

## II Semester

### Course Title: **Mathematics-II for Computer Science and Engineering stream**

[As per Choice Based Credit System (CBCS) scheme]

(From the academic year 2022-23)

Course Code	22MATS21	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-II for Computer Science and Engineering stream (22MATS21)** is to

- **Familiarize** the importance Vector calculus.
- **Learn** vector spaces and linear transformations.
- **Develop** the knowledge of numerical methods and apply them to solve transcendental and differential equations..

### Teaching-Learning Process

#### Pedagogy (General Instructions):

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self-study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
  - As an introduction to new topics (pre-lecture activity).
  - As a revision of topics (post-lecture activity).
  - As additional examples (post-lecture activity).
  - As an additional material of challenging topics (pre-and post-lecture activity).
  - As a model solution of some exercises (post-lecture activity).

## Module-1 Vector Calculus

(6L+3T)

### Introduction to Vector Calculus in Computer Science & Engineering.

Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems.

**Curvilinear coordinates:** Scale factors, base vectors, Cylindrical polar coordinates, Spherical polar coordinates, transformation between cartesian and curvilinear systems, orthogonality. Problems.

**Self-Study:** Volume integral.

**Applications:** Conservation of laws, Electrostatics, Analysis of streamlines.

(RBT Levels: L1,L2 and L3)

## Module-2 Ordinary Differential Equations of higher order

(6L+3T)

### Importance of higher-order ordinary differential equations in Computer Science & Engineering applications.

Higher-order linear ODEs with constant coefficients - Inverse differential operator, method of variation of parameters, Cauchy' s and Legendre' s homogeneous differential equations - Problems.

**Self-Study:** Formulation and solution of Cantilever beam. Finding the solution by the method of undetermined coefficients.

**Applications:.**

(RBT Levels: L1, L2 and L3)

## Module-3 Vector Space and Linear Transformations

(6L+2T)

### Importance of Vector Space and Linear Transformations in the field of Computer Science & Engineering.

**Vector spaces:** Definition and examples, subspace, linear span, Linearly independent and dependent sets, Basis and dimension. Problems.

**Linear transformations:** Definition and examples, Algebra of transformations, Matrix of a linear transformation. Change of coordinates, Rank and nullity of a linear operator, rank-nullity theorem. Inner product spaces and orthogonality. Problems.

**Self-study:** Angles and Projections. Rotation, reflection, contraction and expansion.

**Applications:** Image processing, AI & ML, Graphs and networks, computer graphics.

**(RBT Levels: L1, L2 and L3)**

**Module-4 Numerical methods -1**

**(5L+3T)**

**Importance of numerical methods for discrete data in the field of computer science & engineering.**

Solution of algebraic and transcendental equations - Regula-Falsi and Newton-Raphson methods (only formulae). Problems.

Finite differences, Interpolation using Newton's forward and backward difference formulae, Newton's divided difference formula and Lagrange's interpolation formula (All formulae without proof). Problems.

**Numerical integration:** Trapezoidal, Simpson's (1/3)<sup>rd</sup> and (3/8)<sup>th</sup> rules (without proof). Problems.

**Self-Study:** Bisection method, Lagrange's inverse Interpolation.

**Applications:** Estimating the approximate roots, extremum values, Area, volume, and surface area. Errors in finite precision.

**(RBT Levels: L1, L2 and L3)**

**Module-5 Numerical methods -2**

**(5L+3T)**

**Introduction to various numerical techniques for handling Computer Science & Engineering applications.**

**Numerical Solution of Ordinary Differential Equations (ODE's):** Numerical solution of ordinary differential equations of first order and first degree – Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictor-corrector formula (No derivations of formulae). Problems.

**Self-Study:** Adam-Bashforth method.

**Applications:** Estimating the approximate solutions of ODE.

**(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	Finding gradient, divergent, curl and their geometrical interpretation
2	Solutions of Second-order ordinary differential equations with initial/boundary conditions
3	Solution of a differential equation of oscillations of a spring/deflection of a beam with different loads
4	Computation of basis and dimension for a vector space and Graphical representation of linear transformation
5	Visualization in time and frequency domain of standard functions
6	Solution of algebraic and transcendental equations by Regula-Falsi and Newton-Raphson method
7	Interpolation/Extrapolation using Newton's forward and backward difference formula
8	Computation of area under the curve using Trapezoidal, Simpson's (1/3) <sup>rd</sup> and (3/8) <sup>th</sup> rule
9	Solution of ODE of first order and first degree by Taylor's series and Modified Euler's method
10	Solution of ODE of first order and first degree by Runge-Kutta 4 <sup>th</sup> order and Milne's predictor-corrector method

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

**Course outcome (Course Skill Set)**

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

CO 1	Understand the applications of vector calculus refer to solenoidal, and irrotational vectors. Orthogonal curvilinear coordinates
CO 2	Analyze the solution of higher order ordinary differential equations..
CO 3	Demonstrate the idea of Linear dependence and independence of sets in the vector space and linear transformation
CO 4	Apply the knowledge of numerical methods in analysing the discrete data and solving the physical and engineering problems.
CO 5	Get familiarize with modern mathematical tools namely MATHEMATICA/ MATLAB /PYTHON/ SCILAB

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the

total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

### **Continuous Internal Evaluation (CIE):**

#### **Two Unit Tests each of 20 Marks (duration 01 hour)**

- First test after the completion of 30-40 % of the syllabus
- Second test after completion of 80-90% of the syllabus

One Improvement test before the closing of the academic term may be conducted if necessary. However best two tests out of three shall be taken into consideration.

#### **Two assignments each of 10 Marks**

The teacher has to plan the assignments and get them completed by the students well before the closing of the term so that marks entry in the examination portal shall be done in time. Formative (Successive) Assessments include Assignments/Quizzes/Seminars/ Course projects/Field surveys/Case studies/ Hands-on practice (experiments)/Group Discussions/ others. The Teachers shall choose the types of assignments depending on the requirement of the course and plan to attain the COs and POs. (to have a less stressed CIE, the portion of the syllabus should not be common/repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course). CIE methods /test question paper is designed to attain the different levels of Bloom' s taxonomy as per the outcome defined for the course.

#### **The sum of two tests, two assignments, will be out of 60 marks and will be scaled down to 30 marks CIE for the practical component of the Integrated Course**

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.

- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and **scaled down to 15 marks**.

- The laboratory test (**duration 02/03 hours**) at the end of the 14<sup>th</sup>/15<sup>th</sup> week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and **scaled down to 05 marks**.

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

### **Semester End Examination (SEE): SEE for IPCC**

Theory SEE will be conducted by University 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.

**The theory portion of the Integrated Course shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).**

**Passing standard:**

- The minimum marks to be secured in CIE to appear for SEE shall be 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than 30 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify for the SEE. Marks secured will be scaled down to 50.

**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, 44<sup>th</sup> Ed., 2021.
2. **E. Kreyszig:** “Advanced Engineering Mathematics” , John Wiley & Sons, 10<sup>th</sup> Ed., 2018.

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1. **V. Ramana:** “Higher Engineering Mathematics” McGraw-Hill Education, 11<sup>th</sup> Ed., 2017
2. **Srimanta Pal & Subodh C. Bhunia:** “Engineering Mathematics” Oxford University Press, 3<sup>rd</sup> Ed., 2016.
3. **N.P Bali and Manish Goyal:** “A textbook of Engineering Mathematics” Laxmi Publications, 10<sup>th</sup> Ed., 2022.
4. **C. Ray Wylie, Louis C. Barrett:** “Advanced Engineering Mathematics” McGraw - Hill Book Co., Newyork, 6<sup>th</sup> 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, 3<sup>rd</sup> Ed., 2014.
7. **James Stewart:** “Calculus” Cengage Publications, 7<sup>th</sup> Ed., 2019.
8. **David C Lay:** “Linear Algebra and its Applications” , Pearson Publishers, 4<sup>th</sup> Ed., 2018.

9. **Gareth Williams:** “Linear Algebra with applications. Jones Bartlett Publishers Inc.6<sup>th</sup> 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://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

**COs and POs Mapping (Individual teacher has to fill up)**

COs	POs					
CO1						
CO2						
CO3						
CO4						
CO5						

**Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped**