

**University of Information Technology & Sciences (UITS)**  
**Faculty of Science and Engineering**  
**Department of Computer Science & Engineering**  
**Program: B.Sc. in CSE**  
**Term Final Examination, Spring 2025**  
**Course Title: Differential & Integral Calculus**  
**Course Code: MATH 0541111**

Marks: 50

Time: 3(three) hours

(Answer all questions)

Q.No.	Questions	Marks
1.	<p>✓ a) Compute the intervals on which <math>f(x) = 3x^4 + 4x^3 - 12x^2 + 2</math> is increasing and the intervals on which is decreasing. [04]</p> <p>✓ b) State Mean value theorem. Verify Mean Value theorem for the function [04]</p> $f(x) = x^3 + x - 4, \quad [-1, 2].$	
	<p>✓ c) Determine the absolute maximum and minimum values of the function [02]</p> $f(x) = 2x^3 - 3x^2 - 12x, \text{ on the interval } [-2, 3].$	
2.	<p>✓ a) If <math>y = (\cos^{-1}x)^2</math> then using Leibnitz theorem show that [05]</p> $(1 - x^2)y_{n+2} - (2n + 1)xy_{n+1} - n^2y_n = 0.$	
	<p>✓ b) Define partial differential equation. If <math>v = \ln(x^3 + y^3 + z^3 - 3xyz)</math> then prove that, [05]</p> $x \frac{\partial v}{\partial x} + y \frac{\partial v}{\partial y} + z \frac{\partial v}{\partial z} = 3.$	
3.	<p>Compute the following indefinite integrals: [10]</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>✓ (i) <math>\int \frac{\cos x}{\sin x \sqrt{1 + \sin^2 x}} dx</math></p> <p>✓ (iii) <math>\int \frac{dx}{x^3 \sqrt{x^2 - 1}}</math></p> </div> <div style="text-align: center;"> <p>✓ (ii) <math>\int e^x \sin x dx</math></p> <p>✓ (iv) <math>\int \frac{dx}{\sqrt{10 - 6x + x^2}}</math></p> </div> </div>	
4.	<p>Compute the following definite integrals : [10]</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>(i) <math>\int_0^{\pi/2} \sin^6 x \cos^3 x dx</math></p> <p>(iii) <math>\int_0^{\ln 3} \int_0^{\ln 2} e^{x+y} dy dx</math></p> </div> <div style="text-align: center;"> <p>(ii) <math>\int_1^{\sqrt{2}} \frac{dx}{x^2 \sqrt{4 - x^2}} dx</math></p> <p>(iv) <math>\int_0^{1/2} \sin^{-1} x dx</math></p> </div> </div>	

5. a) Define Gamma and Beta function. Compute the following integrals by using Beta & Gamma function: [06]

(i)  $\int_0^1 x^4(1-x^2)^{3/2} dx$

(ii)  $\int_0^1 x(1-x)^{5/2} dx$

- b) Find the area which is enclosed by the curves [04]

$x = y^3, \quad x + y = 2, \quad y = 0.$