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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)

MCA Integrated

SEM: II - THEORY EXAMINATION (2025 - 2026)

Subject: Applications of Calculus

Time: 3 Hours

Max. Marks: 100

General Instructions:

IMP: Verify that you have received the question paper with the correct course, code, branch etc.

1. This Question paper comprises of **three Sections -A, B, & C**. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.

2. Maximum marks for each question are indicated on right -hand side of each question.

3. Illustrate your answers with neat sketches wherever necessary.

4. Assume suitable data if necessary.

5. Preferably, write the answers in sequential order.

6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION-A

20

1. Attempt all parts:-

(1.1) The value of $\int 6x(x^2 + 6) dx$ is (CO1, K3) 1

(a) $\frac{3x^4}{2} + 18x^2 + c$

(b) $\frac{3x^4}{2} - 18x^2 + c$

(c) $\frac{3x^4}{2} - 18x + c$

(d) $\frac{3x^4}{2} + x^2 + c$

(1.2) The value of $\int \frac{1}{1+x^2} dx$ is (CO1, K1) 1

(a) $\tan^{-1}x^2 + c$

(b) $-\tan^{-1}x + c$

(c) $\tan^{-1}x + c$

(d) none of these

(1.3) Degree of following differential equation is (CO2, K2) 1

$$\left(\frac{d^3y}{dx^3}\right)^4 + \left(\frac{d^2y}{dx^2}\right)^7 + y = e^x$$

(a) 4 (b) 2 (c) 3 (d) 1

- (1.4) If roots are 1,1 then CF is: (CO2, K2) 1
- $c_1 e^x + c_2 e^x$
 - $c_1 + c_2 x$
 - $(c_1 + c_2 x) e^x$
 - $c_1 + c_2 e^x$
- (1.5) The relation $R = \{(1,1), (5,5), (8,8), (1,5), (8,5), (1,8)\}$ is (CO3, K2) 1
- Reflexive
 - Transitive
 - Both of these
 - None of these
- (1.6) The LUB of $B = \{a, c\}$ which is subset of POSET $R = \{(a,a), (b,b), (c,c), (d,d), (a,b), (a,c), (a,d), (b,c), (b,d), (c,d)\}$. (CO3, K2) 1
- b
 - c
 - d
 - a
- (1.7) Partial derivative of $f(x, y, z) = 2x^3yz + 5xyz^2$ with respect to z (CO4, K2) 1
- $2xy + 10xyz$
 - $2x^3y + 10xyz$
 - $2xy + 5xyz$
 - $2x^2y + 10xyz$
- (1.8) The degree of the homogeneous function $f(x,y,z) = x^2y^3 + x^3y^2$ (CO4, K2) 1
- 5
 - 4
 - 3
 - 2
- (1.9) A car travels 8 km towards the north, then it turns right and travels 6 km. The distance from the starting point is (CO5, K3) 1
- 10km
 - 12km
 - 13km
 - 15km
- (1.10) If the ratio of apples to oranges in a basket is 3:5, and there are 25 oranges in the basket, the number of apples in the basket are (CO5, K3) 1
- 12
 - 13
 - 14
 - 15

2. Attempt all parts:-

- (2.1) Find the Integration of the function $f(x) = \cos x - \sec x$. (CO1, K2) 2

- (2.2) Determine I.F. of $\frac{dy}{dx} + x^2y = \cos x$ (CO2, K3) 2
- (2.3) Define a lattice and provide an example. (CO3, K1) 2
- (2.4) Define a critical point. (CO4, K1) 2
- (2.5) Alex is the son of David. Laura is David's sister. Find the relationship between Laura and Alex. (CO5, K2) 2

SECTION-B

30

Answer any one of the following:-

- (3.1) Integrate $\int x \sin(x^2 + 1) dx$. (CO1, K3) 6
- (3.2) Find the value of $\int_{-2}^2 (x^3 + x) dx$. (CO1, K3) 6

Answer any one of the following:-

- (3.3) Use method of separation of variable to solve :(CO2,K3) 6

$$\frac{dy}{dx} + \frac{2}{x} = \frac{1}{x^2}$$
- (3.4) Form the differential equation by eliminating constants from: $y = c_1x + c_2x^2$. (CO2,K3) 6

Answer any one of the following:-

- (3.5) Draw the Hasse diagram of the set $F = \{1, 2, 3, 6, 18\}$ under the relation “divides”; and find greatest and least elements. (CO3, K3) 6
- (3.6) Consider a poset $\{a, b, c, d\}$ with the order relation defined as $a \leq b \leq c \leq d$. Determine the result of the expression $(a \vee b) \vee (c \vee d)$. Also find $(a \wedge b) \wedge (c \wedge d)$. (CO3,K3) 6

Answer any one of the following:-

- (3.7) If $z = e^{xy}$, find $\frac{\partial^2 z}{\partial x \partial y}$ and $\frac{\partial^2 z}{\partial y \partial x}$. (CO4, K3) 6
- (3.8) If $z = xy + y^2$, where $x = u + v$, $y = u - v$, find $\frac{\partial z}{\partial u}$ and $\frac{\partial z}{\partial v}$. (CO4, K3) 6

Answer any one of the following:-

- (3.9) (i) A recipe calls for 2 cups of flour and 3 cups of sugar. If you want to make half the recipe, how much sugar should you use? (ii) The average age of a group of friends is 25 years. If the ages of three friends are 22, 24, and 28, Find the age of the fourth friend. (CO5, K3) 6
- (3.10) John borrows \$20,000 from a bank at an interest rate of 8% per annum, compounded annually. If he agrees to repay the loan after 5 years, find the total interest to be paid. (CO5, K3) 6

SECTION-C

50

4. Answer any one of the following:-

- (4.1) Evaluate $\int \frac{2x+1}{(x+2)(x-1)^2} dx$. (CO1, K3) 10
- (4.2) Find the value of $\int_0^{\pi/2} x \sin x dx$. (CO1, K3) 10

5. Answer any one of the following:-

(5.1) Find y: $(D^2 - 7D + 6)y = \cos 3x$ (CO2, K3) 10

(5.2) Solve by the method of separation of variables: (CO2, K3) 10

$$\frac{dy}{dx} = \frac{2xy}{1 + x^2}$$

6. Answer any one of the following:-

(6.1) Let $A = \{2, 3, 6, 12, 24, 36\}$ and R be the relation in A which is defined by a divides b then show that R is partial order relation in A. (CO3, K3) 10

(6.2) Draw the Hasse diagram of $(A, \leq)$, where $A = \{3, 4, 12, 24, 48, 72\}$ and relation $\leq$ be such that $a \leq b$ if a divides b. Also, check is this a lattice. (CO3, K3) 10

7. Answer any one of the following:-

(7.1) If $u = \sin^{-1}\left(\frac{x^2 + y^2}{x + y}\right)$, then show that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \tan u$. (CO4, K3) 10

(7.2) Discuss the maxima and minimum of $u = xy(1 - x - y)$. (CO4, K3) 10

8. Answer any one of the following:-

(8.1) A container contains a mixture of milk and water in the ratio 3:5. If 10 liters of the mixture is taken out and replaced with water, the ratio becomes 2:5. Find the capacity of the container. (CO5, K3) 10

(8.2) Find the number of words can be formed from the letters of the word "EXTRA" so that the vowels are never together. (CO5, K3) 10