COURSE TITLE	**DIFFERENTIAL CALCULUS**
COURSE CODE	**01AI0101**
COURSE CREDITS	**5**

Objective:

1 This course aims to provide an essential background of differential calculus to students of engineering courses at graduate level. It will enhance the basic understanding of applications of Mathematics in Artificial intelligence and Machine learning.

Course Outcomes: After completion of this course, student will be able to:

1 Understand the concepts of infinite series and its convergence.

2 Understand the concepts of partial derivatives.

3 Apply the knowledge of partial derivatives for constrained and unconstrained optimization.

4 Comprehend Gradient descent method.

5 Understand the role of multiple integrals in finding area between two curves and volume of three-dimensional objects.

Pre-requisite of course: Algebra, Geometry, Trigonometry & Pre-Calculus (Maxima and Minima) till 12th Standard level

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	2	0	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Partial derivatives** Partial derivatives, Implicit functions, Total differentiation, Euler's theorem, Modified Euler's theorem and its Applications	10
2	**Infinite series** Convergence and Divergence, Comparison Test, Integral Test, Ratio Test, Root Test, Alternating Series, Absolute and Conditional Convergence, Taylor and Maclaurin's series expansion	8
3	**Applications of Partial differentiation and Optimization** Tangent plane and normal line to a surface, Jacobian, Multivariable optimization, local/global maxima and minima, Unconstrained optimization, Constrained optimization using Lagrange's multiplier, Kuhn-Tucker conditions	12
4	**Gradient descent algorithm** Introduction to Gradient, Directional derivatives, convex functions, Gradient descent algorithm for univariate and Bivariate convex differentiable functions	8

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Contents : Unit	Topics	Contact Hours
5	**Multiple Integrals** Double integrals, Properties of double integrals, Double integrals over general region, Double integrals in polar co-ordinates, Triple Integrals with constant limits, Change of Order of Integration, Jacobian of several variables, Change of variables	8
Total Hours		**46**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Partial derivatives** Examples related to Partial derivatives, Euler's theorem and Modified Euler's theorem	2
2	**Application of Partial differentiation and Optimization** Application of PD	2
3	**Infinite series** Infinite series	2
4	**Gradient descent algorithm** Gradient descent algorithm	2
5	**Multiple Integrals** Multiple Integrals	2
Total Hours		**10**

Textbook :

1 Calculus with Early Transcendental Functions, James Stewart, Cengage Learning, -

References:

1 Thomas' Calculus, Thomas' Calculus, Maurice D. Weir, Joel Hass, Frank R. Giordano, Pearson Education, -

2 Advanced Engineering Mathematics, Advanced Engineering Mathematics, Wylie & Barrett, McGraw Hill, -

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
20.00	40.00	40.00	0.00	0.00	0.00

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Instructional Method:

1. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc
2. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
3. Practical examination will be directed toward the completion of semester for assessment of performance of understudies in laboratory.
4. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

Supplementary Resources:

1. https://tutorial.math.lamar.edu/Classes/CalcI/CalcI.aspx
2. https://ocw.mit.edu/search/?d=Mathematics&s=department_course_numbers.sort_coursenum
3. http://calculus-help.com/tutorials/
4. http://mathworld.wolfram.com/

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