

KATHMANDU UNIVERSITY
End Semester Examination
June/July 2024

Marks Scored:

Level : B.Pharm
Year : I

Course : MATH 111
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date :

14 JUL 2024

SECTION "A"

[10Q. × 1 = 10 marks]

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

- Let $f(x)$ be a function, then stretch the function vertically by factor $k > 1$ unit is _____
- The range of the function $f(x) = x^2 + 4x + 5$ is _____
- A function is periodic with period P if $f(x) =$ _____ in the domain of x .
- If $\sqrt{6 - x^2} \leq f(x) \leq \sqrt{6 - 3x^2}$ for $-1 \leq x \leq 1$, then $\lim_{x \rightarrow 0} f(x)$ is _____
- The function $y = f(x)$ is continuous at $x = a$ if it satisfies _____ condition.
- The tangent equation to the curve $y = x^2 - 3x$ at $(1, -2)$ is _____
- The point of inflection of $y = x^3 - 3x^2 + 12x - 5$ is _____
- If $y = \sec x$, then the $\int y dx$ is _____
- A linear system of equations is called _____ if it has no solution
- The determinant value of the matrix $\begin{bmatrix} -5 & 2 & -35 \\ 2 & 9 & 14 \\ 3 & 23 & 21 \end{bmatrix}$ is _____

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. The function $f(x)$ is decreasing in the domain of x if _____

$f(x_2) < f(x_1)$ whenever $x_1 < x_2$;

$f(x_2) < f(x_1)$ whenever $x_1 > x_2$;

$f(x_2) > f(x_1)$ whenever $x_1 < x_2$;

$f(x_2) > f(x_1)$ whenever $x_1 > x_2$;

12. If $f(x) = \frac{1}{x}$ and $(x) = \sqrt{3+x}$, then the composite function $f \circ g$ is _____

[$\sqrt{3 + \frac{1}{x}}$; $\frac{x}{\sqrt{3+x}}$; $\frac{1}{\sqrt{3+x}}$; $\frac{\sqrt{3+x}}{x}$]

13. If $f(x) = [x]$ is, then the value of $f(3.72)$ is _____

[3.5; 3.75; 4; 3]

14. _____ is the limit value of $f(x) = \frac{x^2-4}{\sqrt{x}-\sqrt{2}}$ at $x = 2$.

[8; $8\sqrt{2}$; 16; 2]

15. A point $(c, f(c))$ where the graph of a function has a tangent. At a point of inflection $(c, f(c))$, either _____

[$f''(c) > 0$; $f''(c) < 0$;
 $f'(c) = 0$; $f''(c) = 0$ or $f''(c)$ fails to exist]

16. Which of the following is not a type of discontinuity _____

[finite discontinuity; infinite discontinuity;
 jump discontinuity; removable discontinuity]

17. The differential of $f(x) = x^2$ is _____

[x^2 ; $2x$; $2xdx$; $x^2 dx$]

18. Length of the curve $y = f(x)$ from $x = a$ to $x = b$ is _____

[$\sqrt{1 + \left(\frac{dy}{dx}\right)^2}$; $\sqrt{1 - \left(\frac{dy}{dx}\right)^2}$;
 $\int_a^b \sqrt{1 + \left(\frac{dy}{dx}\right)^2} dx$; $\int_a^b \sqrt{1 - \left(\frac{dy}{dx}\right)^2} dx$]

19. A homogeneous system of linear equations $AX = 0$, where A is $m \times n$ matrix with row rank r and $x \in \mathbb{R}^n$, has m independent solutions if _____

[$n = r$; $m > r$; $m < r$; $m = r$]

20. If the determinant value of a square matrix $A_{n \times n}$ is zero is called _____ matrix.

[Identity; singular; triangular; symmetric]

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SECTION "C"

[3Q × 7 = 21 marks]

1. Define the derivative of a function $f(x)$ at a point $x = a$? Prove that every differential function in an interval I is continuous but the converse may not be true. [1+3+3]

OR

Define different types of asymptotes of a function. Find the asymptotes of $y = \frac{2x}{x^2-1}$ and sketch the curve. [1+1+1+2+2]

2. Define the definite integral of a function $f(x)$ on the interval $[a, b]$. Find the area between the curves $y = x^2 - 2x$ and $y = x$. Also, find the value of integral $\int_0^2 (1 + x^2) dx$ by using the limit of Riemann sum. [1+3+3]
3. Define consistent independent, consistent dependent, and inconsistent independent systems of linear equations. Use Gaussian elimination to put the augmented matrix into reduced echelon form and then parametrically represent the solution. Also, find one specific solution. [1+1+1+3+1]

$$x_1 - 7x_2 + 6x_4 = 5$$

$$x_3 - 2x_4 = -3,$$

$$-x_1 + 7x_2 - 4x_3 + 2x_4 = 7$$

SECTION "D"

[6Q × 4 = 24 marks]

4. Evaluate the following limits (ANY TWO):

a. $\lim_{x \rightarrow \infty} (\sqrt{x^2 + x} - \sqrt{x^2 - x})$

b. $\lim_{\theta \rightarrow 0} \frac{1 - \cos \theta}{\sin 2\theta}$

c. $\lim_{x \rightarrow \frac{\pi}{2}} (\tan x)^{\cos x}$

5. Find $\frac{dy}{dx}$ (ANY TWO):

a. $y = x^3 - 3(x^2 + \pi^2)$

b. $y = 2x\sqrt{\cos x}$

c. $y = (x + 1)^x$

P.T.O.

6. Evaluate the following integrals (*ANY TWO*):

a. $\int \frac{1}{x^2+4} dx$

b. $\int_1^3 \frac{\sin(\ln x)}{x} dx$

c. $\int \frac{2x+3}{(x^2-1)(x+2)} dx$

7. When a circular plate of metal is heated in an oven, its radius increases at the rate of $0.01\text{cm}/\text{min}$. At what rate is the plate area increasing when the radius is 50cm ?

8. Find the absolute maxima and minima values of the function $f(x) = -x^4 + 4x^3 - 4x + 1$ on the interval $[-\frac{3}{4}, 3]$ and identify where they occur.

9. Define the rank of the matrix and find the rank of the matrix

$$A = \begin{bmatrix} 3 & -7 & 11 \\ 1 & -2 & 3 \\ -2 & 8 & -16 \end{bmatrix}$$

SECTION "E"
[5Q × 2 = 10 marks]

10. Find $\frac{dy}{dx}$ if $x^3 + y^3 = 18xy$.

11. Find the domain of the function $y = \sqrt{x^2 - 4}$.

12. For what value of a and b will $f(x) = \begin{cases} ax + b, & x \leq -1 \\ ax^2 + x + 2b, & x > -1 \end{cases}$ be differentiable for all values of x ?

13. Find the inverse of the matrix $A = \begin{bmatrix} 2 & -2 \\ 1 & 2 \end{bmatrix}$.

14. Solve $\frac{dy}{dx} = \frac{y}{x}$, find general and particular solution when $y(1) = 1$.