KATHMANDU UNIVERSITY
End Semester Examination
May/June, 2022

Marks Scored:

Level : B.Pharm.
Year : I

Course : MATH 111
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date :

SECTION "A"
[10 Q. × 1=10 marks]

Fill in the blank space (s) by writing the most appropriate word(s) or symbol(s).

1. The relation $y = f(x)$ defines a function if a vertical line intersects its graph in $a(x)$ _____ point(s).

2. If the function $y = 2^x$ is shifted 3 units upward, then the resulting function is $y(x) =$ _____.

3. If a function $f(x)$ grows faster than the function $g(x)$ as $x \to \infty$ then $\lim_{x\to\infty} \frac{g(x)}{f(x)} =$ _____.

4. The derivative of $\ln(e^x)$ is _____.

5. If the derivative of a function $f(x)$ changes from the positive to negative sign at $x = c$, then $f(x)$ attains its _____value at c.

6. The derivative of the function $\int_5^x 2t \cos t \, dt$ is _____.

7. If a function $y = f(x)$ is continuous in $[a, b]$, then the length of the curve from a to b is given by _____ .

8. A system of equations with all constant terms being zero is called _____ equation.

9. $\int \frac{1}{\sqrt{9-x^2}} dx =$ _____ .

10. If A is a nonzero square matrix, then $A^{-1} =$ _____ .

SECTION "B"

[10 Q. × 1=10 marks]

Fill in the blank space(s), **DO NOT TICK**, by selecting the most appropriate answers from among the given ones.

11. An even function $f(x)$ is symmetric about _____.
[x-axis; y-axis; origin; the line $y = x$]

12. The domain of the function f(x) = $\frac{1}{\sqrt{4-x^2}}$ is _____.
[(2, ∞); [-2,2]; (-∞, 2); (-2, 2)]

13. The function $f(x) = \frac{x^2+x-6}{x^2-4}$ is discontinuous at _____.
[$x = \pm 2$; $x = \pm 4$; $x = 0$; $x = 16$]

14. The area of the region bounded by the curve $y = 4 - x^2$ and the x-axis is _____.
[16/3; 1/3; 32/3; 5/3]

15. If $f'(x) \geq 0$ in $[a, b]$, then $f(x)$ is _____ in $[a, b]$.
[increasing; decreasing; concave up; concave down]

16. The horizontal asymptote of the curve $f(x) = \frac{x}{x-1}$ is _____.
[$x = 1$; $y = 0$; $y = 1$; $x = 0$]

17. The length of the major axis of the ellipse $\frac{x^2}{16} + \frac{y^2}{9} = 1$ is _____.
[4; 3; 6; 8]

18. If $f(x) = 2x^2$ and $g(x) = \sqrt{x+1}$, $(fog)(1)$ is _____.
[4; 0; -2; 8]

19. $\lim_{x \to 0} \frac{1-\cos x}{x^2}$ = _____.
[1; 1/2; ∞; 0]

20. The average value of the function $f(x) = -\frac{x^2}{2}$ on [0, 3] _____.
[1/3 ; 3/2; -3/2; -1/2]

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Time : 2 hrs. 30 mins.

Course : MATH 111
Semester : I
F.M. : 55

SECTION "C"
[3 Q. × 7 = 21 marks]

1. Define the derivative of a function at a point. Show that if a function $f(x)$ is differentiable at a point then it is continuous at that point. For what value of a is the function

$$f(x) = \begin{cases} x^2 - 1 & x < 3 \\ 2ax & x \geq 3 \end{cases}$$ continuous at $x = 3$. [1 + 2 + 4]

OR

Define the limit of a function at a point. Write the conditions for a function to be continuous at the point?

For the limit $\lim_{x \to 5} \sqrt{x-1} = 2$, find $\delta > 0$ such that $|\sqrt{x-1} - 2| < 1$ whenever $0 < |x - 5| < \delta$. [1 + 2 + 4]

2. Define the point of inflection of a function. State the second derivative test for a function has local extremum. Find the local maximum, minimum value and the point of inflection of $f(x) = x^4 - 4x^3$. Use the information to sketch the graph. [1 + 1 + 4 + 1]

3. Define consistent of a system of equations. Also, define the row reduced echelon form of a matrix. Solve the following system of linear equations. [2 + 5]

$$3x + 5y - 4z = 7$$
$$-3x - 2 + 4z = -1$$
$$6x + y - 8z = -4$$

SECTION "D"
[6 Q. × 4 = 24 marks]

4. Find $\frac{dy}{dx}$ (*ANY TWO*).

a. $y = \left(\frac{3x-4}{5x+2}\right)^{-5}$ b. $y = e^{\sin\sqrt{(lnx)}}$ c. $x^3 - \sin xy - y^2 = 0$

5. Evaluate (*ANY TWO*).

a. $\int \frac{x^3}{\sqrt{(x^2+4)}} dx$ b. $\int_0^{\sqrt{lnx}} 2xe^{x^2} \cos e^{x^2}\ dx$ c. $\int \frac{5x-13}{(x-2)(x-3)} dx$

6. Solve the initial value problem $\frac{dy}{dx} = \frac{xy}{x^2+1}$, $y(0) = 1$

7. Find the length of the curve $x = t - \sin t,\ y = 1 - \cos t,\ 0 \le t \le 2\pi$.

8. Evaluate the following limits.

a. $\lim\limits_{x \to 4} \frac{4x - x^2}{2 - \sqrt{x}}$ b. $\lim\limits_{x \to \infty} \left(1 + \frac{1}{x^2}\right)^x$.

9. Find the inverse of the matrix $\begin{bmatrix} 0 & 1 & 2 \\ 1 & 0 & 3 \\ 4 & -3 & 8 \end{bmatrix}$.

SECTION "E"

[5 Q. × 2 = 10 marks]

10. Sketch the graph of the function $y = x^2 + 6x + 10$ by using the graph of $y = x^2$.

11. Find the row rank of the matrix $\begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 1 \\ 2 & 7 & 8 \end{bmatrix}$.

12. Find the linearization of the function $f(x) = \sqrt{1 + x}$ at $x = 3$.

13. Find the vertical asymptote of the curve $y = \frac{2x^2 - 3}{7x + 4}$.

14. Find the tangent to the curve $y = 4 - x^2$ at $(-1, 3)$.