SHRI GOVIND GURU UNIVERSITY
Syllabus for B. Sc. Semester I (Mathematics)
BS23MJ1MT1 Major-1: Calculus and Matrix Algebra (Theory)
Hours: 4 /week **Credits: 4**

Prerequisite: Limit and Continuity, Differentiation of function of one variable, Introduction to matrix and operation on matrices, Special type of matrices and their properties.

Course Objectives: The main objective of the course is to gain a deep understanding of fundamental concepts of Calculus and Matrix Algebra, Explore various techniques for differentiating functions, Applications of Differentiation, Develop the ability to model and solve real-world problems using Calculus concepts, Understand fundamental matrix operations, Study matrix properties, Explore eigenvalues and eigenvectors, their computation, and their significance in various fields including Physics and Engineering.

Course Learning Outcomes: The learning outcomes provide a clear understanding of the knowledge and skills that students are expected to acquire upon completing courses. Upon completing the course, students should be able to:

1. Define and comprehend fundamental concepts like limits, continuity, and differentiability.
2. Interpret and solve basic ordinary differential equations.
3. Model and solve real-world problems from different fields using calculus concepts.
4. Analyze eigenvalues and eigenvectors, diagonalize matrices, and their applications in various disciplines.
5. Solve systems of linear equations using matrix methods and understand their geometric interpretation.
6. Apply matrices in various fields, including Engineering, Physics, Data Analysis, and Computer Graphics.

Unit I: Successive Derivatives
Higher order derivatives, Calculation of n^{th} derivatives of some standard functions (rational functions, the product of the powers of sins and cosines) and Leibnitz's Theorem.
(5.1 to 5.5 of [1])

Unit II: Mean Value Theorems and expansion of functions
Rolle's Mean Value Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem, Geometric interpretations and applications of these theorems, Taylor's and Maclaurin's Theorems and their applications.
(8.1, 8.2, 8.5, 6.1 and 6.2 of [1])

Unit III: Maxima Minima and Indeterminate forms
Maximum and minimum value of a function, A necessary condition for extreme values, Sufficient condition for extreme values and its applications, L'Hospital's rule and Indeterminate forms $(0/0, \infty/\infty, 0.\infty, \infty - \infty, 0^{\infty})$ (9.1 to 9.5 and 10.1 to 10.6 of [1]).

Unit IV: Matrix Algebra
Elementary operations on matrices, Linear dependence and independence of row and column vectors/matrices, Row reduced echelon form of a matrix and matrix inversion using it, Rank of a

matrix, Eigen values, Eigen vectors and the characteristic equation of a matrix, Cayley-Hamilton theorem and its applications.
(To be referenced from reference books)

Reference Books:

1. Differential Calculus - Shanti Narayan, P. K. Mittal, S. Chand and Co.
2. Calculus and Analytic Geometry - G. B. Thomas and R. L. Finney, Pearson Education, Indian Reprint, 2010.
3. Calculus - Stewart James, Cengage Learning, 2011.
4. Calculus and Matrix algebra - Sanjay K. Patel, Bhikhalal P. Patel, Haribhai R. Kataria and Bhikha L. Ghodadra, University granth nirman board, Ahmedabad.
5. An Introduction to Linear Algebra- V. Krishnamurthy, V. P. Mainra, J. L. Arora, East-West Press, New Delhi.
6. A Textbook of Matrices - Shanti Narayan, P. K. Mittal, S. Chand Publishing, 2010.
7. Matrix and Linear Algebra - K. B. Dutta, Prentice-Hall of India, New Delhi, India.
8. Matrices, J. N. Kapur and M. K. Singal, R. Chand and Co., 1996.

Teaching Plan: The teaching plan may be followed as:
Weeks 1 and 2: Higher order derivatives and calculation of derivatives of some standard functions.
Weeks 3 and 4: Leibnitz,s theorem and solving examples.
Weeks 5 and 6: Rolle's, Lagrange's and Cauchy's Mean Value theorems, Gemetric interpretations and applications of these theorems.
Weeks 7 and 8: Taylor's and Maclaurin's Theorems and their applications.
Weeks 9 and 10: Maximum and minimum value of a function, and theorem on extreme values and its applications.
Weeks 11 and 12: L'Hospital's rule and Indeterminate forms.
Weeks 13 and 14: Elementary operations on matrices, Linear dependence and independence of vectors/matrices. RRE, Eigen values and Eigen vectors.
Week 15: The characteristic equation of a matrix, Cayley-Hamilton theorem and its applications. Discussion about learning outcomes of the course.

SHRI GOVIND GURU UNIVERSITY
Syllabus for B. Sc. Semester-I (Mathematics)
BS23MN1MT1 Minor: Linear Algebra-I (Theory)

Hours: 2 /week **Credits: 2**

Prerequisite:Introduction to matrix and operation on matrices.

Course Objectives: The primary objective of the course is to encompass a comprehensive range of skills, knowledge and deep understanding of fundamental concepts in Matrix Algebra including matrices, determinant and systems of linear equations, Explore various techniques for system of linear equations, Recognize and analyze properties of matrices such as symmetry, skew-symmetry, transposition and inverses, Calculate determinants of matrices and understand their significance, Understand fundamental matrix operations, Study matrix properties, Explore eigenvalues and eigenvectors, their computation, and their significance in various fields and Develop problem-solving skills by using Linear Algebra techniques to solve real-world problems.

Course Learning Outcomes: The learning outcomes reflect the comprehensive understanding of the knowledge and skills. Upon completing the course, students should be able to:

1. Perform basic and advanced operations on matrices.
2. Identify and analyze properties of matrices.
3. Calculate determinants of matrices, understand their geometric and algebraic significance, and apply them in solving systems of equations.
4. Apply matrix methods to solve systems of linear equations.
5. Compute eigenvalues and eigenvectors, diagonalize matrices, and their applications in various disciplines.

Unit I: Special type of matrices and their properties, Elementary row operations on matrices, Linear dependence and independence of row and column vectors/matrices, Row reduced echelon form of a matrix and matrix inversion using it, Rank of a matrix.

Unit II: Existence of inverse of a square matrix, Cancellation law in matrix multiplication, Eigen values, Eigen vectors and the characteristic equation of a matrix, Cayley-Hamilton theorem and its applications.

Unit III: Definition and properties of determinant of a square matrix, Solving System of simultaneous linear equations using Cramer's method, Graphical method (two variables), RRE method and Inverse method.

Reference Books:

1. An Introduction to Linear Algebra- V. Krishnamurthy, V. P. Mainra, J. L. Arora, East-West Press, New Delhi.
2. A Textbook of Matrices - Shanti Narayan, P. K. Mittal, S. Chand Publishing, 2010.
3. Matrix and Linear Algebra - K. B. Dutta, Prentice-Hall of India, New Delhi, India.
4. Matrices, J. N. Kapur and M. K. Singal, R. Chand and Co., 1996.

5. A Textbook of Matrices, Hari Kishan, Atlantic publishers, 2008.

6. Advanced Engineering Mathematics, Erwin Kreyszig, 10th edition, John Wiley and Sons .

Teaching Plan: The teaching plan may be followed as:
Weeks 1 and 2: Elementary operations on matrices, Linear dependence and independence of vectors/matrices.
Weeks 3 and 4: Rank of matrix, RRE and matrix inversion using it.
Weeks 5, 6 and 7: Square matrix, Eigen values, Eigen vectors and the characteristic equation of a matrix.
Weeks 8 and 9: Existence of inverse of a square matrix, Cancellation law in matrix multiplication, Cayley-Hamilton's Theorem and its application.
Weeks 10 and 11: Definition and Properties of determent of a square matrix.
Weeks 12, 13 and 14: Solving System of simultaneous linear equations using Cramer's method, Graphical method (two variables), RRE method and Inverse method.
Week 15: Discussion about learning outcomes of the course.

Minor: Linear Algebra-I (Practical)

Hours: 4 /week **Credits: 2**

Number of Practicals: 12

List of Practicals:

1. Examples of elementary row operations.
2. Examples of linearly dependent and independent vectors.
3. Examples on finding rank of a matrix using linearly independent row/column vectors.
4. Examples on finding rank of a matrix using RRE form.
5. Examples on finding the Eigenvalue and Eigenvector.
6. Examples on finding the characteristic equation of a matrix.
7. Examples on verification of Cayley-Hamilton Theorem.
8. Examples on applications of Cayley-Hamilton Theorem.
9. Examples on verifying properties of determinant of square matrices.
10. Examples on solving system of simultaneous linear equations using Cramer's rule.
11. Examples on solving system of simultaneous linear equations using RRE form.
12. Examples on solving system of simultaneous linear equations using Inverse method.

Reference Books:

1. An Introduction to Linear Algebra- V. Krishnamurthy, V. P. Mainra, J. L. Arora, East-West Press, New Delhi.
2. A Textbook of Matrices - Shanti Narayan, P. K. Mittal, S. Chand Publishing, 2010.
3. Matrix and Linear Algebra - K. B. Dutta, Prentice-Hall of India, New Delhi, India.
4. Matrices, J. N. Kapur and M. K. Singal, R. Chand and Co., 1996.
5. A Textbook of Matrices, Hari Kishan, Atlantic publishers, 2008.
6. Advanced Engineering Mathematics, Erwin Kreyszig, 10th edition, John Wiley and Sons .

SHRI GOVIND GURU UNIVERSITY

Syllabus for B. Sc. Semester I (Mathematics)

BS23MD1MT1 Multidisciplinary: Differential Equations (Theory)

Hours: 2 /week **Credits: 2**

Prerequisite: Introduction to Ordinary Differential Equation.

Course Objectives: The specific objective of the course is to develop crystal clear understanding of fundamental concepts of differential equations, Explore various techniques for solving differential equations, Apply these methods to solve real-world problems, Establish a strong foundation for advanced mathematics courses, Understand the ethical implications of mathematical modeling and problem-solving.

Course Learning Outcomes: The learning outcomes reflect the breadth and depth of understanding that students are expected to achieve in this course. Upon completing the course, students should be able to:

1. Classify differential equations based on degree and order of the equation.
2. Solve various types ordinary differential equations and recognize their applications in modeling dynamic systems.
3. Demonstrate understanding of techniques applied to solve a differential equation..
4. Establish a strong foundation for advanced courses that build upon Differential Equations, such as Real Analysis, Mechanics, Theoretical Physics and Engineering Mathematics.

Unit I: Definition of differential equation, order and degree of differential equation, types of first-order and first-degree differential equations: separable variable, homogeneous differential equation, non-homogeneous differential equation, exact differential equation, necessary and sufficient condition of exact differential equation,linear differential equation and Bernoulli's differential equation.

Unit II: Linear differential equation first order and higher degree with application, Method of solving differential equations of first order and higher degree: solvable for y, solvable for x, solvable for p (where $p = \frac{dy}{dx}$), Clairaut's differential equation and Lagrange's Differential Equation.

Unit III: Linear differential equations of higher order and degree one with constant and variable coefficients: Complementary Function and Particular Integrals, Inverse operator, and methods of finding particular integral (Integral corresponds to terms of the form $e^{ax}, x^m, \sin ax, \cos ax, e^{ax}V$ and xV).

Reference Books:

1. Differential equations and their applications, - Zafar Ahsan, Prentice Hall of India, 2004.
2. Elementary Differential equations-Kella, Mcgraw-Hill.
3. Advanced Engineering Mathematics, Erwin Kreyszig, 10th edition, John Wiley and Sons .
4. Introductory course in Differential equations - Murray, Ulan Press.

Teaching Plan: The teaching plan may be followed as:
Weeks 1 and 2: order and degree of differential equation, and Types of linear differential equations.
Weeks 3 and 4: Linear differential equations, Bernoulli's differential equation and solving examples.
Weeks 5, 6 and 7: Linear differential equation first order and higher degree with application, and method of solving differential equation first order and higher degree.
Weeks 8 and 9: Clairaut's differential equation and Lagrange's Differential Equation.
Weeks 10, 11 and 12: Linear differential equations of higher order and degree one with constant and variable coefficients.
Weeks 13 and 14: Inverse operator and Methods of finding particular integral (Integral corresponds to terms of the form $e^{ax}, x^m, \sin ax, \cos ax, e^{ax}V$ and xV).
Week 15: Discussion about learning outcomes of the course.

Multidisciplinary: Differential Equations (Practical)

Hours: 4 /week **Credits: 2**

Number of Practicals: 12

List of Practicals:

1. Problems on finding the order and degree of the differential equations.
2. Problems on Exact differential equations and Integrating factors.
3. Problems on Linear differential equations.
4. Problems on Bernoulli's differential equations.
5. Problems on Method of solving differential equations of first order and higher degree: solvable for y.
6. Problems on Method of solving differential equations of first order and higher degree: solvable for x.
7. Problems on Method of solving differential equations of first order and higher degree: solvable for p (where $p = \frac{dy}{dx}$).
8. Problems on Clairaut's and Lagrange's differential equations.
9. Examples on finding the Particular integral terms of the form e^{ax}, x^m.
10. Examples on finding the Particular integral terms of the form $\sin ax, \cos ax$.
11. Examples on finding the Particular integral terms of the form $e^{ax}V$, xV.
12. Problems on Differential equation of higher order with variable coefficients.

Reference Books:

1. Differential equations and their applications, - Zafar Ahsan, Prentice Hall of India, 2004.
2. Elementary Differential equations-Kella, Mcgraw-Hill.
3. Advanced Engineering Mathematics, Erwin Kreyszig, 10th edition, John Wiley and Sons .
4. Introductory course in Differential equations - Murray, Ulan Press.

SHRI GOVIND GURU UNIVERSITY
Syllabus for B. Sc. Semester I (Mathematics)
BSC23SE106 Skill Enhancement Course: Discrete Mathematics
Hours: 2 /week **Credits: 2**

Prerequisite: Introduction to set theory, logic, algebraic structures, understanding of basic mathematical concepts such as algebra, arithmetic, geometry, and basic calculus.

Course Objectives: The objectives encompass the wide range of knowledge and skills that students are expected to gain from a Discrete Mathematics course. The more detailed objective of the course includes a solid understanding of foundational concepts in Discrete Mathematics; Grasp Boolean algebra, simplify Boolean expressions, understand binary arithmetic, truth tables and applications in digital circuit design; Build a strong foundation for advanced courses in theoretical computer science, algorithms and cryptography; Consider ethical implications of solving problems and applying Discrete Mathematics concepts.

Course Learning Outcomes: The learning outcomes capture the comprehensive knowledge and skills that students are expected to acquire after completing this course. Upon completing the course, students should be able to:

1. Recognize discrete mathematics' application in computer science, including algorithms, data structures, and formal languages.
2. Demonstrate proficiency in simplifying Boolean expressions and Boolean Functions.
3. Work with propositional and predicate logic, construct truth tables, and utilize quantifiers for logical reasoning.
4. Build a strong foundation for advanced courses in areas like algorithm design, theory of computation, and cryptography.
5. Identify and apply Discrete Mathematics concepts in computer science, algorithms, data structures, and apply logical reasoning and analytical skills to solve complex problems in various areas.
6. Consider ethical implications when solving problems and applying Discrete Mathematics in real-world contexts.

Unit I: Propositions and compound statements, Basic logical operations, Propositions and truth tables, Tautologies and Contradictions, Logical Equivalence .
(4.1 to 4.6 of [1])

Unit II: Algebra of Propositions, Conditional Propositions, Biconditional Propositions, Propositional Functions, Quantifiers, Negation of Quantified Statements.
(4.7 to 4.11 of [1])

Unit III: Boolean Algebra: Boolean Functions, Boolean Expressions and Boolean Functions, Duality, Sum-of-Products Expression, Minimal Sum-of-Products, Prime Implicants.
(15.1,15.2,15.3,15.4,15.8,15.9 of [1])

Reference Books:

1. Theory and Problems of Discrete Mathematics, S. Lipschutz and M. L. Lipson, Schaum's Outline Series, Third Edition, McGraw-Hill, New Delhi, 2007.

2. Discrete Mathematics and its Applications, Kenneth H. Rosen, Eighth Edition, McGraw-Hill, New York, 2019.

3. Discrete Mathematics, B. S. Vatssa, Third Edition, Wishwa Prakashan, New Delhi, 2002.

Teaching Plan: The teaching plan may be followed as:

Weeks 1 and 2: Fundamental theory, Propositions and compound statements, and Basic logical operations.
Weeks 3 and 4: Propositions and truth tables, Tautologies and Contradictions, and Logical Equivalence.
Weeks 5, 6 and 7: Algebra of Propositions, Conditional Propositions, and Biconditional Propositions.
Weeks 8 and 9: Propositional Functions, Quantifiers, and Negation of Quantified Statements.
Weeks 10, 11 and 12: Boolean Functions, Boolean Expressions and Boolean Functions.
Weeks 13 and 14: Duality, Sum-of-Products Expression, Minimal Sum-of-Products, and Prime Implicants.
Week 15: Discussion about learning outcomes of the course.

SHRI GOVIND GURU UNIVERSITY
Syllabus for B. Sc. Semester II (Mathematics)
BS23MD2MT1 Multidisciplinary: Geometry (Theory)
Hours: 2 /week **Credits: 2**

Prerequisite: Plane Geometry (Geometry in $\mathbb{R}^2$).

Course Objectives: The geometry course typically aims to provide students with a well-rounded understanding of geometry, from fundamental concepts to practical applications that ensure they acquire a comprehensive understanding of geometric principles. The main objective of this course is to develop their problem-solving and analytical thinking skills within a geometric context that deals with the properties, measurements, and relationships of points, lines, angles, surfaces, and solids.

Course Learning Outcomes: The learning outcomes of this course outline the skills and knowledge that students are expected to gain by the end of the course. The below-mentioned learning outcomes collectively reflect the acquisition of a comprehensive set of skills and knowledge in geometry, emphasizing both theoretical understanding and practical application. Upon completing the course, students should be able to:

1. Develop a strong foundational understanding of basic geometric concepts, including points, lines, planes, angles, surfaces, and solids.
2. Demonstrate competence in circular geometry, understanding the properties of the sphere, cone, and cylinder.
3. Apply geometric concepts to real-world situations, solving practical problems in architecture, art, engineering, and other fields.
4. Develop analytical thinking skills, the ability to critically analyze geometric relationships, the ability to enhance logical reasoning and deduction skills.
5. Effectively communicate geometric ideas and solutions, both in written and oral form.
6. Demonstrate mastery in problem-solving by applying geometric principles to solve a variety of challenging problems.

Syllabus:
Unit I: Definition of a sphere, Cartesian equation of a sphere, General equation of a sphere, Equation of a sphere with diametrically opposite end points, Equation of a sphere through a given circle, Intersection of a sphere with Line, Intersection of a sphere with plane, Intersection of a sphere with sphere (No theory but only problems), Equation of a tangent and normal plane to a sphere, Orthogonal spheres.

Unit II: Definition of cone, Homogeneous equation of cone, right circular cone, Equation of envelope of cone, Problems on cone, Definition of cylinder, Homogeneous equation of cylinder, right circular cylinder, Equation of envelope of cylinder, Problems on cylinder.

Reference Books:

1. Analytical solid geometry - Shanti Narayan, S.Chand & Company

2. Co-ordinate Geometry By : R.J.T. Bell

3. Solid Geometry(three dimension) - H. K. Das, S. C. Saxena and Raisinghania, S. Chand.

4. Coordinate Geometry of Two and Three Dimension, P. Balasubramanyam, et. al. , Tata Mc Graw Hill Publ. Co., 1994.

Teaching Plan: The teaching plan may be followed as:
Weeks 1 and 2: Definition of a sphere, Cartesian equation of a sphere, General equation of a sphere.
Weeks 3 and 4: Equation of a sphere with diametrically opposite end points, Equation of a sphere through a given circle.
Weeks 5, 6 and 7: Intersection of a sphere with Line, Intersection of a sphere with plane, Intersection of a sphere with sphere (No theory but only problems), Equation of a tangent and normal plane to a sphere, Orthogonal spheres.
Weeks 8 and 9: Definition of cone, Homogeneous equation of cone, right circular cone.
Weeks 10, 11 and 12: Equation of envelope of cone, Problems on cone, Definition of cylinder, Homogeneous equation of cylinder, right circular cylinder.
Weeks 13 and 14: Equation of envelope of cylinder, Problems on cylinder.
Week 15: Discussion about learning outcomes of the course.

Multidisciplinary: Geometry (Practical)

Hours: 4 /week **Credits: 2**

Number of Practicals: 08

List of Practicals: 08

1. Problems on Cartesian equation and General equation of a sphere.
2. Equation of a sphere with diametrically opposite end points, Equation of a sphere through a given circle, Intersection of a sphere with Line.
3. Problems on Intersection of a sphere with plane, Intersection of a sphere with sphere.
4. Problems on Equation of a tangent and normal plane to a sphere, Orthogonal spheres.
5. The mutual relations among Cartesian, Cylindrical and Spherical coordinate system in $\mathbb{R}^3$ and transformation equation from one system to another system.
6. Problems on equation of a cone with conic as guiding curve and enveloping cone of a sphere.
7. Problems on cone.
8. Problems on Cylinder.

Reference Books:

1. Analytical solid geometry - Shanti Narayan, S.Chand & Company
2. Co-ordinate Geometry By : R.J.T. Bell
3. Solid Geometry(three dimension) - H. K. Das, S. C. Saxena and Raisinghania, S. Chand.
4. Coordinate Geometry of Two and Three Dimension, P. Balasubramanyam, et. al. , Tata Mc Graw Hill Publ. Co., 1994.

SHRI GOVIND GURU UNIVERSITY
Syllabus for B. Sc. Semester II (Mathematics)
BS23MJ2MT1 Major-1: Analysis-I (Theory)
Major-1: Analysis-I (Theory)

Hours: 4 /week **Credits: 4**

Prerequisite: Basic set theory, basic properties of real numbers, knowledge of trigonometry, knowledge of functions.

Course Objectives: The specific objectives of this course are to enrich the students with a deep and nuanced understanding of the fundamental principles and techniques in the study of real numbers, calculus, and complex numbers. More precisely, students are expected to develop a rigorous understanding of the properties of real numbers; explore the convergence and divergence of sequences and series; develop proficiency in constructing and understanding mathematical proofs; Provide a solid foundation for more advanced courses in mathematics, such as complex analysis; Enhance written and oral communication skills in presenting mathematical ideas and proofs.

Course Learning Outcomes: The learning outcomes capture the comprehensive knowledge and skills that students are expected to acquire after completing this course. Upon completing the course, students should be able to:

1. Demonstrate a thorough understanding of the properties of real numbers.
2. Analyze the convergence and divergence of sequences and series.
3. Demonstrate critical thinking and abstract reasoning skills in analyzing and solving mathematical problems.
4. Communicate mathematical ideas and proofs effectively, both in writing and orally.
5. Foster independence in learning and problem-solving, encouraging exploration of additional topics, build a foundation for more advanced mathematics courses, such as complex analysis or functional analysis.

Syllabus:

Unit I: Real Numbers

Algebraic properties of real numbers, Order structure of real numbers, Intervals, Bounded and unbounded Sets, Supremum and infimum, Non-Completeness of $\mathbb{Q}$, Archimedean property of real numbers.
(2.1 to 4.2 of Chapter-1 of [1])

Unit II: Real Sequences

Sequences, Bounded and unbounded Sequences, Limit point of a sequence, Convergent sequences, Convergence of monotonic real sequences, Cauchy sequences, Cauchy criterion for convergence of real sequences, Algebra of convergent sequences.

Unit III: Infinite Series of Real Numbers

Convergence and divergence of an infinite series, Necessary condition for convergence, Cauchy criterion for convergence of series, Tests for convergence of positive term series, Applications of the integral test, Comparison tests, D'Alembert's ratio test, Cauchy's root test, Alternating series, Leibniz alternating series test, Absolute and conditional convergence.

Unit IV: Introduction to Complex Number
Algebraic properties of complex numbers, Complex conjugate, Exponential form, Products and powers in complex Form, Arguments of products and quotients, Roots of complex numbers, Regions in complex plane.
(1.2 to 1.10 of [4])

Reference Books:

1. Mathematical Analysis (5th Edition) - S. C. Malik, Savita Arora, New age international publishers

2. Elements of Real Analysis - Charles G. Denlinger, Jones nad Bartlett publishers.

3. Introduction to Real Analysis - Robert G. Bartle and Donald R. Sherbert, Wiley Student Edition

4. Complex variables and applications (8th Edition) - R. V. Churchill, J. W. Brown, McGraw-Hill Higher Education.

Teaching Plan: The teaching plan may be followed as:
Weeks 1 and 2: Algebraic properties of real numbers, Order structure of real numbers, Intervals
Weeks 3 and 4: Bounded and unbounded Sets, Supremum and infimum, Non-Completeness of $\mathbb{Q}$, Archimedean property of real numbers.
Weeks 5, 6 and 7: Sequences, Bounded and unbounded Sequences, Limit point of a sequence, Convergent sequences, Convergence of monotonic real sequences.
Weeks 8 and 9: Cauchy sequences, Cauchy criterion for convergence of real sequences, Algebra of convergent sequences.
Weeks 10, 11 and 12: Convergence and divergence of an infinite series, Necessary condition for convergence, Cauchy criterion for convergence of series, Tests for convergence of positive term series.
Weeks 13 and 14: Applications of the integral test, Comparison tests, D'Alembert's ratio test, Cauchy's root test, Alternating series, Leibniz alternating series test, Absolute and conditional convergence.
Week 15: Discussion about learning outcomes of the course.

SHRI GOVIND GURU UNIVERSITY
Syllabus for B. Sc. Semester II (Mathematics)
BS23MJ2MT2 Major-2: Analysis-I (Practical)
Major-2: Analysis-I (Practical)

Hours: 8 /week **Credits: 4**

Number of Practicals: 16

List of Practicals:

1. Problems on difference of properties of $\mathbb{N}, \mathbb{Z}, \mathbb{Q}$ and $\mathbb{R}$.
2. Problems on intervals and boundedness of subsets of $\mathbb{R}$.
3. Problems on Supremum and Infimum.
4. Problems on absolute value of real numbers.
5. Examples on Limit point of a sequence.
6. Examples on Convergence of Sequences.
7. Examples on Cauchy Sequences and Cauchy Criterion for Convergence of Real Sequences.
8. Problems on monotonic sequences.
9. Examples on Comparison tests.
10. Examples on D'Alembert's ratio test.
11. Examples on Cauchy's root test.
12. Problems on Leibniz alternating series test.
13. Problems on Algebraic Properties of Complex Numbers, Complex Conjugate.
14. Problems on Exponential Form, Products and Powers in Complex Form.
15. Problems on Roots of Complex Numbers.
16. Problems on Arguments of Products and Quotients and Regions in complex plane.

Reference Books:

1. Mathematical Analysis (5th Edition) - S. C. Malik, Savita Arora, New age international publishers
2. Elements of Real Analysis - Charles G. Denlinger, Jones nad Bartlett publishers.
3. Introduction to Real Analysis - Robert G. Bartle and Donald R. Sherbert, Wiley Student Edition
4. Complex variables and applications (8th Edition) - R. V. Churchill, J. W. Brown, McGraw-Hill Higher Education.

SHRI GOVIND GURU UNIVERSITY
Choice Based Credit System (CBCS)
Syllabus for B. Sc. Semester II (Mathematics)
BS23MN2MT1 Minor : Calculus-II(Theory)

Hours: 2 /week **Credits: 2**

Prerequisite: Basic calculus (derivatives and integration of functions on one variable)

Course Objectives: The objectives of introducing this course to enrich the students with the necessary skills and knowledge to apply calculus in solving real-world problems, to prepare them for more advanced mathematics, to enhance their critical thinking and analytical reasoning abilities, to learn the definition of a derivative and understand the interpretation of derivatives as rates of change, and to enhance written and oral communication skills in presenting mathematical ideas and solutions.

Course Learning Outcomes: The learning outcomes of a calculus course reflect the skills and knowledge that students are expected to acquire by the end of the course. These outcomes demonstrate the practical application of calculus principles and the development of analytical and problem-solving skills. Upon completing the course, students should be able to:

1. Apply the concept of derivatives to solve problems involving rates of change and optimization, and interpret and analyze the significance of derivatives in various contexts.
2. Apply calculus concepts to model and solve real-world problems in various disciplines.
3. Develop analytical thinking skills and the ability to critically analyze problems and solutions.
4. Develop a solid foundation for more advanced courses in mathematics that build upon calculus concepts.
5. Discuss and consider ethical implications related to the application of calculus in various contexts.

Syllabus:
Unit I: Mean Value Theorems
Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem, Geometric interpretations and applications of these theorems, Increasing and decreasing functions.

Unit II: Indeterminate Forms and series expansion of functions
L'Hospital's rule, Definition of Indeterminate forms, Indeterminate forms ($0/0, \infty/\infty, 0.\infty,$ $\infty - \infty, 0^{\infty}$) (9.1 to 9.5 and 10.1 to 10.6 of [1]),
Taylor's and Maclaurin's Theorems and their applications (8.1, 8.2, 8.5, 6.1 and 6.2 of [1]).

Reference Books:

1. Differential Calculus - Shanti Narayan, P.K. Mittal, S. Chand and Co.
2. Calculus and Analytic Geometry - G. B. Thomas and R. L. Finney. Pearson Education. Indian Reprint.
3. Calculus - James Stewart, Sixth edition.

4. Calculus and Matrix algebra - Sanjay K. Patel, Bhikhalal P. Patel, Haribhai R. Kataria and Bhikha L. Ghodadra, University granth nirman board, Ahmedabad.

Teaching Plan: The teaching plan may be followed as:
Weeks 1 and 2: Rolle's Theorem, Lagrange's Mean Value Theorem.
Weeks 3, 4 and 5: Cauchy's Mean Value Theorem, Geometric interpretations and applications of these theorems.
Weeks 6 and 7: Increasing and decreasing functions.
Weeks 8 and 9: L'Hospital's rule, Definition of Indeterminate forms.
Weeks 10, 11 and 12: Indeterminate forms ($0/0, \infty/\infty, 0.\infty, \infty - \infty, 0^{\infty}$).
Weeks 13 and 14: Taylor's and Maclaurin's Theorems and their applications.
Week 15: Discussion about learning outcomes of the course.

Minor: Calculus-II (Practical)

Hours: 4 /week **Credits: 2**

Number of Practicals: 08

1. Examples on Verify Rolle's Theorem and its application.
2. Examples on Verify Lagrange's Mean Value Theorem and its application.
3. Examples on Verify Cauchy's Mean Value Theorem and its application.
4. Examples on Increasing and decreasing functions.
5. Problems on Indeterminate forms - I ($0/0, \infty/\infty, 0.\infty$ and $\infty - \infty$).
6. Problems on Indeterminate forms - II ($0^\infty, 1^\infty$ and ∞^∞).
7. Problems on Taylor's Theorem.
8. Examples of Maclaurin series expansion of some trigonometric and logarithmic functions.

Reference Books:

1. Differential Calculus - Shanti Narayan, P.K. Mittal, S. Chand and Co.
2. Calculus and Analytic Geometry - G. B. Thomas and R. L. Finney. Pearson Education. Indian Reprint.
3. Calculus - James Stewart, Sixth edition.
4. Calculus and Matrix algebra - Sanjay K. Patel, Bhikhalal P. Patel, Haribhai R. Kataria and Bhikha L. Ghodadra, University granth nirman board, Ahmedabad.

SHRI GOVIND GURU UNIVERSITY
Syllabus for B. Sc. Semester II (Mathematics)
BSC23SE206 Skill Enhancement Course: Introductory Calculus
Hours: 2 /week **Credits: 2**

Prerequisite: Basic set theory, trigonometry, algebra.

Course Objectives: The introductory calculus course is introduced to enrich the students with a foundational understanding of calculus concepts and their applications. The course objectives collectively aim to provide students with a strong foundation in calculus, understand the interpretation of derivatives as rates of change, apply derivatives to solve real-world problems, and prepare them for more advanced mathematical studies and applications in various disciplines. This course is also useful for science stream students who have not learned mathematics at the HSC level.

Course Learning Outcomes: The learning outcomes of this course are to reflect the comprehensive understanding of introductory calculus, specific skills, and knowledge that students are expected to acquire by the end of the course. The below-mentioned outcomes emphasize the practical application of calculus principles and the development of analytical and problem-solving skills. Upon completing the course, students should be able to:

1. Demonstrate a thorough understanding of limits and continuity.
2. Apply derivatives to solve real-world problems, and interpret and communicate the meaning of derivatives in various contexts.
3. Develop analytical thinking skills and the ability to critically analyze problems and solutions.
4. Present mathematical ideas and solutions clearly and use appropriate mathematical notation and language.
5. Discuss and consider ethical implications related to the application of calculus in various contexts.
6. Students with majors in chemistry, physics, or biological sciences will have more confidence to solve problems involving mathematics in their field of study.

Syllabus:
Unit I: Functions, Inverse of a function, Exponential and Logarithmic function, Trigonometric functions, Graphs of some known functions Limit & continuity of a function.

Unit II: Definition of the derivative, Basic rules of derivatives, Derivatives of known functions, Chain rule, Examples of use of differentiation (see Chapter 4 of [3]).

Reference Books:

1. Calculus - James Stewart, Sixth edition.
2. Class 11,12 Mathematics, Gujarat State Board of School Textbooks, Gandhinagar.
3. Calculus for Biology and Medicines (4th Edition), Neuhauser, Claudia, Pearson.
4. Differential Calculus - Shanti Narayan, P.K. Mittal, S. Chand and Co.

Teaching Plan: The teaching plan may be followed as:
Weeks 1 and 2: Functions, Inverse of a function.
Weeks 3 and 4: Exponential and Logarithmic function, Trigonometric functions.
Weeks 5, 6 and 7: Graphs of some known functions Limit & continuity of a function.
Weeks 8 and 9: Definition of the derivative, Basic rules of derivatives.
Weeks 10, 11 and 12: Derivatives of known functions, Chain rule.
Weeks 13 and 14: Examples of use of differentiation.
Week 15: Discussion about learning outcomes of the course.