**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: f(x) =** x**3** – 3x2 – 9x +12

f**1(x)** =3x2 – 6x – 9 =0, (single differentiation to get critical values)

again, differentiating to find the maximum and minimum in critical values

**f2(x)** =6x-6 = 0

x2-2x -3= 0

x² + ( -3 +1) x +(-3)×1 =0

(x-3)(x+1) =0

**x = 3 , (-1)**

then , f₂(3) = 6×3 - 6 = 12 > 0  ;  minima of f(x) lies at x = 3

and , f₂(-1) = 6×(-1) -6 = -12 < 0  ; maxima of f(x) lies at x = (-1)

∴ maximum value of f(x) is , f(-1) = (-1)³ - 3(-1)² - 9(-1) +12= 17

∴ minimum value of f(x) is , f(3) = (3)³ - 3(3)² - 9(3) +12 = (-15)

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

**Answer:**

slope = y2-y1/x2-x1

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

Slope = (8+1)/ (3+1) = 9/4

Equation of the line y-y1 = M(x-x1)

(y+1) = 9/4 (x+1)

4y+4 9x+9

4y+4-9x-9 = 0

4y-9x-5 = 0 --------------(1)

y-y2 = M (x-x2)

(y-8) = 9/4 (x-3)

4y-32 = 9x-27

4y-32-9x+27 = 0

4y-9x-5 = 0 ---------------------------(2)

Therefore (1) = (2)

Q3) Solve for w’(z) when



**Answer:** Apply Quotient rule,

w’(z)= 2-z[d/dz(4z-5)-(4z-5)d/dz(2-z)]/92-z)^2

(2-z)[4-0]-(4z-5)(-1)/(2-z)^2

8-4z-[-4z+5]/(2-z)^2

8-4z+4z-5/(2-z)^2

3/(2-z)^2

Q4) Consider . Identify the critical values and verify if it is the maxima or minima.

**Answer:** To find critical value is max or min we need to do double derivative,

y(x) = 2x3+6x2+3x

Y’(x) = 6x2+12x+3

**Applying quadrant rule**:

Critical values therefore (x0 = -0.2928,-1.7071)

Y”(x) = 12x+12

Y”(-0.2928) = 8.4864>0

Therefore x0 = -0.2928 is a mini

Y”(-1.7071) = -8.4864 <0

Therefore X0 = -1.707 is a max

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



Ans: Diff w.r.to. x1 keeping x1 constant

Y’(x1) = 4x1+2x2+6---------------(1)

Diff w.r.to. x2 keeping x2 constant

Y’(x2) = 2x2+4x2 ---------------(2)

(1)-(2)

(4x1+2x2+6)-( 2x2+4x2+0)

2x2-2x2+6 = 0

2(x1-x2) = -6

X1-x2 = -6/2

X1-x2 = -3

X1 = -3+x2

4(-3+x2)+2x2+6

-12+6x2+6

6x2 = 6

X2 = 1

Therefore x1 = -3+x2 = -3+1 = -2

On double differentiation,

Y”(x1) = 4>0

Y”(x2) = 4>0

Therefore its having 2maxima point also there is no manima point