

KATHMANDU UNIVERSITY
End Semester Examination [C]
April/May, 2023

03. May

Level : B.Pharm.
Year : I
Time : 2 hrs. 30 mins.

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

SECTION "C"

[3Q. × 7 = 21 marks]

1. Discuss the curve $y = x^4 - 4x^3$ with respect to critical points, increasing/decreasing, points of inflection and concavity. Use this information to sketch the curve.

[1+1.5+1+1.5+2]

OR

Discuss the curve $y = \frac{2x^2}{x^2-1}$ with respect to asymptotes and concavity and sketch the curve.

[3+2.5+1.5]

2. State first fundamental theorem of integral calculus. Find $\frac{d}{dx} \int_1^{x^4} \sec t \, dt$. Find the area shared by the curves $x = 0$, $y = 1$ and $y = \sqrt[4]{x}$.
3. Define row rank and consistency of a matrix. Use Gaussian elimination to put the augmented matrix into reduced echelon form and then parametrically represent the solution. Also find two specific solutions.

[1+1+4+1]

$$\begin{aligned}x_1 + 2x_2 + 2x_3 - 3x_4 &= -1 \\3x_2 - x_3 + 3x_4 &= 5 \\2x_1 + 5x_2 + 4x_3 + 2x_4 &= 10\end{aligned}$$

SECTION "D"

[6Q. × 4 = 24 marks]

4. Evaluate the following limits (ANY TWO):

a. $\lim_{x \rightarrow 2} \frac{\sqrt{4x+1}-3}{x-2}$

b. $\lim_{x \rightarrow 0} \frac{\tan x - x}{x^3}$

c. $\lim_{x \rightarrow 0^+} x^x$

5. Find dy/dx (ANY TWO):

a. $y = \frac{x \sin x}{1+x}$

b. $y = 2^{\sin \pi x}$

c. $x e^y = x - y$

6. Evaluate the following integrals (ANY TWO):

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

b. $\int \frac{dx}{x\sqrt{\ln x}}$

c. $\int_1^e x^3 \ln x \, dx$

7. Find absolute maximum and minimum values of $f(x) = x^3 - 3x + 1$ on $[0,3]$.

8. A particle moves along a line so that its velocity at time t is $v(t) = t^2 - t - 6$ (m/s).

- a. Find the displacement of the particle during the time period $1 \leq t \leq 4$.
b. Find the distance travelled during this time period.

9. Use Gaussian elimination to put the augmented matrix in row echelon form and solve the system:

$$\begin{aligned}2x + 4y - 2z &= 2 \\4x + 9y - 3z &= 8 \\-2x - 3y + 7z &= 10\end{aligned}$$

SECTION "E"

[5Q. \times 2 = 10 marks]

10. For what value of a is $f(x) = \begin{cases} x^2 - 1 & x < 3 \\ 2ax & x \geq 3 \end{cases}$ continuous at every x .
11. Shift the graph $y^2 = x^3$, 2 units to the left and 2 units up.
12. At time t , the position of a body moving along a line is $s = t^3 - 6t^2 + 9t$ (m). Find the body's velocity and acceleration at $t = 2s$.
13. Find the angle between two curves: $x^2 + y^2 = 5$, $y^2 = 4x$.
14. Find a constant of integration by solving the initial value problem $\frac{dy}{dx} = \frac{1}{2\sqrt{x}}$, $y(4) = 0$.

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Marks Scored:

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Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date : 03-May-2023

SECTION "A"
[10Q. × 1 = 10 marks]

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

1. A polynomial function is continuous
2. A function $f(x) = \begin{cases} 3 - x, & x < 2 \\ 2, & x = 2 \\ x/2, & x > 2 \end{cases}$ has discontinuity at $x = 2$.
3. If $f(x)$ has local maximum or minimum value at $x = c$ and if $f(x)$ is defined then
4. A line $y = b$ is a horizontal asymptote of the graph of a function $y = f(x)$ if
5. If $f(x)$ is integrable on $[a, b]$, its average value on $[a, b]$ is $av(f) = \dots\dots\dots$
6. If $f(x)$ is continuous at every point of $[a, b]$ and $F(x)$ is any antiderivative of $f(x)$ on $[a, b]$, then $\int_a^b f(x)dx = \dots\dots\dots$
7. Rank of a matrix A is defined as in row echelon form.
8. A homogeneous system of linear equations is one in which
9. The graph of the equation $y = ax^2 + bx + c, a \neq 0$ is a parabola which opens upward if
10. When variable x is constant multiple of variable y , x and y varies

SECTION "B"
[10Q. × 1 = 10 marks]

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

11. The slope of a function $y = \sqrt{x}$ at $x = 9$ is
[1/6; 1/3; 1/2; 1]
12. The area under the curve $y = \cos x$, x -axis from 0 to π equals
[0; 1/2; 1; 2]

13. If a function $y = f(x)$ is shifted $h > 0$ units to the right then the equation of shifted function is
 [$y - h = f(x)$; $y + h = f(x)$; $y = f(x + h)$; $y = f(x - h)$]
14. $\lim_{x \rightarrow 0} \frac{1 - \cos x}{x + x^2} = \dots\dots\dots$
 [0; 1/2; 1; 2]
15. The function $y = x^2$ is continuous on $[0, 2]$ and differentiable on $(0, 2)$. Then there exists at least one point c in $(0, 2)$ such that $c = \dots\dots\dots$
 [0; 1; 2; 4]
16. $\frac{d}{dx} a^u = \dots\dots\dots$
 [$a^u \frac{du}{dx}$; $\frac{a^u}{\ln a} \frac{du}{dx}$; $a^u \ln a \frac{du}{dx}$; $ua^{u-1} \frac{du}{dx}$]
17. The critical point of a function $h(x) = x^{2/3}$ is
 [∞ ; 2/3; 3/2; 0]
18. $\int \tan u \, du = \dots\dots\dots$
 [$\ln|\cos u| + c$; $\ln|\sin u| + c$; $\sec^2 u + c$; $\ln|\sec u| + c$]
19. The volume of gas in a cylinder decreases as pressure increases. The relation between volume and pressure is a
 [direct variation; indirect variation; Joint variation; Combined variation]
20. The equation $z = 5xy^2$ is an example of
 [direct variation; indirect variation; Joint variation; Combined variation]