# COURSE DATA SHEET

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| **SEMESTER** | **I** | **BATCH** | **2026-2029** |
| **COURSENAME** | **MATHEMATICS FOR DATA SCIENCE** | **COURSE CODE** | **26UMAGE1E04** |
| **COURSE UNITS** | **5** | **COURSE TYPE** | **GENERIC ELECTIVE -I** |
| **CONTACT HOURS (L-T-P)** | **4-2-0** | **CREDITS** | **4** |
| **OFFERED BY** | **MATHEMATICS** | **SHIFT-(I/II) Shift-I-8.15am - 12.50pm Shift-II-1.00pm to 5.30pm** | **II** |

| **COURSE OBJECTIVES** | |
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| 1 | Introduce the fundamental concepts of matrices and Eigen values/Eigenvectors with applications. |
| 2 | Familiarize students with vector spaces and linear transformations. |
| 3 | Develop calculus skills involving differentiation for solving optimization and evaluation problems. |
| 4 | Provide knowledge of numerical techniques to solve algebraic, transcendental, and linear systems of equations. |
| 5 | Introduce interpolation methods for approximating unknown values using numerical techniques. |

**COURSE OUTCOMES: On completion of the course the students will be able to…**

| | **CO Statement** | **Cognitive Level** |
|---|---|---|
| **CO1** | Understand and apply the concepts of matrices, Eigen values, and Eigen vectors in solving real-world problems. | **K1-K5 (Understand and Apply)** |
| **CO2** | Demonstrate understanding of vector spaces and perform operations involving linear transformations. | **K1-K5 (Understand and Apply)** |
| **CO3** | Apply differentiation techniques to solve problems involving maxima, minima. | **K1-K4 (Understand, Apply and Analyze)** |
| **CO4** | Use numerical methods like Bisection, Newton-Raphson, and Gauss elimination to solve equation | **K1-K5 (Understand, Apply,** |

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| | | **Analyze and Evaluate)** |
| **CO5** | Employ interpolation techniques (Newton's and Lagrange's) to estimate missing or unknown values in datasets. | **K1-K5 (Understand, Apply, Analyze and Evaluate)** |

## SYLLABUS

| UNIT | TOPICS | HOURS |
|---|---|---|
| **1** | **Matrices:** Matrices: Symmetric, Skew-Symmetric, Orthogonal, Hermetian, Skew-Hermetian and Unitary matrices. Eigen values and Eigen-vectors, Cayley-Hamilton theorem (without proof) – verification- Computation of inverse of matrix using Cayley - Hamilton theorem.<br><br>**Vol I-Chapter 4: Section 4.1.1 to 4.1.6,4.5, 4.5.2, 4.5.3. (Omit 4.5.1)** | **15** |
| **2** | **Differentiation :**Successive Differentiation-nth derivative – standard results (except $e^{ax}\sin(bx+c)$, $e^{ax}\cos(bx+c)$) ,Leibnitz theorem(Without proof), Jacobian, Maxima and Minima of functions of two independent variables- Simple problems.<br><br>**Chapter 1: Section 1.1.1 to 1.2 & 1.3.1** | **15** |
| **3** | **Differential Equations**:Ordinary Differential Equations: Second order non-homogeneous differential equations with constant coefficients of the for $ay''_{\alpha}+by'+cy=X$ where X is of the form $e^{ax}\cos\beta x$ and $e^{ax}\sin\beta x$ -Related problems only.<br><br>Partial Differential Equations: Formation, complete integrals and gene ndard solving Lagrange's linear equation $Pp+Qq=R$.<br><br>**Vol-II-Chapter5: Section 5.2.1,**<br>**Chapter 6: Section 6.1 & 6.4** | **15** |
| **4** | **Numerical Solution of Equations**: Solutions of Algebraic and Transcendental Equations: Bisection method, Newton-Raphson's method.<br>Solution of Simultaneous Linear Algebraic Equations:<br>Gauss elimination, Gauss – Jordan elimination (no derivations, no proofs).<br>**Chapter 3: Section 3.3, 3.5.**<br>**Chapter 4: Section 4.3, 4.4** | **15** |

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| **5** | **Numerical Interpolation :** Interpolation with unequal intervals- Divided differences and their properties, Newton's divided difference formula for interpolation, Lagrange's formula for interpolation, Lagrange's formula for Inverse interpolation (no derivations, no proofs).<br><br>**Chapter 7: Sections7.3 to7.6** | **15** |
| **Note (if any)** | Definitions and simple problems from all units may be asked in section A | **75 Hours** |

**TEXT/REFERENCE BOOKS/E - RESOURCES:**

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| **Text Books** | 1. P. Duraipandian, S. Udayabaskaran. Allied Mathematics: Volume I and II. 2022, S. Chand Publications.<br>2. S. Arumugam, A. Thangapandi Isaac, A. Somasundaram. Numerical Methods. Scitech Publications (India) Pvt. Ltd., 2015. |
| **Books For Reference** | 1. P. Kandasamy, K. Thilagavathy. Mathematics – I, II., S. Chand & Company Pvt. Ltd. Reprint: 2004<br>2. P. R. Vittal, V. Malini. Algebra and Trigonometry., Margham Publications., Reprint: 2007<br>3. E. Balagurusamy. Numerical Methods. McGraw-Hill Education, 2017.<br>4. S. Satteluri, R. K. Iyengar, R. K. Jain. Numerical Methods. New Age International (P) Ltd. Publishers, 2020.<br>5. Seymour Lipschutz and Marc Lipson. *Schaum's Outline of Linear Algebra*. 5th Edition, McGraw-Hill Education, 2017. |
| **E-Learning Resources** | 1. https://www.khanacademy.org/math/linear-algebra/alternate-bases/eigen-everything/v/linear-algebra-introduction-to-eigenvalues-and-eigenvectors<br>2. https://www.khanacademy.org/math/differential-equations<br>3. https://www.sjsu.edu/me/docs/hsu-Chapter%2010%20Numerical%20solution%20methods.pdf<br>4. https://stemez.com/subjects/maths/SNumericalAnalysis/SNumericalAnalys.php<br>5. https://byjus.com/reduction-formula/ |

**PEDAGOGY(TEACHING METHODOLOGY)**:

- Chalk & Talk
- LCD/SMART Boards
- Student Assignments/Student Seminars/Quizzes
- MCQ
- NPTEL/Others - Add-on-courses
- Web Resources

- Group Activities / Peer Teaching
- Flipped Classroom

| CO-PO AND CO-PSO MAPPING: | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | **3** | **2** | **2** | **1** | **2** | **1** | | **2** | **1** | **3** |
| **CO2** | **3** | **2** | **2** | **1** | **2** | **1** | | **2** | **1** | **3** |
| **CO3** | **2** | **3** | **1** | **1** | **2** | **1** | | **1** | **1** | **2** |
| **CO4** | **2** | **2** | **3** | **1** | **2** | **1** | | **3** | **2** | **2** |
| **CO5** | **2** | **2** | **3** | **1** | **2** | **1** | | **3** | **2** | **2** |
| **Average (Use only filled in cells for calculation)** | **2.4** | **2.2** | **2.2** | **1.0** | **2.0** | **1.0** | | **2.0** | **1.0** | **2,2** |

**Correlation Level:** **1-Low 2-Moderate 3-Strong**

| JUSTIFICATION OF CO-PO/PSO MAPPING | | | |
|---|---|---|---|
| **CO** | **PO/PSO** | **Level of correlation** | **Justification** |
| **CO1** | PO1 | **3** | Applies concepts of matrices, Eigenvalues and Eigenvectors confidently to solve mathematical and computational problems. |
| | PO2 | **3** | Develops logical reasoning by analyzing matrix properties and interpreting mathematical results. |
| | PO3 | **3** | Uses matrix techniques to develop computational solutions for data-driven and societal problems. |
| | PO4 | **3** | Builds programme-centric mathematical knowledge required for higher studies in Data Science. |
| | PO5 | **3** | Encourages lifelong learning by applying linear algebra concepts in emerging computational technologies. |
| | PO6 | **3** | Demonstrates discipline, accuracy and ethical responsibility while performing mathematical computations. |
| | PSO1 | **3** | Develops competency in the fundamental concepts of linear algebra. |
| | PSO2 | **3** | Applies matrix techniques in computational and analytical applications. |
| | PSO3 | **3** | Strengthens analytical and computational skills required for research and employability. |
| **CO2** | PO1 | **3** | Applies concepts of vector spaces and linear transformations to solve mathematical problems confidently. |
| | PO2 | **3** | Analyzes vector operations using logical reasoning to interpret mathematical relationships. |
| | PO3 | **3** | Develops computational models using vector spaces and linear transformations. |
| | PO4 | **3** | Enhances programme-specific mathematical competency for advanced studies. |
| | PO5 | **3** | Promotes continuous learning through applications of vector algebra in modern computing. |
| | PO6 | **3** | Demonstrates systematic and ethical practices while solving mathematical problems. |
| | PSO1 | **3** | Strengthens competence in vector algebra and linear transformations. |
| | PSO2 | **3** | Applies vector concepts in computational and mathematical modelling. |

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| | PSO3 | **3** | Develops analytical thinking and problem-solving abilities for research and employability. |
| **CO3** | PO1 | **2** | Applies differentiation techniques to solve optimization problems effectively. |
| | PO2 | **2** | Evaluates maxima and minima using logical reasoning and analytical thinking. |
| | PO3 | **2** | Applies optimization methods to formulate mathematical solutions for practical problems. |
| | PO4 | **2** | Provides programme-specific knowledge essential for higher studies involving optimization. |
| | PO5 | **2** | Enhances lifelong learning through applications of differential calculus in emerging fields. |
| | PO6 | **2** | Demonstrates accuracy and responsibility while solving optimization problems. |
| | PSO1 | **2** | Builds the foundation of differential calculus for advanced mathematics. |
| | PSO2 | **2** | Applies optimization techniques in computational mathematics. |
| | PSO3 | **2** | Develops analytical and problem-solving skills for data-driven applications. |
| **CO4** | PO1 | **2** | Applies numerical methods to solve algebraic and linear systems efficiently. |
| | PO2 | **2** | Analyzes numerical algorithms and interprets approximate solutions logically. |
| | PO3 | **2** | Develops computational solutions for real-world problems using numerical algorithms. |
| | PO4 | **2** | Strengthens mathematical competency required for advanced computational studies. |
| | PO5 | **2** | Promotes lifelong learning through numerical computing and algorithmic techniques. |
| | PO6 | **2** | Demonstrates ethical practices and systematic approaches in numerical computation. |
| | PSO1 | **2** | Builds strong competency in numerical methods and computational mathematics. |
| | PSO2 | **2** | Applies numerical algorithms in data analysis and scientific computing. |
| | PSO3 | **2** | Enhances analytical and computational problem-solving skills. |
| **CO5** | PO1 | **2** | Applies interpolation techniques to estimate unknown values accurately. |
| | PO2 | **2** | Evaluates interpolation methods and selects suitable approximation techniques using logical reasoning. |
| | PO3 | **2** | Develops mathematical models for prediction and estimation using interpolation methods. |
| | PO4 | **2** | Supports programme-specific knowledge required for higher studies in numerical analysis. |
| | PO5 | **2** | Encourages continuous learning through predictive numerical techniques used in Data Science. |

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| | PO6 | **2** | Demonstrates responsibility, precision and ethical practices while estimating numerical values. |
| | PSO1 | **2** | Strengthens competency in numerical approximation and interpolation techniques. |
| | PSO2 | **2** | Applies interpolation methods in computational mathematics and data analysis. |
| | PSO3 | **2** | Develops modelling and analytical skills required for research and data science applications. |