PKM EDUCATIONAL TRUST®

R R Institute of
◆ RAJA REDDY LAYOUT, NEAR CHIKKABANAVARA RAILWAY STATION, CHIKKABANAVARA,

An Autonomous Institution under
Approved by AICTE, New Delhi & Government of

ACCREDITED
NAAC
NATIONAL ASSESSMENT AND ACCREDITATION COUNCIL
NATIONAL BOARD OF

DEPARTMENT OF BASIC SCIENCE (MATHEMATICS)
CSE STREAM

Course Title:	**Integral Calculus, Vector calculus & Numerical techniques**	Semester	**II**
Course Code:	**BMATS201**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:1:2:0	Exam Hours	03
Total Hours of Pedagogy	40 hours Theory + 10 to12 Lab slots	Credits	04

Course learning objectives: The goal of the course **Integral Calculus, Vector calculus & Numerical techniques** for Computer Science and Engineering stream is to

 CLO 1. Familiarize the importance of Integral calculus and Vector calculus.

 CLO 2. Learn vector spaces and linear transformations.

 CLO 3. 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 Integral Calculus (8 hours)

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. (Derivation and 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-2 Vector Calculus(8 hours)

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: Vector integration and Vector line integral.
Applications: Conservation of laws, Electrostatics, Analysis of streamlines.

Module-3 Vector Space and Linear Transformations(8 hours)

 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(without proof). 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(8 hours)

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)rd and (3/8)th 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(8 hours)

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. Program to compute area, surface area, volume and centre of gravity.
2. Evaluation of improper integrals.
3. Finding gradient, divergent, curl and their geometrical interpretation.
4. Computation of basis and dimension for a vector space and Graphical representation of linear transformation.
5. Computing the inner product and orthogonality.
6. Solution of algebraic and transcendental equations by Ramanujan's, 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)rd and (3/8)th 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 4th order and Milne's predictor-corrector method.

     Suggested software: Mathematica/MatLab /Python/Scilab

Course outcome (Course Skill Set)

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

1. Apply the concept of change of order of integration and variables to evaluate multiple integrals and their usage in computing area and volume.
2. Understand the applications of vector calculus refer to solenoidal, and irrotational vectors. Orthogonal curvilinear coordinates.
3. Demonstrate the idea of Linear dependence and independence of sets in the vector space, and linear transformation.
4. Apply the knowledge of numerical methods in analysing the discrete data and solving the physical and engineering problems.

CO 5. Familiarize with modern mathematical tools namely MATHEMATICA/ MATLAB /PYTHON/ SCILAB

Course Assessment and Evaluation Details (both CIE and SEE)

Continuous Internal Evaluation: 50 marks

Theory Assessment Tool	Marks	Reduced marks
IAT-1	50	15
IAT-2	50	
Assessment -1	10	10
Assessment -2(activity based)	10	
Lab Assessment Tool	**Marks**	**Reduced marks**
Conducting Experiment and Laboratory Record(10 labs)	15(each lab)	15
Lab Test	10	10

Semester End Examination (SEE) : 50 marks

SEE	Marks	Reduced marks
Course end examination (Answer any one question from each unit – Internal choice)	100	50

Suggested Learning Resources:

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

3. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed., 2017
4. **Srimanta Pal & Subodh C.Bhunia**: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016.
5. **N.P Bali and Manish Goyal**: "A Textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022.
7. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co., New York, 6th Ed., 2017.
8. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
9. **H. K. Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S. Chand Publication, 3rd Ed., 2014.
10. **James Stewart: "**Calculus" Cengage Publications, 7th Ed., 2019.
11. **David C Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4th Ed., 2018.
12. **Gareth Williams:** "Linear Algebra with Applications", Jones Bartlett Publishers Inc., 6th Ed., 2017.
13. **Gilbert Strang:** "Linear Algebra and its Applications", Cengage Publications, 4th Ed. 2022.
14. **William Stallings:** "Cryptography and Network Security" Pearson Prentice Hall, 6th Ed., 2013.
15. **Kenneth H Rosen:** "Discrete Mathematics and its Applications" McGraw-Hill, 8th Ed. 2019.
16. **Ajay Kumar Chaudhuri:** "Introduction to Number Theory"NCBA Publications, 2nd Ed., 2009.
17. **Thomas Koshy:** "Elementary Number Theory with Applications"Harcourt Academic Press, 2nd Ed., 2008.

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/

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

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1												
CO2												
CO3												
CO4												
CO5												

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