National University of Computer and Emerging Sciences, Lahore Campus				
	Course:	Calculus and Analytical Geometry	Course Code:	MT-119
	Program:	BS(CS), BS(DS), BS(SE)	Semester:	Fall 2020
	Duration:	90 min	Total Marks:	50%
	Paper Date:	25-11-20	Weight	15%
	Section:	All	Page(s):	2
	Exam:	MID II	Roll No:	
Instruction/Notes:	Attempt All Questions, Programmable calculators are not allowed.			

Question 1[6] [CLO-3]: Verify that P(2,3) lies on the curve given below and find the lines that are tangent and normal to the given curve:

$$x^2 + xy - y^2 = 1.$$

Question 2[8] [CLO-4]: For the function $f(x) = |x^3-9x|$, determine the following:

a) Does $f'(0)$ exist?

b) Does $f'(3)$ exist?

c) Does $f'(-3)$ exist?

d) Determine all extreema of f(x)?

Question 3[5] [CLO-4]: For what value of **a, m and b** does the function

$$f(x) = \begin{cases} 3 & x = 0 \\ -x^2 + 3x + a & 0 < x < 1 \\ mx + b & 1 \le x \le 2 \end{cases}$$

Satisfy the hypotheses of Mean Value Theorem on the interval [0, 2]?

PTO

Question 4[15] [CLO-4]: Sketch the graph of the function $f(x) = 1 - 9x - 6x^2 - x^3$ using the following steps

a) Determine the **Domain** and **Range** of f(x),

b) Find the **Critical** point(s) and point(s) of **Inflection** (if any),

c) Identify where the **Extreema** of f(x) may occur,

d) Find the interval(s) on which f(x) is **Increasing/Decreasing,**

e) Find where the graph of f(x) is **Concave up/Concave down,**

f) Sketch the **General Shape** of the graph of f(x).

g) Plot some specific points such as **local maximum** and **minimum** points, points of **inflection** and intercepts then sketch the curve.

Question 5[8] [CLO-4]: Use the L'Hopital rule to find the limits

$$\text{a) } \lim_{h\to 0} \frac{Sin(a+h)-sin\ a}{h}$$

$$\text{b) } \lim_{x\to\infty} (x - \sqrt{x^2 + x}).$$

Question No.6 [8] [CLO- 3]: If x , y and z are lengths of the edges of a rectangular box, the common length of **"f(x)"** the box diagonal is $s = \sqrt{x^2 + y^2 + z^2}$

a) Assuming that x, y and z are differentiable function of t, how is ds/dt related to dx/dt. dy/dt and dz/dt?

b) How ds/dt related to dy/dt and dz/dt if x is constant?

c) How dx/dt, dy/dt and dz/dt related if s is constant?

BONUS QUESTION [10]: Suppose that "f" is a continuous on [0, 2] and differentiable function on (0, 2) with range as set of real numbers. Suppose that f(0) = 0, f(1) = 1 and f(2) = 1:

1. Show that there exist C_1 in (0,1) such that derivative of f(x) at C_1 equals 1,
2. Show that there exist C_2 in (1,2) such that derivative of f(x) at C_2 equals 0,
3. Show that there exist C in (0,2) such that derivative of f(x) at C equals 1/3,

Best of Luck