KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2019

Marks Obtained:

Level : B.Arch.
Year : I

Course : MATH 105
Semester : I

Exam Roll No.: Time: 30 mins. F.M. : 20

Registration No.: Date FEB 26 2019

SECTION "A"

[10 Q.×1=10 marks]

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

1. A function y = f(x) is odd function if ______________________.

2. If $f : \mathfrak{R} \rightarrow \mathfrak{R}$. The domain of the function $f(x) = \frac{1}{x^2-9}$ is ______________________.

3. The value of $\frac{d}{dx}\log(\sin^2 x)$ ______________________.

4. The slope of tangent to the curve $2x^2+2xy = 4$ at (1, 1) is given by______________________.

5. If $\lim_{x\to 5^+} f(x) \neq \lim_{x\to 5^-} f(x)$, then function $y = f(x)$ has a ______________________ discontinuity at $x = 5$.

6. If $F(x) = \int_4^x \sqrt[3]{t+7}\, dt$, the derivative of F(x) at x = 20 is ______________________.

7. $\lim_{x\to 5^+} \frac{[x]}{x} =$ ______________________.

8. The value of $\Gamma\left(\frac{1}{4}\right)\Gamma\left(\frac{3}{4}\right)$ ______________________.

9. The first order differential equation of $x^2 + y^2 = 25$ is ______________________.

10. The center of sphere $x^2 + y^2 + z^2 - 8x + 2y - 4 = 0$ 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 graph of the function $y^2 = 4ax$ is symmetric about______________________.

 [y-axis; x-axis; line y = x; origin]

12. Two planes $a_1x + b_1y + c_1z = d_1$ and $a_2x + b_2y + c_2z = d_2$ will be perpendicular if

____

[$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$; $a_1a_2 + b_1b_2 + c_1c_2 = 0$;

$\frac{a_1}{a_2} = \frac{b_1}{b_2}$; $b_1b_2 + c_1c_2 = 0$]

13. A function f(x) will have a point of inflection at the point when ____________

[$f''(x) > 0$; $f''(x) = 0$; $f'(x) > 0$; $f'(x) = 0$]

14. The average value of $\frac{1}{x}$ on the closed interval [1, 3] is __________.

[1/2; 2/3; ln2/2; ln3/2]

15. The value of $f(x) = 4x^3 - 12x + 7$ is maximum when_____________.

[$x = -2$; $x = 2$; $x = 1$; $x = -1$]

16. The value of $\Gamma(n)$ is (n-1)! if n is ___________________________.

[even number; real number; rational number; positive integer]

17. The oblique asymptote to the curve $y = \frac{x^2-3}{2x-4}$ is ______________________.

[$y = \frac{x}{2} + 1$; $y = \frac{x}{2} - 1$; $y = -\frac{x}{2} + 1$; $y = \frac{x}{2} + 2$]

18. The value of $\frac{d^n}{dx^n}(e^{nx})$ is ______________.

[$n^n e^{nx}$; $n!\, e^{nx}$; ne^{nx}; $n^n e^n$]

19. If $f'(x) = \frac{1}{\sqrt{1-x^2}}$, $f(0) = 0$. Then f(x) = _________________________.

[$\sqrt{1-x^2}$; $\sqrt{1+x^2}$; $\tan^{-1}x$; $\sin^{-1}x$]

20. If F and f are continuous function such that $F'(x) = f(x)$ for all x, then $\int_a^b f(x)dx$ is

________________________.

[$F(b) - F(a)$; $F'(b) - F'(a)$; $f'(b) - f'(a)$; $f(b) - f(a)$]

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SECTION "C"
[3Q. × 7 = 21 marks]

1. Define the sphere and find the equation of sphere with center at origin and passing through (1, 2, 3). Write in a symmetrical form of the equation of a line of integration of the planes $x - 2y + 3z = 2$ and $3x - 4y + 5z = 8$. [1 + 2 + 4]

2. Define limit and continuity of a function y=f(x) at a point x=a. Prove that differentiability of a function at a point implies continuity at that point but converse may not be true. [2 + 3 + 2]

3. Define the differential coefficient of a function $f(x)$ at a point $x = a$. What is right hand derivative and left hand derivative of a function at a point?

$$\text{If } f(x) = \begin{cases} x, \text{ for } 0 < x < 1 \\ 2 - x, \text{ for } 1 \le x \le 2 \\ x - \frac{x^2}{2}, \text{ for } x > 2 \end{cases}$$

Does $f'(x)$ exists at $x = 1$ and 2? [2 + 2 + 3]

OR

Define critical point and point of inflection of a function. Find local maxima and minima of function $f(x) = x^4 - 4x^3 + 10$. Also sketch the graph of function f. [2 + 2 + 3]

SECTION "D"
[6Q. × 4 = 24 marks]

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

i) $y^{\sin y} = x^{\sin x}$ ii) $xy + y^2 = 1$ at (0, -1) iii) $x = e^{\cos 2t}, y = e^{\sin 2t}$

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

i) $\int cosec^3\, x dx$ ii) $\int_0^{\pi/4} (1 + e^{\tan\theta})\sec^2\theta \, d\theta$ iii) $\int \frac{x^2 + 8}{x^2 - 5x + 6} dx$

6. Find the average value of $f(x) = \sin x$ on $[0, \frac{\pi}{2}]$ and verify the mean value theorem of average value.

7. Find the length of the curve $y = \frac{3}{4}x^{\frac{4}{3}} - \frac{3}{8}x^{\frac{2}{3}} + 5$ from x = 1 to x = 8

OR

Find the area of the region between the curve $y = x^4$ and $y = 8x$.

8. Define Beta and gamma function. Evaluate: $\Gamma\left(\frac{5}{2}\right)\,\Gamma\left(\frac{3}{2}\right)$.

9. Define exact differential equation and solve: $(x + y - 1)dx + (x - y - 2)dy = 0$.

SECTION "E"

[5Q. × 2=10 marks]

10. Define $f: R^2 \rightarrow R$ defined by $f(x, y) = x^3 - 5x^2y + 2y^3 + 100$, find f_x and f_y, where the symbols have their usual meaning.

11. Find the points on the curve $x^2 + y^2 = 25$, where the tangent is parallel to y - axis.

12. Evaluate limit: $\lim_{x \rightarrow 0} \frac{\sin x - x}{x^3}$.

13. For what value of **k** will two planes $2x + 3y + 4z - 14 = 0$ and $2x - ky + 5z - 9 = 0$ be perpendicular.

14. Find all asymptotes of the curve $f(x) = \frac{2x}{x+1}$.