Course Name:	Calculus and Analytical Geometry	Course Code:	MT 1003
Degree Program:	BS (CS, DS, BSE)	Semester:	Fall 2021
Exam Duration:	60 Minutes	Total Marks:	40
Paper Date:	20-10-21	Weight	12.5
Section:	ALL	Page(s):	
Exam Type:	Midterm-I		

Student : Name:_____   Roll ...____   Section._____

Instruction/Notes: Attempt all questions. Programmable calculators are not allowed.

Question 1[CLO-1] Solve the given inequality and show the solution set on real line.

$$\left|\frac{x}{5} - 1\right| \le 1$$

Question 2[CLO-2] Write the equation and plot the graph of each of the following for the given function

$$f(x) = x^2$$

a) Shift the graph of $f(x)$ upward 4 units

b) Shift the graph of $f(x)$ to the left by 2.5 units

c) Compress vertically by the factor of 2 units

d) Stretch horizontally by the factor of 1.5 units

e) Reflect $f(x)$ across the x-axis

Question 3[CLO-3] For the following function

$$g(x) = \frac{x^2 + x - 6}{x^2 + 2x - 8}$$

a) What is the domain of $g(x)$

b) What are x and y intercepts

c) Use the limit to determine all asymptotes of $g(x)$

Question 4[CLO-3] For what values of a and b

$$g(x) = \begin{cases} ax + b, & x \le 0 \\ x^2 + 3a - b, & 0 < x \le 2 \\ 3x - 5, & x > 2 \end{cases}$$

Is continuous at every x?

Course Name:	Calculus and Analytical Geometry	Course Code:	MT 1003
Degree Program:	BS (CS, SE & DS)	Semester:	Fall 2021
Exam Duration:	3 hours	Total Marks:	90
Paper Date:	10-01-22	Weight	50%
Section:	ALL	Page(s):	
Exam Type:	Final Exam		

Instruction/Notes: Attempt all questions. Programmable calculators are not allowed.

Question#1: CLO-3 [10+5]

a) For the given function

$$f(x) = \begin{cases} x^2 - 1, & -1 \le x \le 0 \\ 2x, & 0 < x < 1 \\ 1, & x = 1 \\ -2x + 4, & 1 < x < 2 \\ 0, & 2 < x < 3 \end{cases}$$

1. Does $f(-1)$ exist? Yes
2. Does $\lim\limits_{x \to -1^-} f(x)$ exist? Yes
3. Does $\lim\limits_{x \to -1^-} f(x) = f(-1)$? Yes
4. Is f continuous at $x = -1$? No
5. Is f defined at $x = 3$? No
6. Is f continuous at $x = 3$? No
7. At what value of x, f is continuous? No value
8. What value should be assigned to $f(2)$ to make the extended function continuous at $x = 2$? = 0

b) Evaluate the limit using l'Hôpital's rule

$e^{1/2}$

$$\lim_{x \to \infty} (1 + 2x)^{\frac{1}{2\ln x}}$$

$2(-2u) - 2(1+u^2)(2u)(2)(1-u^2)$

$1 + u^2 = 0$

$-8u^2 = -(1-u^4)$

$\dfrac{2(-2u) - 2(1+u^2)(2u)(4u^2)}{} \quad 8u + 8u^5$

$-8u(1-u^4) \qquad \dfrac{-18u + 8u^5}{(1+u^2)^2}$

Question#2: CLO-5 [15]

Let $f'(x) = \dfrac{2(1-x^2)}{(1+x^2)^2}$

$\dfrac{-4u - 4u + 4u^4}{(1+u^2)^2}$

1. Find f''.
2. Find the critical points of f, if any, and identify the function's extreme values at each one. $-1, 1$
3. Find intervals where the curve is increasing and where it is decreasing. did
4. Find the points of inflection, if any, occur, and determine the concavity of the curve. $0, \sqrt[4]{3/2}, 1$
   up down up
5. Sketch the general shape of the curve with asymptotes (if any).

Question#3: CLO- 4[10+5]

a) A police cruiser, approaching a right angled intersection from the north is chasing a speeding car that has turned the corner and is now moving straight east. When cruiser is 6 mi north of intersection and the car is 0.8 mi to the east, the police determine with radar that the distance between them and the car is increasing at 20 mph. If the cruiser is moving at 60 mph at the instant of measurement, what is the speed of the car? *600*

b) Solve the given inequality. Express the solution set as interval or union of intervals. Also show the solution set on real line.

$$\left|3 - \frac{1}{x}\right| \geq \frac{1}{2}$$

$x \leq \frac{2}{7}$

$x \geq \frac{2}{5}$

Question#4: CLO-7 [10+5]

a) Find the area of the region enclosed by the curves given by $x = 1, -1$ (4)

$$y = 7 - 2x^2 \quad \text{and} \quad y = x^2 + 4$$

b) Evaluate the integral using an appropriate substitution

$$\int \frac{1}{x^2} \cos^2\left(\frac{1}{x}\right) dx \qquad -\frac{1}{4}\sin\frac{2}{x} - \frac{1}{2x}$$

Question#5 CLO-7 [7+8]

a) Use **DISK METHOD** to find the volume of the solid generated by revolving the region bounded by the curves about y-axis.

$\frac{1}{2}\pi$

$$x = \frac{\sqrt{2y}}{y^2 + 1}, \quad x = 0 \quad \text{and} \quad y = 1$$

$y = y^2 + 1$

$\frac{\partial u}{\partial y}$

$\frac{du}{dy} = 2y$

$\frac{1}{y^2 + 1} \frac{du}{dy}$

$\frac{1}{u}$

$dy = \frac{du}{2y}$

b) Using Fundamental Theorem of Calculus find the length of the curve

$\frac{7\sqrt{3}}{3}$

$$y = \int_{-2}^{x} \sqrt{3t^4 - 1} \, dt, \quad -2 \leq x \leq -1$$

Question#6 CLO-6, 8 [7+8]

Evaluate the improper integrals and determine whether the given improper integral converges or diverges

a) $$\int_0^1 \frac{\theta + 1}{\sqrt{\theta^2 + 2\theta}} \, d\theta \quad \sqrt{3}$$

b) $$\int_0^{\infty} 2e^{-\theta} \sin \theta \, d\theta \qquad \text{diverge.}$$

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Exam Duration:	60 Minutes		Total Marks:	40
Paper Date:	03-12-21		Weight	12.5
Section:	ALL		Page(s):	
Exam Type:	Midterm-II			

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Student : Name:_____

Instruction/Notes: Attempt all questions. Programmable calculators are not allowed.

[20 points]

Question 1[CLO-4, 5]: For the given function,

$$f(x) = 4x^3 - x^4$$

$12x^2 - 4x^3$

find

a) critical points of f , if any, and identify the function's behavior at each one $24x - 12x^2$
b) intervals where the curve is decreasing and where it is increasing
c) the points of inflection, if any occur, and determine the concavity of the curve.

Question 2[CLO-5] You are designing a rectangular poster to contain 50 in^2 of printing with a 4-in. margin at the top and the bottom and 2-in. margin at each side. What overall dimension will minimize the amount of paper used?   [10 points]

Question 3[CLO-6]

a) Evaluate the integral given below   [5 points]

$$\int \frac{1}{x^3} \sqrt{\frac{x^2 - 1}{x^2}} \, dx$$

b) Find the total area between the region and x-axis.   [5 points]

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

$Q2$

$5\sqrt{2}$

$5\sqrt{2} + 6$

$5\sqrt{2} + 4$