Enclosure – III

Shree Manibhai Virani & Smt. Navalben Virani Science College (Autonomous)
Department of Mathematics

Core 1 (Theory) For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: **Mathematics**	Offered to: **B.Sc. Mathematics**	
Semester – I		
Course Code	Course Title	Course Credit and Hours
21UMTCC101	**Core 1: Differential Calculus(F)**	**3 Credits – 3 hrs/wk**

Course Description:

This course deals with the fundamental aspects of differential calculus. The learners are benefited with this course as a progress to the broad areas of calculus. This course is designed to introduce learners with some concepts of single variable calculus. Differential calculus including its applications and it provides the learners with proficiency and skills of working with limits and continuity of any real valued function of single variables. It introduces the learners with the advance concepts of mean value theorems and its deductions.

Course Purpose:

This course aims to provide basic understanding of calculus. This is designed in such a way that learners will able to compute the higher order derivatives of given functions and the applications of derivatives to solve a variety of problems and it will develop learner's skills required for problem solving. The purpose of this course is to provide the learners with proficiency in differential calculus.

Course Outcomes: Upon completion of this course, the learner will be able to

CO No.	**CO Statement**	**Blooms taxonomy Level (K_1 to K_6)**
CO_1	Recognize and Interpret the deductions of various mean value theorems for differentiable functions.	K1, K2
CO_2	Describe the methods of finding Curvature, Asymptotes and Singular points.	K1, K2
CO_3	State and prove Leibnitz rule and implement the rule to compute the n^{th} derivative of given functions.	K1 and K4
CO_4	Verify the existence of limit and calculate the limit, if exists, of single variable function and utilize the concept of limit to verify the continuity of single variable function.	K3
CO_5	Apply the L Hospital's rule for limits to calculate the limit of function of single variable.	K3
CO_6	Derive the series expansion of a given function.	K3

Course Content	Hours
Unit-I: Limit and continuity of functions of one variable	**9 hrs**
• Limit and continuity. • Properties of limits. • Properties of continuous function. • Discontinuity. • Types of Discontinuity.	
Unit-II: Successive differentiation	**9 hrs**
• Successive differentiation $e^{(ax+b)},\ a^{bx},\ (ax+b)^m,\ \log(ax+b),\ \sin(ax+b),\ \cos(ax+b),$ $e^{ax}\sin(bx+c),\ e^{ax}\cos(bx+c)$ • Leibnitz's theorem and its applications.	
Unit- III: Mean value theorems and Taylor's theorem	**9 hrs**
• Mean value theorems and its geometrical interpretations. • Increasing and decreasing functions. • Expansion of functions using Taylor's Series and Maclaurin's series • Expansions of standard functions, method of inversion. • Expansion of a function by method of differentiation or integration. • Method of expansion of implicit function by Maclaurin's series.	
Unit- IV: Indeterminate Forms	**9 hrs**
• Indeterminate Forms including $\frac{0}{0},\ \frac{\infty}{\infty},\ 0\times\infty,\ \infty-\infty,\ 0^0\ ,\infty^0\ ,1^\infty$ • L' Hospitals Rules for above indeterminate forms.	
Unit- V: Curvature, asymptotes and multiple points	**9 hrs**
• Various formulae for curvature (formulae for Cartesian coordinates, parametric equations and Polar coordinates only). • Newton's method for curvature at origin. • Concavity, Convexity and point of inflexion. • Asymptotes parallel to co-ordinate axes. • Oblique type and algebraic methods. • Rules for finding asymptotes. • Multiple points, Types of double points.	

Pedagogic tools:

- Chalk and Board
- Power point presentation
- Seminars
- Videos
- Online resources
- Mathematical Software.

Text books:

1. George B. Thomas, Joel Hass, Christopher Heil, Maurice D. Weir, (May 2018) *Thomas' Calculus* 14th Edition Pearson Education.
2. Howard Anton (January 2015), *Calculus,* 10ed, Wiley India Pvt. Ltd

Reference books:

1. James Stewart, (2018), *Calculus*, 9th Edition, Brooks Cole.
2. M. J. Strauss, G. L. Bradley and K. J. Smith, (2007), *Calculus* (3rd Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.
3. S. C. Arora and Ramesh Kumar, (2016), *A Text book of Calculus*, Pitamber Publishing Company Ltd. Delhi.

Suggested reading / E-resources:

1. https://ocw.mit.edu/courses/find-by-topic/#cat=mathematics&subcat=calculus
2. https://math.mit.edu/academics/undergrad/major/course18/general.php
3. https://www.vmi.edu/media/contentassets/documents/academics/appliedmath/calculus

Suggested MOOCs:

1. https://nptel.ac.in/courses/111/106/111106146/
2. https://onlinecourses.nptel.ac.in/noc21_ma60/preview

Methods of assessing the course outcomes

Components of CIE: 30 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1st 2 units	$1^{1/2}$ hours	5 (Set for 30)	20
	Test 2	All 5 units	3 hours	15 (Set for 70)	
B	Assignment			04	10
C	Class activity			06	
				Grand Total	**30**

Assignment	• Problem formulation and its analysis. • Notes to be written by the learner on the different topics in the syllabus. • Book Review • Chapter review
Class activity	• Quiz • Class Test • Seminars • Group Discussion • Concept based questions.

Note: Any other assessment tools or methods can be adopted as per requirement of the course

Shree Manibhai Virani & Smt. Navalben Virani Science College (Autonomous)
Department of Mathematics

Core 2 (Theory) For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: **Mathematics**	Offered to: **B.Sc. Mathematics**	
Semester – I		
Course Code	Course Title	Course Credit and Hours
21UMTCC102	**Core 2: Matrix Algebra (F)**	**3 Credits – 3 hrs/wk**

Course Description:

This is a course in an elementary linear algebra. Linear algebra is the theory of vectors, matrices and linear transformations. Linear algebra is a key tool in many parts of pure and applied mathematics. This course focuses on some fundamental concepts of matrix algebra which is a part of linear algebra. This course introduces learners to matrices, its different types and operation on matrices, rank of the matrices and related results, Cayley Hamilton theorem and inverse of matrix using Cayley Hamilton theorem, applications of matrices and diagonalization of a matrix.

Course Purpose:

This course aims to provide basic understanding of Matrix Theory. This is designed in such a way that learners will able to understand the basic and some advanced methods of matrix algebra. Learners will be able to define and utilize the concept of matrix, understand the concept of rank of a matrix and compute the rank of a given matrix. Solve the systems of linear equations using concept of matrix and elementary row operations, understand and utilize the elementary row operations to obtain echelon forms of given matrix. Find eigen values, eigen vectors and characteristic equation of a matrix. Compute any power of a given matrix. This course is necessary to understand and learn basic and some advanced topics of linear algebra.

Course Outcomes: Upon completion of this course, the learner will be able to

CO No.	**CO Statement**	**Blooms taxonomy Level (K_1 to K_6)**
CO_1	Define and utilize the concept of matrix.	K_1
CO_2	Recognize the concept of Rank of a matrix and compute the rank of a given matrix.	K_1, K_2
CO_3	Recognize and utilize the elementary row operation to obtain echelon forms of given matrix and solve the systems of linear equations using concept of matrix.	K1, K_3
CO_4	Perform the process of the diagonalization and compute any power of a given matrix.	K_2, K_3
CO_5	Calculate Eigen values and obtain inverse using Cayley Hamilton theorem.	K_3

Course Content	Hours
Unit-I : Concept of a matrix	**9 hrs**
• Introduction to matrices. • Different types of matrices. • Operations on matrices. • Theorems on matrices. • Elementary operations on matrices and types of matrices. • Symmetric and skew - symmetric matrices. • Hermitian and skew - Hermitian matrices. • Adjoint of a matrix. • Inverse of a matrix.	
Unit-II: Rank and determinant of a matrix	**9 hrs**
• Linear dependence and independence of row and column matrices. • Row rank, column rank and rank of a matrix. • Row Reduced Echelon form of a matrix and matrix inversion using it • Determinant of a matrix and rank using it. • Properties of determinant.	
Unit- III: Cayley-Hamilton theorem	**9 hrs**
• Eigen values, Eigen vectors and the characteristic equation of a matrix. • Cayley-Hamilton theorem and its use in finding inverse of a matrix.	
Unit- IV: Application of matrices	**9 hrs**
• Application of matrices in solving a system of simultaneous linear equations. • Theorem of consistency of system of simultaneous linear equations. • Gauss elimination method. • Gauss Jordan method. • Cramer's rule. .	
Unit- V: Diagonalization of a matrix	**9 hrs**
• Similar matrices- Definition and properties. • Diagonalizable matrix. • To find power of a matrix by using Diagonalization. • To find power of a matrix by using Cayley-Hamilton Theorem.	

Pedagogic tools:

- Chalk and Board
- Power point presentation
- Seminar
- Videos
- Online resources
- Mathematical Software.

Text books:

1. David C. Lay, (2017), Linear *Algebra and its Applications*, 4rd Edition, Pearson Education Asia, Indian Reprint.
2. Howard Anton and Chris Rorres, (2014), *Elementary Linear Algebra*, 11th Edition, Wiley.

Reference books:

1. Seymour Lipschutz and Marc Lars Lipson, (2018), *Linear Algebra (Schaum's Outline Series)*, 9th Edition, Mc Graw Hill Education.
2. V. Krishnamurthy, V. P. Mainra and J. L. Arora, (2005), *Introduction to Linear Algebra,* Affiliated East-West Press Pvt. Ltd.-New Delhi.

Methods of Assessment & Tools:

Components of CIA: 30 marks (Example as below)

Suggested reading / E-resources:

1. http://math.mit.edu/~gs/linearalgebra/
2. https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/index.htm
3. http://joshua.smcvt.edu/linearalgebra/book.pdf
4. https://www.vmi.edu/media/contentassets/documents/academics/appliedmath/Fundamentals-of-Matrix-Algebra-3rd-Edition.pdf
5. https://open.umn.edu/opentextbooks/textbooks/fundamentals-of-matrix-algebra

Suggested MOOCs:

1. https://nptel.ac.in/courses/111/106/111106051/
2. https://onlinecourses.nptel.ac.in/noc20_ma08/preview

Methods of assessing the course outcomes

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1st 2 units	1 1/2 hours	5 (Set for 30)	20
	Test 2	All 5 units	3 hours	15 (Set for 60)	
B	Assignment			04	10
C	Class activity			06	
				Grand Total	**30**

Assignment	• Problem formulation and its analysis. • Problem Solving • Notes written by the learner on the different topics in the syllabus. • Book Review • Chapter review …
Class activity	• Surprise Quiz • Quiz • Seminar • Situation based question etc..

Note: Any other assessment tools or methods can be adopted as per requirement of the course.

Shree Manibhai Virani & Smt. Navalben Virani Science College (Autonomous)
Department of Mathematics

Core Practical 1 For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: **Mathematics**	Offered to: **B.Sc. Mathematics**	
Semester – I		
Course Code	Course Title	Course Credit and Hours
21UMTCC103	**Core Practical 1: Practical on Differential Calculus and Matrix Algebra (including mathematical software)**	**6 Credits – 12 hrs/wk**

Course Description:

This course is an introduction to the use of mathematical software in differential calculus and matrix algebra. Although mathematics is still largely taught as a pen-and-paper subject, this approach ignores the important role of the computing technology. With advancement in the information technology very powerful and useful mathematical software became available which are useful to understand and visualize the mathematical concepts. This course will introduce learners to a broad but coherent collection of open-source software tools, and to diverse examples of its usage deal with the problems Differential Calculus and Matrix Algebra.

Course Purpose:

This course aims to provide basic understanding of Differential Calculus and Matrix Algebra using open-source mathematical software. In this course learners will able to visualize various concepts of differential calculus and matrix algebra. Moreover, this course also helps to enhance computer skills of the learners.

Course Outcomes: Upon completion of this course, the learner will be able to

CO No.	**CO Statement**	**Blooms taxonomy Level (K_1 to K_6)**
CO_1	Recognize the domain and range of given functions including polynomials, and hyperbolic functions and plot graph of the same through mathematical software.	S1
CO_2	Utilize the mathematical software to visualize limits & continuity and L-Hospital Rule to calculate the limit of function of single variable.	S2
CO_3	Recognize the importance of the Cayley-Hamilton theorem to find the inverse of the given matrix and utilize mathematical software to work-out the problems of Matrices.	S1, S3

CO_4	Obtain the expansions as well as interpret those expansions graphically with the help of different tools of mathematical software.	S2, S3
CO_5	Utilize direct methods including Gauss elimination method, Gauss Jordan method and Cramer's rule to solve the system of linear equations and find any power of a matrix by Diagonalization and Cayley Hamilton theorem.	S3

List of Practicals

Sr.	Experiments	Hrs
1	Plotting of graphs of function of type the greatest integer function, even and odd positive integer.	6
2	Plotting of graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.	6
3	Plotting of graphs of Hyperbolic functions.	6
4	Examples based on limit.	6
5	Examples based on continuity.	6
6	Examples based on L'Hospital rule.	6
7	Expansions of functions in infinite power series using Taylor's and McLaurin's formula	6
8	Problems based on mean value theorem.	6
9	Problems based on Radius of curvature.	6
10	Problems based on Asymptotes.	6
11	Problems based on multiple points.	6
12	Find Row Reduced Echelon form.	6
13	Find rank of a Matrix.	6
14	Solve the system of simultaneous linear equation by using Gauss elimination method.	6
15	Solve the system of simultaneous linear equation by using Gauss Jordan method.	6
16	Find inverse of a Matrix by using Gauss Jordan method.	6
17	Solutions of system of linear equations using Cramer's rule.	6
18	Verify the Cayley-Hamilton theorem.	6
19	Find eigen value and eigen vector of a Matrix.	6
20	Find inverse of a Matrix by using Cayley-Hamilton theorem.	6

Pedagogic tools:

- Chalk and Board
- Power point presentation
- Handouts
- Computer
- Videos / Online Resources

Text books:

- Hohenwarter J. and Hohenwarter M. (2011), *Introduction to GeoGebra*, International GeoGebra Institute.
- Das V. (2008), *Programming in Scilab*, New Age International (P) Limited.
- Baudin M. (2010), *Introduction to Scilab*, Consortium Scilab.

Reference books:

1. James Stewart, (2018), *Calculus*, 9th Edition, Brooks Cole.
2. M. J. Strauss, G. L. Bradley and K. J. Smith, (2007), *Calculus* (3rd Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.
3. S. C. Arora and Ramesh Kumar, (2016), *A Text book of Calculus*, Pitamber Publishing Company Ltd. Delhi.
4. David C. Lay, (2017), *Linear Algebra and its Applications*, 4rd Edition, Pearson Education Asia, Indian Reprint.
5. Howard Anton and Chris Rorres, (2014), *Elementary Linear Algebra*, 11th Edition, Wiley.
6. V. Krishnamurthy, V. P. Mainra and J. L. Arora, (2005), *Introduction to Linear Algebra,* Affiliated East-West Press Pvt. Ltd.-New Delhi.
7. Hohenwarter J. and Hohenwarter M. (2012), *The official manual of GeoGebra*, International GeoGebra Institute.
8. Roux P. (2016), *Scilab from theory to practice*, D-Booker editions.
9. Affouf M. (2012), *Scilab by example*, Create Space Independent Publishing Platform.

Suggested reading / E-resources:

1. https://www.extension.harvard.edu/academics/courses/introduction-mathematics
2. https://www.maths.cam.ac.uk/

Suggested MOOCs:

1. https://ocw.mit.edu/courses/mathematics/7-01sc-fundamentals-of-mathematics-fall-2011/mathematics/
2. https://swayam.gov.in/course/4017-mathematics

Methods of Assessment & Tools:

Components of CIE: 40 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1-10 Experiments	$1\frac{1}{2}$hours	15	30
	Test 2	11-20 Experiments	$1\frac{1}{2}$hours	15	
B	Attendance and Regularity			5	10
C	Class activity			5	
				Grand Total	**40**
Class activity	• Surprise Quiz • Quiz • Situation based question				

Note: Any other assessment tools or methods can be adopted as per requirement of the course.