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.