K. S. INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU, Approved by AICTE

Department of Mathematics

FIRST SEMESTER SYLLABUS

Course : **Applied Mathematics-I for CSE Stream: Calculus And Linear Algebra**		Semester	I
Course Code	**25BMACS101**	CIE Marks	50
Teaching Hours/Week(L:T:P:S)	3:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory+20 Hours Tutorials	Total Marks	100
Credits	04	Exam Hours	03
Examination type(SEE)	**Theory**		

Course Objectives (Course Skill Set)

The goal of the course **Applied Mathematics-I for CSE Stream** is to

1. **Familiarize** the importance of calculus associated with one variable and multivariable for computer science and engineering.
2. **Analyze** Computer science and engineering problems by applying Ordinary Differential Equations.
3. **Learn** vector spaces and linear transformations**.**
4. **Develop** the knowledge of Linear Algebra to solve the system of equations.

Module-1: Calculus

Partial differentiation, Euler's theorem for homogeneous functions, total derivative -differentiation of composite functions, Jacobian.

Statement of Taylor's and Maclaurin's series expansion for two variables. Maxima and minima for the function of two variables.

(Text 1: Ch-5(5.1, 5.2, 5.3, 5.4, 5.5(1), 5.7(1), 5.9, 5.11)

Number of Hours: 8 Hours Theory+4 Hours Tutorials

Module-2: Vector Calculus

Scalar and vector fields, Gradient, directional derivatives, divergence and curl - physical interpretation, solenoidal vector fields, irrotational vector fields and scalar potential.

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

(Text 1: Ch-8(8.4 to 8.7, 8.18, 8.19 to 8.21))

Number of Hours: 8 Hours Theory+4 Hours Tutorials

Module-3: System of Linear Equations, Eigenvalues and Eigenvectors

Elementary row transformation of a matrix, Echelon form, ranks of a matrix.

Consistency and solution of system of linear equations, Gauss elimination method, Gauss Jordan method. Applications: Traffic flow.

Eigenvalues and Eigenvectors, modal matrix, diagonalization of the matrix.

(Text 1:Ch-2(2.7, 2.10, 2.13, 2.14, 2.16), Ch-28(28.6(1, 2),

Text 2: Ch-4(4.0),Ch-8(8.1), Ch-7(7.3(Problem21))

Number of Hours: 8 Hours Theory+4 Hours Tutorials

Module-4: Vector Space
Vector spaces: definition and examples, subspace: definition and examples. Linear Combinations, linear span, linearly independent and dependent sets, basis and dimension. Row space and column space of a matrix, Coordinates, inner products and orthogonality. (Text 3: Ch-4(4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.11), Ch-7(7.1, 7.2, 7.3, 7.5, 7.6)) **Number of Hours: 8 Hours Theory+4 Hours Tutorials**
Module-5: Linear Transformation
Definition and examples, algebra of linear transformations, matrix of a linear transformation. Singular, non-singular linear transformations and invertible linear transformations. Rank and nullity of linear transformations, rank-nullity theorem. Computer graphics (Rotation, scaling and projection) **(**Text 3: Ch-5(5.3, 5.4, 5.5, 5.6, 5.7**))** **Number of Hours: 8 Hours Theory+4 Hours Tutorials**
Course outcome (Course Skill Set) At the end of the course, the student will be able to: CO1: **Apply** the concepts of multivariable calculus and vector calculus to compute derivatives. CO2: **Analyze** vector fields by optimizing the functions for applications in computer science engineering. CO3: **Solve** system of linear equations and determine eigenvalues and eigenvectors using direct and iterative methods. CO4: **Apply** the concepts of vector spaces and linear transformations to problems in computer science engineering. CO5: **Demonstrate** the applications of computer science and allied engineering Science using modern ICT tools.
Suggested Learning Resources: **Books(Name of the author/Title of the Book/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. 3. Seymour Lipschutz and Marc Lipson, Linear Algebra, Schaum's outlines series, 4th Ed., 2008. **Reference books:** 1. B.V. Ramana, Higher Engineering Mathematics, McGraw-Hill Education, 11th Ed., 2017 2. N. P. Bali and Manish Goyal, A Textbook of Engineering Mathematics, Laxmi Publications, 10th Ed., 2022. 3. James Stewart, Calculus, Cengage Publications, 7th Ed., 2019. 4. David Poole, Linear Algebra, a modern introduction, Cengage publishers, 4th Ed., 2014. 5. David C Lay, Linear Algebra and its Applications, Pearson Publishers, 4th Ed., 2018. 6. Gareth Williams, Linear Algebra with applications, Jones Bartlett Publishers Inc., 6th Ed., 2017.
Web links and Video Lectures(e-Resources): • https://nptel.ac.in/courses/111105121 • https://nptel.ac.in/courses/111105122 • http://academicearth.org/ • VTU e-Shikshana Program • VTU EDUSAT Program • https://nptel.ac.in/courses/111106135 • https://nptel.ac.in/courses/111105160

- https://ocw.mit.edu/courses/18-06-linear-algebra-spring-2010/
- https://ocw.mit.edu/courses/18-02sc-multivariable-calculus-fall-2010/

Teaching-Learning Process (Innovative Delivery Methods)

The following are sample strategies that educators may adopt to enhance the effectiveness of the teaching learning process and facilitate the achievement of 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).

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

Continuous Internal Evaluation(CIE):

- Three Tests each of 25 Marks;
- 1st, 2nd, and 3rd tests shall be conducted after completion of the syllabus of 30-35%, 70-75%, and 90-100% of the course/s respectively. Average of three tests will be scaled down to 25 marks.
- Continuous Comprehensive Assessments will be conducted with a total of 25 marks. It is recommended to include a maximum of two learning activities aimed at enhancing the holistic development of students. These activities should align with course objectives and promote higher-order thinking and application-based learning.

  Learning Activity-1: Practicing problems (Lab Activities/Surprise Test/ Seminar for 15 Marks) Execute the following lab exercises with the aid of any modern technological tool

(Matlab/ Mathematica/ Scilab/ Python/ Maxima, etc).

Learning Activity-2: Assignments (Marks-10)

List of Lab Activities:

1) Finding partial derivatives and Jacobian,
2) Expansion of Taylor's and Maclaurin's series,
3) Finding Gradient, divergence and curl,
4) Finding rank, reduced echelon form, solving system of linear equations using Gauss elimination method,
5) Solving system of linear equations using Gauss-Jordan method,
6) Determine Eigenvalues and Eigenvectors,
7) Linearly Independence and Dependence sets,
8) Basis and dimension,
9) Linear transformation-range space and null space,
10) Verification of the rank nullity theorem.

Total CIE marks will be the sum of average of three tests (25 marks) and continuous comprehensive assessments (25 marks) which will be scaled down to50 marks.

Semester End Examination(SEE):

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

- The question paper shall be set for 100 marks. The medium of the question paper shall be English). The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.

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.

Suggested Learning Activities may include (but are not limited to):

- Course Project
- Case Study Presentation
- Programming Assignment
- Tool/Software Exploration
- Literature Review
- Open Book Test (preferably at RBL4 and RBL5 levels)
- GATE-based Aptitude Test
- Assignment (at RBL3, RBL4, or RBL5 levels)
- Any other relevant and innovative academic activity
- Use of MOOCs and Online Platforms

Suggested Innovative Delivery Methods may include (but are not limited to):

- Flipped Classroom
- Problem-Based Learning (PBL)
- Case-Based Teaching
- Simulation and Virtual Labs
- Partial Delivery of course by Industry expert/ industrial visits
- ICT-Enabled Teaching
- Role Play