I Semester

Course Title: **Mathematics-I for Computer Science and Engineering stream** [As per Choice Based Credit System (CBCS) scheme] (From the academic year 2022-23)				

Course Code	22MATS11	CIE Marks	50
Credits	04	SEE Marks	50
Course Type	Integrated		
Contact Hours/Week (L-T-P)	2-2-2	Total Marks	100
Contact Hours of Pedagogy	40 hours Theory +10 or 12 Lab slots	Exam Hours	03

Course objectives: The goal of the course **Mathematics-I for Computer Science and Engineering stream** (**22MATS11**) is to

- **Familiarize** the importance of calculus associated with one variable and multivariable for computer science and engineering.
- **Analyze** computer science and engineering problems by applying Ordinary Differential Equations and Integral calculus .
- **Apply** the knowledge of modular arithmetic to computer algorithms.
- **Develop** the knowledge of Linear Algebra to solve the system of equations.

Module-1 Calculus   (6L+3T)

Introduction to polar coordinates and curvature relating to Computer Science and engineering.

   Polar coordinates, Polar curves, angle between the radius vector and the tangent, angle between two curves. Pedal equations. Curvature and Radius of curvature - Cartesian, Parametric, Polar and Pedal forms. Simple Problems.

Self-study: Center and circle of curvature, evolutes and involutes.

Applications: Computer graphics, Image processing.

(RBT Levels: L1, L2 and L3)

Module-2 Series Expansion and Multivariable Calculus   (6L+3T)

Introduction of series expansion and partial differentiation in Computer Science & Engineering applications.

   Taylor's and Maclaurin's series expansion for one variable (Statement only) − problems. Indeterminate forms – L'Hospital's rule-Problems.

Partial differentiation, total derivative - differentiation of composite functions. Jacobian and problems. Maxima and minima for a function of two variables. Problems.

Self-study: Euler's theorem and problems. Method of Lagrange's undetermined multipliers with single constraint
Applications: Series expansion in computer programming, Errors and approximations, calculators

(RBT Levels: L1, L2 and L3)

Module-3 Ordinary Differential Equations (ODEs) of first order   (5L+3T)

Introduction to first-order ordinary differential equations pertaining to the applications for Computer Science & Engineering.

Linear and Bernoulli's differential equations. Exact and reducible to exact differential equations, Integrating factors on $\dfrac{1}{N}\left(\dfrac{\partial M}{\partial y}-\dfrac{\partial N}{\partial x}\right)$ and $\dfrac{1}{M}\left(\dfrac{\partial N}{\partial x}-\dfrac{\partial M}{\partial y}\right)$. Orthogonal trajectories, L-R & C-R circuits. Problems.

Non-linear differential equations: Introduction to general and singular solutions, Solvable for p only, Clairaut's equations, reducible to Clairaut's equations. Problems.

Self-Study: Applications of ODEs, Solvable for x and y.

Applications of ordinary differential equations: Rate of Growth or Decay2

(RBT Levels: L1, L2 and L3)

Module-4 Integral Calculus   (6L+2T)

Introduction to Integral Calculus in Computer Science & Engineering.

Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Applications to find Area and Volume by double integral. Problems.
Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions. Simple Problems.
Self-Study: Center of gravity, Duplication formula.

Applications: Antenna and wave propagation, Calculation of optimum value in various geometries. Analysis of probabilistic models.

(RBT Levels: L1, L2 and L3)

	Module-5 Linear Algebra	**(5L+3T)**

Introduction of linear algebra related to Computer Science & Engineering.

    Elementary row transformation of a matrix, Rank of a matrix. Consistency and Solution of system of linear equations - Gauss-elimination method, Gauss-Jordan method and approximate solution by Gauss-Seidel method. Eigenvalues and Eigenvectors, Rayleigh′s power method to find the dominant Eigenvalue and Eigenvector.

Self-Study: Solution of system of equations by Gauss-Jacobi iterative method. Inverse of a square matrix by Cayley- Hamilton theorem.

Applications: Boolean matrix, Network Analysis, Markov Analysis, Critical point of a network system. Optimum solution.

(RBT Levels: L1, L2 and L3)

List of Laboratory experiments (2 hours/week per batch/ batch strength 15)
10 lab sessions + 1 repetition class + 1 Lab Assessment

1	2D plots for Cartesian and polar curves
2	Finding angle between polar curves, curvature and radius of curvature of a given curve
3	Finding partial derivatives, Jacobian and plotting the graph
4	Applications to Maxima and Minima of two variables
5	Solution of first-order differential equation and plotting the graphs
6	Program to compute surface area, volume and centre of gravity
7	Evaluation of improper integrals
8	Numerical solution of system of linear equations, test for consistency and graphical representation
9	Solution of system of linear equations using Gauss-Seidel iteration
10	Compute eigen values and eigen vectors and find the largest and smallest eigen value by Rayleigh power method.

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Suggested software's: Mathematica/MatLab/Python/Scilab

Semester End Examination (SEE):

Theory SEE will be conducted by Institute as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO 1	apply the knowledge of calculus to solve problems related to polar curves and learn the notion of partial differentiation to compute rate of change of multivariate functions
CO 2	analyze the solution of linear and nonlinear ordinary differential equations
CO 3	Apply the concept of change of order of integration and variables to evaluate multiple integrals and their usage in computing area and volume.
CO 4	make use of matrix theory for solving for system of linear equations and compute eigen values and eigenvectors
CO 5	familiarize with modern mathematical tools namely MATHEMATICA/MATLAB/ PYTHON/ SCILAB

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)
Text Books

1. **B. S. Grewal**: ″Higher Engineering Mathematics″, Khanna publishers, 44th Ed., 2021.

2. **E. Kreyszig**: ″Advanced Engineering Mathematics″, John Wiley & Sons, 10th Ed., 2018.

Reference Books

1. **V. Ramana:** ″Higher Engineering Mathematics″ McGraw-Hill Education, 11th Ed., 2017

2. **Srimanta Pal & Subodh C. Bhunia**: ″Engineering Mathematics″ Oxford University Press,3rd Ed., 2016.

3. **N.P Bali and Manish Goyal**: ″A textbook of Engineering Mathematics″ Laxmi Publications, 10th Ed., 2022.

4. **C. Ray Wylie, Louis C. Barrett:** ″Advanced Engineering Mathematics″ McGraw – Hill Book Co., Newyork, 6th Ed., 2017.

5. **Gupta C.B, Sing S.R and Mukesh Kumar:** ″Engineering Mathematic for Semester I and II″, Mc-Graw Hill Education(India) Pvt. Ltd 2015.

6. **H. K. Dass and Er. Rajnish Verma:** ″Higher Engineering Mathematics″ S. Chand Publication, 3rd Ed., 2014.

7. **James Stewart: "**Calculus″ Cengage Publications, 7th Ed., 2019.

8. **David C Lay:** ″Linear Algebra and its Applications″, Pearson Publishers, 4th Ed., 2018.

9. **Gareth Williams:** ″Linear Algebra with applications″, Jones Bartlett Publishers Inc., 6th Ed., 2017.

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Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning
- Quizzes
- Assignments
- Seminar

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