Semester I

Differential And Integral Calculus

Course Code	Teaching hours per week				Credits	Exam Hours	Course Type	CIE Marks	ESE Marks
	L	T	P	R					
26ANNBS101	2	1	0	0	3	2 Hrs. 30 Mins.	Theory	40	60

1. **Preamble:** This course introduces advanced concepts in multivariable calculus, differential equations and multiple integrals essential for engineering and scientific applications. It covers partial differentiation, gradients, optimization techniques, second-order differential equations, and methods of double and triple integration, providing students with analytical and problem-solving skills for mathematical modeling and advanced studies.

2. **Pre-requisites:** Basic knowledge in single variable calculus.

Syllabus

Module Number	Syllabus Description	Contact Hours
1	**Differential Calculus - 1:** Linearization, Concavity: The Second Derivative Test for Concavity, Functions of Several Variables, Limit and Continuity in Higher Dimensions, Partial derivatives, Higher Order Partial Derivatives, The Chain Rule and Implicit Differentiation. **[Relevant topics from Text 1 - Sections: 3.9, 4.4, 14.1,14.2,14.3,14.4]**	**9**
2	**Differential Calculus - 2:** Directional Derivatives and Gradient, Differentials (Tangent Planes excluded), Linearization, Local Extreme Values for Functions of Two Variables, Relative Extrema, Absolute Maxima and Minima on Closed Bound Regions, Lagrange multipliers with One Constraint. **[Relevant topics from Text 1 – Sections: 14.5, 14.6, 14.7,14.8]**	**9**
3	**Differential Equations:** Homogeneous Linear Ordinary Differential Equations of Second Order, Superposition Principle, Homogeneous Linear Ordinary Differential Equations of Second Order with Constant Coefficients, Wronskian – Linear Independence or Dependence of Solutions, Non-homogeneous Linear Ordinary Differential Equations (with Constant Coefficients) – General Solution, Particular Solution by the Method of Undetermined Coefficients (for the functions of the form	**9**

Module Number	Syllabus Description	Contact Hours
	ke^{ax}, kx^{n}, $ksin\,ax$, $k\cos ax$), Solution by Variation of Parameters. **[Relevant topics from Text 2 – Sections: 2.1, 2.2, 2.6, 2.7, 2.10]**	
4	**Multiple Integrals:** Double Integrals, Reversing the Order of Integration in Double Integrals, Evaluation of Double Integrals by Converting into Polar Coordinates, Area Using Double Integrals, Triple Integrals, Volume Using Triple Integrals. [**Relevant topics from Text 3 – Sections: 14.1, 14.2, 14.3, 14.5**]	**9**
	Total Hours	**36**

3. Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions.

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	60

4. Course Outcomes:

At the end of the course students should be able to:

Course Outcomes		Blooms Taxonomy Level
CO1	Apply concepts of Calculus to linearize functions, determine concavity, calculate limits of multivariable functions and partial derivatives.	K3
CO2	Apply the concept of directional derivatives and solve problems involving maxima and minima of multivariable functions.	K3
CO3	Solve homogeneous and non-homogeneous linear differential equations with constant coefficients.	K3
CO4	Apply the theoretical idea of multiple integrals to find areas and volumes of geometrical shapes.	K3

Note: *K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6- Create*

5. Mapping of Course Outcomes with Program Outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	-	-	-	-	-	-	2
CO2	3	3	2	2	-	-	-	-	-	-	2
CO3	3	3	2	2	-	-	-	-	-	-	2
CO4	3	3	-	2	-	-	-	-	-	-	2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), - : No Correlation

6. Text Books:

Sl. No.	Title of the Book	Name of the Author	Name of the Publisher	Edition and Year
1	Thomas' Calculus	Maurice D. Weir, Joel Hass, Christopher Heil, Przemyslaw Bogacki	Pearson	15/e, 2023
2	Advanced Engineering Mathematics	Erwin Kreyszig	John Wiley & Sons	10/e, 2016
3	Calculus: Early Transcendentals	H. Anton, I. Biven, S.Davis	Wiley	12/e, 2024

7. Reference Books

Sl. No.	Title of the Book	Name of the Author	Name of the Publisher	Edition and Year
1	Essential Calculus	J. Stewart	Cengage	2/e, 2017
2	Multivariable Calculus	Ron Larson, Bruce Edwards	Brooks/Cole, Cengage Learning	10/e, 2014
3	Calculus & Its Applications	Goldstein, Schneider, Lay, Asmar	Pearson	14/e, 2018
4	Bird's Higher Engineering Mathematics	John Bird	Taylor & Francis	9/e, 2021
5	Higher Engineering Mathematics	B. V. Ramana	McGraw-Hill Education	39/e, 2023

8. Video Links or any other Reference Materials:

Sl. No.	Details Like Weblink, Publication Details	Module
1	https://nptel.ac.in/courses/111106146	1
2	https://nptel.ac.in/courses/111107108	2
3	https://nptel.ac.in/courses/111107108	3
4	https://nptel.ac.in/courses/111107108	4

9. Model Question Paper

MODEL QUESTION PAPER			
FEDERAL INSTITUTE OF SCIENCE AND TECHNOLOGY (FISAT) (Autonomous) FIRST SEMESTER B. TECH DEGREE EXAMINATION (2026 Scheme)			
Course Code: 26ANNBS101 Course Name: Differential And Integral Calculus			
Programme : CSE/CSD			
Max. Marks: 60	**Duration: 2 hours 30 minutes**		
PART A			
	Answer all questions. Each question carries 3 marks	**CO**	**Marks**
1	Find the derivative of the function $f(x) = \frac{ln\,2x}{x^4}$.	1	(3)
2	Find the linearization of $f(x) = cos\,x$ at $x = \frac{\pi}{2}$.	1	(3)

3		Find the gradient of $f(x, y, z) = y\,ln(x + y + z)$ at (-4, 5,0)	2	(3)
4		If $z = 3x^2y^3$, where $x = t^4$ and $y = t^3$, find $\frac{dz}{dt}$.	2	(3)
5		Solve the ordinary differential equation $y'' - 5y' + 6y = 0$.	3	(3)
6		Show that the solutions of $y'' - 2y' + y = 0$ are linearly independent.	3	(3)
7		Evaluate $\int_1^a \int_1^b \frac{dxdy}{xy}$.	4	(3)
8		Evaluate $\int_0^{log3} \int_0^{log2} e^{x+2y} dx\,dy$.	4	(3)
PART B				
Answer any one full question from each module. Each question carries 9 marks				
Module 1				
9	a)	Find the domain and range of the function $f(x, y) = \frac{1}{\sqrt{16 - x^2 - y^2}}$.	1	(4)
	b)	Determine the concavity of the function $f(x) = x^3 - 3x^2 + 2$ and find the points of inflection.	1	(5)
10	a)	Find the first and second derivatives of the function $y = \frac{(x+1)(x^2+x+1)}{x^3}$.	1	(4)
	b)	Show that the point (2,4) lies on the curve $x^3 + y^3 - 9xy = 0$. Then find the tangent and normal to the curve there.	1	(5)
Module 2				
11	a)	Find the maximum and minimum values of the function $f(x, y) = 3x + 4y$ on the circle $x^2 + y^2 = 1$.	2	(4)
	b)	Find the partial derivatives of $f(x, y) = x^3y + 2x\,y^3$ and verify mixed derivative theorem.	2	(5)
Module 3				
13	a)	Solve $y'' + 2y' + 4y = 3\,e^{-x}$ by the method of undetermined coefficients.	3	(4)
	b)	Apply the method of variation of parameters to solve $\frac{d^2y}{dx^2} + 4y = 4\,sec^2x$.	3	(5)

14	a)	Suppose that $y_1 = e^{\lambda_1 x}$ and $y_2 = e^{\lambda_2 x}$ are 2 solutions of the second order differential equation of the form $y'' + p(x)y' + q(x)y = 0$. Show that they form a fundamental set of solutions if $\lambda_1 \neq \lambda_2$.	3	(4)
	b)	Solve the initial value problem $y'' + y' + 0.25y = 0$, $y(0) = 3$ and $y'(0) = -3.5$.	3	(5)
Module 4				
15	a)	Use polar coordinates evaluate the double integral $\iint_R e^{-(x^2+y^2)} dA$ where R is the region enclosed by the circle $x^2 + y^2 = 1$.	4	(3)
	b)	Change the order of integration in $\int_0^1 \int_{x^2}^{2-x} xy\, dy\, dx$ and evaluate.	4	(6)
16	a)	Evaluate $\int_0^1 \int_0^x \int_0^{x+y} (x + y + z) dz\, dy\, dx$.	4	(3)
	b)	Find the volume of the solid in the first octant bounded by the coordinate planes and the plane $x + 2y + z = 6$.	4	(6)

****