Goa

Vide Chowgule College notice F.133(C)/744 dated 27th September 2023 a meeting of this BOS was convened on 14th October 2023, at 9:30 am at Parvatibai Chowgule College of Arts & Science, Margao – Goa. Since the number of members present represented the Quorum, the BOS began its proceedings.

Members present:

1. Ms. Danielle Monteiro
2. Dr. Chitra Mekoth
3. Ms. Aniksha Mayekar
4. Dr. Milind Kulkarni
5. Dr. Rajeev Sapre

Member Absent with Intimation

1. Mr. Rovan Vaz
2. Mr. Meetal Raikar
3. Dr. Stephen Dais Barreto

Proceedings

The Chairperson welcomed the members of the Board of Studies (BOS). The Chairperson introduced and explained the agenda for the meeting and read out the minutes of the previous B.O.S meet. The meet continued taking up the following agenda.

Agenda Items:

1. To approve the UG syllabus for Semesters III & IV under NEP 2020.
2. To approve the Multidisciplinary, Skill Enhancement, Vocational Education & Training Syllabus under NEP 2020.
3. To approve the course "Introduction to Data Science" offered by the Department of Computer Science as an elective for Semester 6 students of the Mathematics department
4. A.O.B.

PART A: The BOS passed the resolutions as follows:

1. In the course Mathematical Analysis I, it was suggested to add applications of limits, continuity and differentiation instead of just differentiation.
2. The reference book, Modern Algebra by A.R. Vaisishtha was suggested as a reference book for the course Algebra I
3. The subtopic of characterization of Pythagorean triples was suggested to replace the equation $x^2 + y^2 = z^2$
4. The semester III and IV courses' syllabus under the new structure was approved.
5. The course "Introduction to Data Science" offered by the Department of Computer Science was approved as an elective for Semester 6 students of the Mathematics department.

PART B: Important Points/ recommendations of BOS that require consideration / approval of Academic Council:

1. To seek approval for UG syllabus for Semesters III & IV under NEP 2020.
2. To seek approval for the syllabus for multidisciplinary, skill enhancement and vocational courses.
3. To seek approval for the course "Introduction to Data Science" offered by the Department of Computer Science as an elective for Semester 6 students of the Mathematics department.

The following members of the Board of Studies in Mathematics were present for the meeting.

1. Ms. Danielle Monteiro
2. Dr. Chitra Mekoth
3. Ms. Aniksha Mayekar
4. Dr. Milind Kulkarni
5. Dr. Rajeev Sapre

Member Absent with Intimation

1. Mr. Rovan Vaz
2. Mr. Meetal Raikar
3. Dr. Stephen Dais Barreto

Dr. Chitra Mekoth
Member Secretary
Board of Studies

Ms. Danielle Monteiro
Chairperson
Board of Studies

Dated: 16th October 2023

PART C: The remarks of the Dean of the Faculty:-

a. The minutes are in order.

b. The minutes may/not be placed before the Academic Council with remark, if any.

c. Important points of the minutes which need clear policy decision of the Academic Council to be recorded.

Date: 20|10|2023

Signature of the Academic Dean:

Dr. Meghana Devli

PARTD:The remarks of the Members Secretary of theAcademic Council:-

a. The minutes are in order.

b. The minutes may be placed before the Academic Council with remark,if any.

c. Important points of the minutes which need clear policy decision of the Academic Council to be recorded.

Date: 20|10|2023

Signature of the Member Secretary of Academic Council

Mr. V.C. Kumaresh

Annexure A

DEPARTMENT OF MATHEMATICS
SYLLABUS FOR THREE/FOUR YEAR UNDERGRADUATE DEGREE HONOURS PROGRAMME IN MATHEMATICS
(Implemented from the Academic Year 2023-2024 onwards)

COURSE STRUCTURE

SEMESTER	MAJOR CORE	MINOR/ VOCATIONAL	MULTIDISCIPLINARY COURSE (MDC)	VALUE ADDED COURSES (VAC)	ABILITY ENHANCEMENT COURSE (AEC)	SKILL ENHANCEMENT COURSE (SEC)
I	**UG-MAT-101:** Basic Algebra	**UG-MAT-102:** Basic Calculus	**UG-MAT-MDC1:** Statistics I			**UG-MAT-SEC1:** Differential Equations I
II	**UG-MAT-103:** Basic Real Analysis	**UG-MAT-104:** Mathematics for Sciences	**UG-MAT-MDC2:** Mathematics for Competitive Exams			**UG-MAT-SEC2:** Operations Research I
III	**UG-MAT-201:** Mathematical Analysis I	**UG-MAT-203:** Combinatorics	**UG-MAT-MDC3:** Statistics II			**UG-MAT-SEC3:** Numerical Methods
	UG-MAT-202: Algebra I					
IV	**UG-MAT-204:** Mathematical Analysis II	**UG-MAT-VOC1:** Pedagogy of Mathematics				
	UG-MAT-205:					

	Linear Algebra					
	UG-MAT-206: Number Theory I					
	UG-MAT-207: Coordinate Geometry					
V	**UG-MAT-301:** Functions of Several Variables	**UG-MAT-VOC2:** Probability				
	UG-MAT-302: Graph Theory					
	UG-MAT-303: Advanced Analysis					
	UG-MAT-304: Operations Research II					
VI	**UG-MAT-305:** Vector Analysis					
	UG-MAT-306: Complex Analysis					
	UG-MAT-307: Metric Spaces					
	UG-MAT-308: Differential Equations II					
VII	**UG-MAT-401:** Algebra II					
	UG-MAT-402: Advanced Analysis II					
	UG-MAT-403: Topology					
	UG-MAT-404: Functional Analysis					
	UG-MAT-405: Computational Linear Algebra					
VIII	**UG-MAT-406:** Measure Theory					
	UG-MAT-407:					

	Partial Differential Equations					
	UG-MAT-408: Rings and Modules					
	UG-MAT-409: Number Theory II					
	UG-MAT-410: Cryptography					

Semester III

DISCIPLINE-SPECIFIC CORE COURSE (DSCC)

Course Title: MATHEMATICAL ANALYSIS I
Course Code: UG-MAT-201
Marks: 100
Credits: 4
Duration : 60 hours
Prerequisites: Basic Real Analysis
Course Objective: To gain a solid understanding of calculus concepts, limits, continuity, differentiation, and their applications in various domains.
Course learning Outcomes: After completion of this course students will be able to

- CLO1 Develop an understanding of limits, including limits at infinity, and calculate limits algebraically and graphically.
- CLO2 Understand the epsilon-delta definition of continuity, pointwise and uniform.
- CLO3 Analyze continuous functions on closed and bounded intervals.
- CLO4 Prove and explain the various results of differentiation.
- CLO5 Find the roots of continuous functions using various methods.
- CLO6 Apply differentiation techniques to analyze real-world scenarios in physics, economics, and other fields.

Course Content:

Unit 1: Continuous Functions **(25 lectures)**
Limit of a function (Limit at ∞ and lim ---› ∞) , Algebra of limits, continuous functions(ε–δ definition), types of discontinuity, sequential continuity, continuous functions on closed and bounded intervals , their properties, All results of continuous function, IVT , uniform continuity,

Unit 2: Differentiable functions **(25 lectures)**

Definition, properties, theorems, increasing/decreasing functions, Taylor's theorem, L'Hospital's rules, maxima-minima, MVTs. , convex / concave functions, singular points.

Unit 3: Applications **(10 lectures)**

Bisection method and Newton's method to find root of a continuous functions
Application of limits, continuity and differentiation in Physics, Economics and other subjects.

List of Books recommended for reference:

1. Bartle Robert G. and Sherbert Donald R. *Introduction to Real Analysis*, Third Edition. Wiley Student edition.
2. Malik S.C. and Arora Sarita. *Mathematical Analysi*s, Second edition. Wiley Eastern Ltd, 1994.
3. Apostol Tom, *Calculus Vol. I*. Second Edition. Wiley Students Edition, India, 2012.
4. Narayan Shanti. *Differential Calculus*. S. Chand and Company Pvt. Ltd. 1988.
5. Goldberg Richard R., *Methods of Real Analysis*. Oxford and IBH Publishing Co. Pvt. Ltd. Indian Edition, 1970.
6. Bhat R.D. *A Textbook of Mathematical Analysis II*. Vipul Prakashan, First Edition.

Course Title: ALGEBRA I
Course Code: UG-MAT-202
Marks: 100
Credits: 4
Prerequisites: Basic Algebra
Course Objectives: To provide a comprehensive introduction to abstract algebra, equipping students with a strong foundation in algebraic structures and their properties.
Course Learning Outcome: Upon completion of the course, the student will be able to

- CLO1 understand the fundamental algebraic structures, including groups and rings
- CLO2 investigate the properties of algebraic structures with the help of examples.
- CLO3 apply theorems and techniques from group theory and ring theory to solve a variety of mathematical problems
- CLO4 prove and explain key theorems and concepts related to groups, rings, substructures, and homomorphisms

Course Content

Unit 1: **(10 Hours)**

Definition and Examples of Groups, Elementary Properties of Groups, finite and infinite groups, Subgroups-definition and examples, Subgroup Tests

Unit 2: **(15 hours)**

Cyclic Groups, Cosets, Properties of Cosets, Lagrange's Theorem and consequences. Permutation Groups, Normal Subgroups, Factor Groups,

Unit 3: **(15 Hours)**

Isomorphisms definition and examples, Properties of Isomorphism., Cayley's Theorem, Automorphisms, Homomorphisms, Properties of Homomorphisms, The Isomorphism theorems.

Unit 4: **(20 Hours)**

Rings-definition and examples, Properties of Rings, Subrings, Integral Domains, Fields, Characteristic of a Ring, Ideals and Factor Rings, Prime Ideals and Maximal Ideals, Ring Homomorphisms, properties and examples, The Field of quotients.

List of books recommended for reference:

1) Gallian J, *Contemporary Abstract Algebra*, Cengage Learning
2) Fraleigh J.B., *A First Course in Abstract Algebra*, Pearson
3) Herstein I.N., *Topics In Algebra*, Wiley
4) A.R.Vaisishtha, *Modern Algebra,* Krishna Publications

Course Title: COMBINATORICS
Course Code: UG-MAT-203
Marks: 100
Credits: 4
Duration: 60 hours
Course Objectives: To develop a strong understanding of combinatorial principles, generating functions, recurrence relations, and the principle of inclusion and exclusion, enabling students to apply these concepts to solve a wide range of counting and combinatorial problems

Course Learning Outcome: - Upon completion of the course, the students will be able to

- CLO1 apply the fundamental counting principles to solve counting problems.
- CLO2 use generating functions to model and solve various combinatorial problems
- CLO3 solve linear recurrence relations with constant coefficients using methods such as the characteristic equation and generating functions.
- CLO4 apply the principle of inclusion and exclusion to solve complex counting problems.

Unit I: - Counting principles **(20Lectures)**

Rules of sum and product, Permutation – Combination, Distributions of distinct/ identical objects, Pigeon hole Principle

Unit II: - Generating Functions **(15Lectures)**

Generating functions for combinations, Enumerators for permutations, distribution of distinct objects into identical cells, Partitions of integers, and relations. Exponential generating function

Unit III: - Recurrence Relations **(10Lectures)**

Linear recurrence relations with constant coefficients, Characteristic equation method, Solutions by technique of generating function, recurrence relations with two indices.

Unit IV: - The principle of inclusion and exclusion **(15Lectures)**

The general formula, derangements, Permutations with restrictions on relative positions, the rook polynomials, permutations with forbidden positions.

List of books recommended for reference:

1. Brualdi R.A., *Introductory Combinatorics*, Pearson
2. Liu C.L., *Introduction to Combinatorial Mathematics*, McGraw-Hill Book Company
3. Knuth, Graham, Patashnik, *Concrete Mathematics: A Foundation for Computer Science*, Addison Wesley.
4. Tucker Alan, Applied *Combinatorics*, Wiley Pvt. Ltd.
5. Chuan-Chong Chen & Khee-Meng Koh, *Principles and techniques in Combinatorics*, World Scientific Publishing
6. Berge C, *Principles of Combinatorics*, Academic Press
7. Stanley R., *Enumerative Combinatorics*, Volume 1, Springer

SKILL ENHANCEMENT COURSE (SEC)

Course Title: Numerical Methods
Course Code: UG-MAT-SEC 3
Marks: 75
Credits: 3
Duration: 45 hours
Course Objectives: To equip students with a strong foundation in numerical methods and mathematical techniques, enabling them to solve complex mathematical problems and apply their knowledge in various domains.
Course learning outcome: Upon completion of the course the student will be able to:

CLO1 round off numbers, compute errors, and deal with significant figures in numerical calculations.

CLO2 create and use finite difference tables for purposes such as estimating derivatives and interpolating data.

CLO3 apply numerical integration methods to approximate definite integrals of functions

CLO4 apply root-finding techniques to find real roots of algebraic or transcendental equations, with a clear understanding of the geometric significance of these methods.

CLO5 use the method of least squares for fitting linear, polynomial, and exponential curves to data points and understand the practical applications of curve fitting in various fields.

Course Content:

Unit 1: Finite differences and interpolation **(15 lectures)**

Approximate numbers, significant figures, rounding off numbers, Error- Absolute, relative and percentage

Operators- Δ, ∇ and E (definitions and some relations among them), finite difference tables, fundamental theorem on differences of a polynomial, and examples.

Newton Gregory Forward and backward interpolation formulae (with deduction of formulae) and examples (for equal intervals)

For unequal intervals- Lagrange's Formula and Newton's divided difference formula and examples

Unit 2: Numerical Integration and Differentiation **(15 lectures)**

Trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rules (with proof) and problems. Weddle's rule (no proof, only problems)

Numerical differentiation and examples.

Unit 3: Numerical Solutions of Equations **(15 Lectures)**

To find a real root of an algebraic or transcendental equation using the Bisection method, regular falsi method, Newton Raphson method with geometrical significance and problems and method of iteration.

Curve fitting: Method of least squares- fitting a line, second-degree polynomial, exponential curve and examples

List of books recommended for reference:

1. Atkinson K., *An Introduction to Numerical Analysis*, John Wiley & Sons
2. Chatterji P.N, *Numerical Analysis*
3. Comte S.D and Carl de Boor, *Elementary Numerical analysis - An Algorithmic approach*, McGraw Hill
4. Hildebrand F.B, *Introduction to Numerical Analysis*, McGraw Hill
5. Sastry S.S, *Introductory Methods of Numerical Analysis*, Prentice Hall India
6. Scarborough J.B, *Numerical Mathematical Analysis*, Oxford and IBH Publishing Company, New Delhi.

MULTIDISCIPLINARY COURSE(MDC)

Course Title: STATISTICS II
Course Code: UG-MAT-MDC3
Marks: 75
Credits: 3
Prerequisites: Statistics I
Course Objectives: To build a strong foundation in probability and statistics, enabling students to analyze data, make informed decisions, and apply statistical concepts in their field of study.
Course Learning Outcome: Upon completion of the course, the student will be able to

- CLO1 understand basic probability concepts, including sample spaces, events, and probability axioms.
- CLO2 use different probability distributions, including binomial, Poisson, and normal distributions, and understand how to work with random variables.
- CLO3 explore various sampling techniques
- CLO4 perform various methods for hypothesis testing and interpret the results in different scenarios

Course Content:

Unit 1: Probability **(10 lectures)**

Random Experiment and Sample space, Events, Independent and Mutually Exclusive Events, Conditional Probability, Addition and Multiplication Rule, Baye's Theorem.

Unit 2: Probability Distributions **(15 lectures)**

Binomial Distribution, Poisson Distribution, Normal Distribution

Unit 3: Sampling **(5 lectures)**

Definition of Sampling, Population, and Sample, Sample survey vs Census, Types of Sampling: Simple random sampling, Stratified sampling, systematic sampling, cluster sampling, multistage sampling, Quota Sampling,

Unit 4: Significance tests **(15 lectures)**

Testing of hypothesis, tests of significance, Null and Alternative hypothesis, Chi-square distribution, chi-square test of goodness of fit, chi-square test for independence of attributes, t-distribution, t-test for means, ANNOVA test.

List of books recommended for reference

1. S.C. Gupta, *Fundamentals of Statistics,* Himalayan Publishing House
2. B.L. Agarwal, *Basic Statistics,* New Age International

Semester IV

DISCIPLINE-SPECIFIC CORE COURSE(DSCC)

Course Title: Mathematical Analysis II
Course Code: UG-MAT-204
Marks: 100
Credits: 4
Duration: 60 hours
Prerequisites: Mathematical Analysis I
Course objective:- To acquire a comprehensive understanding of Riemann and Darboux integrals and their practical applications in mathematics.
Course learning outcome:- After completion of this course students will be able to

- CLO1 understand Riemann sums and analyze their role in approximating definite integrals.
- CLO2 Identify Darboux integrable functions using upper and lower sums and prove related theorems.
- CLO3 Apply the fundamental theorems of integration and associated results to solve complex integration problems.
- CLO4 Define and identify cases of improper integration, and calculate β and γ functions for specific functions.
- CLO5 compare the relations between the different types of integrals.

Course Content:

Unit 1: Riemann integrals:- **(15 lectures)**
Tagged partition, Riemann sum, Riemann integrable functions, some simple results on integrable functions using Riemann sum.

Unit 2: Darboux integrals **(15 lectures)**
Upper/lower sum, integrable function, Riemann criteria of integrable function, classes of integrable functions,

Unit 3: Fundamental Theorems **(15 lectures)**
Fundamental theorems of integration and their applications (chain rule, substitution and product rule theorems)

Unit 4: Improper Integration **(15 lectures)**
Improper integration(Type I and II) , β and γ functions.

References:

1. Bartle Robert G. and Sherbert Donald R. *Introduction to Real Analysis,* Third Edition. Wiley Student edition.
2. Malik S.C. and Arora Sarita. *Mathematical Analysi*s, Second edition. Wiley Eastern Ltd, 1994.
3. Apostol Tom, *Calculus Vol. I*. Second Edition. Wiley Students Edition, India, 2012.
4. Narayan Shanti. *Differential Calculus*. S. Chand and Company Pvt. Ltd. 1988.
5. Goldberg Richard R., *Methods of Real Analysis*. Oxford and IBH Publishing Co. Pvt. Ltd. Indian Edition, 1970.
6. Bhat R.D. *A Textbook of Mathematical Analysis II*. Vipul Prakashan, First Edition.

Course Title: LINEAR ALGEBRA
Course Code: UG-MAT-205
Marks: 100
Credits: 4
Duration: 60 hours
Prerequisites: Basic Algebra
Course Objectives: To provide students with a solid theoretical understanding of vector spaces, subspaces, and the fundamental concepts of linear algebra.
Course Learning Outcome:

CLO1 understand vector spaces, including their properties, definitions, and examples
CLO2 identify subspaces, determine linear independence, and establish relationships between subspaces within a vector space.
CLO3 represent linear transformations using matrices and understand the connection between linear transformations and matrix operations.
CLO4 Compute and analyse eigenvalues and eigenvectors
CLO5 explore inner product spaces, and orthogonality, and apply the Gram-Schmidt process to find orthogonal bases.

Course Content

Unit 1: Vector Spaces **(15 lectures)**

Vector space -definition and examples, subspaces, sum and direct sum of subspaces. Linear span, linear dependence, independence and their properties. Finite dimensional vector space, Basis, dimension of a vector space. Dimension of sum of subspaces. Existence of complementary subspace of a finite-dimensional vector space. Quotient space and its dimension.

Unit 2: Linear Transformations **(15 lectures)**

Linear transformation, Kernel and Range of a Linear Transformation. Matrix representation of linear transformation, composition of linear maps, change of basis, similar matrices, Rank Nullity theorem.

Unit 3: Eigen values and Eigen Vectors **(15 lectures)**

Eigen values and Eigen vectors of a linear transformation and matrices. Eigen space, Algebraic and Geometric Multiplicity of an eigenvalue. Diagonalisability of an n x n matrix over IR

Unit 4: Inner Product Spaces **(15 lectures)**

Inner products spaces. Cauchy- Schwarz inequality, Triangle inequality, orthogonal vectors, orthogonal complement, orthogonal sets and bases, Gram-Schmidt Process

List of books recommended for reference

1. Hoffman K. & Kunze R., *Linear Algebra* , PHI
2. Vasishtha A.R., *Linear Algebra,* Krishna Prakashan
3. Kumaresan S., Linear Algebra: A Geometric Approach, PHI
4. Anton H, Elementary Linear Algebra, Wiley Pvt. Ltd.
5. Strang G., Linear Algebra and its Applications, Cengage Learning

Course Title: NUMBER THEORY I

Course Code: UG-MAT-206

Marks: 100

Credits: 4

Duration: 60 hours

Course Objectives: To provide students with an understanding of key concepts in number theory and equip them with the skills needed to solve various types of number theory problems.

Course Learning Outcome: After completion of the course, the student will be able to

- CLO1 apply fundamental number theory concepts to solve a variety of integer-related problems.
- CLO2 solve congruence and Diophantine equations and apply the techniques to real world problems.
- CLO3 determine the prime factorization of integers and apply this knowledge in various contexts.
- CLO4 understand the mathematical implications of Fermat's and Wilson theorems.
- CLO5 explore number theoretic functions and use these functions to solve problems

Course Content:

Unit 1: Divisibility: **(15 lectures)**

Division Algorithm, Greatest Common divisor, Euclidian Algorithm, Fundamental Theorem of Arithmetic, Linear Diophantine equations ax+by=c

Unit 2: Congruence: **(15 lectures)**

Basic properties, Linear Congruence, Chinese Remainder Theorem, Quadratic Congruence.

Unit 3: Fermat's Theorem: **(15 lectures)**
Fermat's and Wilson's Theorem, characterization of Pythagorean triples, Fermat's Last Theorem.

Unit 4: Number Theoretic Functions: **(15 lectures)**
Sum and number of divisors, Multiplicative function, Mobius function, Mobius Inversion, greatest integer function, Euler's phi function

List of books recommended for reference

1. Burton David, *Elementary Number Theory*, 2012, Mc Graw Hill, 7th Edition.
2. Niven & Zuckerman, *An Introduction to the Theory of Numbers*, Wiley Publications
3. Adams & Goldstein, *Introduction to Number Theory*, Prentice Hall
4. Baker Alan, *A concise introduction to the Theory of Numbers*, Cambridge University Press
5. Telang S.G. & Nadkarni M.D, *Number Theory*

Course Title: COORDINATE GEOMETRY
Course Code: UG-MAT-207
Marks: 100
Credits: 4
Duration: 60 hours
Course Objectives: To build a strong foundation in coordinate systems, conic sections, three-dimensional geometry, and curve tracing, solve a wide range of mathematical problems, and apply these concepts in various fields of science and engineering.
Course learning outcome: Upon completion of the course the student will be able to:

- CLO1 differentiate between Cartesian, Polar, Cylindrical, and Spherical coordinate systems and apply the appropriate system to represent points and solve geometric problems.
- CLO2 derive equations for various geometrical objects, and understand their significance in geometric applications.
- CLO3 analyze how translation and rotations of axes affect the equations and properties of geometric objects.
- CLO4 classify quadratic equations based on their standard forms and sketch their diagrams.
- CLO5 apply calculus concepts to analyze and sketch curves in rectangular and polar coordinates.

Course Content:
Unit 1: Coordinate systems **(15 lectures)**
Coordinate systems: Cartesian, Polar, Cylindrical, and Spherical coordinate systems and relations between them.
Equations of a straight line, plane, and circle in two dimensions.

Transformation of Coordinates: translation and rotation and its effect on the equation of geometrical object.

Unit 2:Conic Sections **(15 lectures)**

Conic Sections: ellipse, parabola, and hyperbola. Their equations, properties, and their graphs.

General equation of second degree in two variables. Reduction to standard form. Techniques for sketching parabola, ellipse, and hyperbola. . (To be also shown with Geogebra)

Classification of quadratic equations representing lines, parabolas, ellipses, and hyperbolas.

Unit 3: Geometry of three dimensions: **(15 lectures)**

Concepts of the plane, straight line, sphere, cone, cylinder, their equations, and properties

Central Conicoid: ellipsoid, hyperboloid, and paraboloid, their equations and geometrical interpretation.

Unit 4: Tracing of curves **(15 lectures)**

Tracing of curves using concepts of derivatives, concavity-convexity, singular points (double point, cusp, and node), monotonicity of function, polar coordinates, and asymptotes. (To be also shown with Geogebra)

List of books recommended for reference:

1. Loney S.L., *The Elements of Coordinate Geometry (Part I): Cartesian Coordinates* , MacMillan
2. P.K.Jain,Khalil Ahmad, *Analytic Geometry of three dimension*,2nd edition,Wiley Eastern Ltd. (1991)
3. Shanti Narayan, P.K.Mittal , *Differential Calculus* – S. Chand Publications.
4. Gibson C.G., *Elementary Euclidean Geometry: An undergraduate introduction*, Cambridge University Press.

VOCATIONAL COURSE (VOC)

Course Title: PEDAGOGY OF MATHEMATICS

Course Code: UG-MAT-VOC1

Marks: 100

Credits: 4

Duration: 45 hours Theory, 30 hours practical

Course Objectives: To equip students with the knowledge, skills, and strategies necessary to effectively teach mathematics in a school setting.

Learning outcome: Upon completion of the course, students will be able to

CLO1 Understand the meaning, nature and scope of mathematics and its relation with other subjects.

CLO2 Write instructional objectives using Bloom's taxonomy

CLO3 Perform pedagogical analysis of various topics in mathematics

CLO4 Prepare lesson plans using various methods

CLO5 Select and use various methods and techniques to teach mathematics

Unit 1: Nature and Scope of Teaching Mathematics (10 lectures)

Meaning, scope and nature of mathematics, History of Mathematics, Relation of mathematics with other school subjects, Values of Mathematics, Aims and objectives of teaching mathematics, Instructional objectives using Bloom taxonomy

Unit 2: Pedagogical Analysis and Lesson Planning (15 Lectures)

Meaning and importance of pedagogical analysis

Pedagogical Analysis of Arithmetic, Algebra, Geometry, Trigonometry and Menstruation

Lesson Planning: Need of a lesson plan, steps in lesson planning

Unit 3: Methods and Techniques of Teaching Mathematics (20 lectures)

Methods of teaching: Lecture, demonstration, inductive-deductive, Heuristic, Analytic-synthetic, problem-solving, laboratory, project method

Techniques of teaching: Oral work, written work, drill, assignment, homework, review

Differentiated Teaching: Backward and Gifted students, causes and solutions.

Practicals: (30 hours)

1. Framing Course objectives using blooms taxonomy
2. Preparation of lesson plans for topics
3. Development of teaching aids for various topics in mathematics.
4. Book review of mathematics textbook
5. Prepare a PowerPoint presentation on some topic
6. Demonstrate the teaching methods
7. Prepare a diagnostic test for various topics

References:

1. R.G. Goel, Teaching of Mathematics, Lotus Press
2. A. James., Methods of teaching Mathematics, Neelkamal
3. Kline Morris, Mathematical Thought From Ancient to Modern Times, Oxford University Press
4. S. Krantz, How to teach Mathematics, American Mathematical Society
5. G. Polya, How to Solve It, Penguin UK
6. Sidhu Kulbir Singh., Teaching of Mathematics, Sterling Publishers Pvt. Ltd
7. J. Stillwell, Mathematics and its History, Springer
8. P.P Zubair., Teaching of Mathematics, Aph Publishing
9. M. Ediger, Essays on teaching mathematics, Discovery Publishing Pvt.Ltd