**Mathematical Foundations**

**Instructions**

Please share your answers wherever applicable in-line with the word document. Submit code separately wherever applicable. Mathematical calculations which are manually performed should be uploaded with a picture along with the explanation in a word document.

Please ensure you update all the details:

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**Topic: Mathematical Foundations**

**Note: Submit pictures of mathematical calculations**

**Guidelines:**

**1. An assignment submission is considered complete only when correct and executable code(s) are submitted along with the documentation explaining the method and results. Failing to submit either of those will be considered an invalid submission and will not be considered as correct submission.**

**2. Ensure that you submit your assignments correctly and in full. Resubmission is not allowed.**

**3. Post the submission you can evaluate your work by referring to keys provided. (will be available only post the submission).**

**Problem Statements**

Q1) Find the maximum and minimum values of the function: x3 - 3x2 - 9x + 12

**Answers -> Let function be y = x3 - 3x2 - 9x + 12.**

**Finding the first derivative y’ = 3x2-6x-9 and equating it to zero.**

**y’ = 0, 3x2-6x-9 = 0, 3(x2-2x-3) = 0, x2-2x-3=0, x2-3x+x-3 = 0, x(x-3)+(x-3) = 0,**

**x-3 = 0, x+1 = 0. Therefore, x = 3 or x = -1 are the critical values. 3 being max value and -1 being minimum.**

**Finding the second derivative to find the maximum and minimum values.**

**y’’ = 6x – 6 = 0, Substituting the x values.**

**6(3)-6 = 12> 0 is the maximum value and 6(-1)-6 = -12<0 is the minimum value.**

Q2) Calculate the slope and the equation of a line which passes through the points (-1, -1), (3, 8)

**Answers ->**

**(x1,y1)(x2,y2) = (-1,-1)(3,8),**

**Slope = y2-y1 / x2-x1 = 8-(-1)/3-(-1) = 9/4**

**Slope = 9/4 and the equation is y = mx+c , y = 9/4x+c is the equation.**

Q3) Solve for w’(z) when



**Answers->**

**d/dx(u/v) =[ v(du/dx) – u(dv/dx) ] / v^2**

**[(2-z)(4) – (4z-5)(-1)]/(2-z) ^2**

**Solving the same = Answer = 3/(2-z)^2.**

Q4) Consider Y = 2x3+6x2+3x. Identify the critical values and verify if it is the maxima or minima.

**Answers ->**

**Y = 2x3+6x2+3x,**

**Y’ = 6x2+12x+3 = 0, 3(2x^2+4x+1) = 0, 2x^2+4x+1 = 0, as per this equation this is a quadratic equation, the roots would be -b+sqrt(b^2-4ac)/2a and -b-sqrt(b^2-4ac)/2a**

**Solving the same,**

**x = -2+sqrt(2)/2 or-2-sqrt(2)/2 , <0 is the critical value.**

**Y’ = 6x2+12x+3,**

**Y’’ = 12x+12. Equating the same to zero.**

**12x+12 =0, 12(x+1)=0, x =-1 < 0. Negative. Hence the given function is a Maxima.**

Q5) Determine the critical points and obtain relative minima or maxima of a function defined by



**Answers ->**

**y’ = 4x1 + 2 + 4x2 + 6 = 4x1+4x2+8. Solving for critical values -> x2 = 1 and x1=-2 are the critical values.**

**y’ = x1+x2+2 = 0,**

**y’’ = 1+1 = 2 y’’ = 2> 0 , Hence the given function is a relative Minima.**