BRAC UNIVERSITY

Inspiring Excellence

Assignment 1 (Spring'24)

Integral Calculus & Differential Equations (MAT120)

For all the questions:

$$p = \text{Second digit of your ID}$$

$$q = \text{Last digit of your ID}$$

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1. (a) Find the value of the first and second derivative of the following functions at $x = \pi/3$ and $x = 2\pi/3$: (2)

$$f(x) = p^x e^{-\sin(x^p)} \qquad \text{and} \quad g(x) = \frac{q + \tan^p(x)}{1 + \cos^2(x)}$$

   (b) If $y = \sin(px)$,

   (a) then find the expression: $f = y_2 + 3y_1 - qy$; where, y_1 and y_2 are the 1^{st} & 2^{nd} derivative of y respectively. (1)

   (b) all the extrema of the expression f in the interval $x \in [-3\pi/2, 5\pi/2]$. Also, plot f and f' in the same graph for the given interval of x. (2)

2. (a) Given $\phi(x, y, z) = ax^3 + bx^2y - cz^3$, where a, b, and c are constants. Now evaluate the Laplacian at point $(2, -1, 1)$: (2)

$$\nabla^2\phi = \frac{\partial^2\phi}{\partial x^2} + \frac{\partial^2\phi}{\partial y^2} + \frac{\partial^2\phi}{\partial z}$$

   (b) Find the factorial of the number 13.7. (1)

   (c) Integrate using sympy: (1)

$$\int_0^{\pi/2} \frac{dx}{p^2\cos^2 x + (1+q)^2 \sin^2 x}$$

   (d) Consider an object is under the anharmonic force $F = -2x - 0.1x^3$. Find the work required to move it from $x = 0$ to $x = 2$. (1)

NB: Copied code will receive half marks.