

BACHELOR'S DEGREE EXAMINATION, OCTOBER 2025  
2024 ADMISSIONS REGULAR  
SEMESTER III - MINOR - (MATHEMATICS )  
MT3DSCB101B24 - Essential Mathematics for Sciences

Time : 1.5 Hours

Maximum Marks : 50

## Part A

Answer all questions. Each question carries 1 mark.

(1x10=10)

1. Identify whether  $y = \frac{c}{x}$  is a solution of ordinary differential equation  $xy' = -y$  for all  $x \neq 0$ ,  $c$  is a constant  
[CO1,Remember]
2. Discuss the exactness of  $(2x + e^y) dx + xe^y dy = 0$   
[CO1,Understand]
3. Differentiate between General solution and Particular solution of a differential equation  
[CO1,Understand]
4. Define Lagrange's PDE  
[CO2,Remember]
5. Determine the order and degree of the PDE,  $\left(\frac{\partial z}{\partial x}\right)^2 + \frac{\partial^3 z}{\partial y^3} = 2x \left(\frac{\partial z}{\partial x}\right)$   
[CO2,Apply]
6. Compute the PDE,  $z = (x + a)^2 + (y - b)^2$   
[CO2,Apply]
7. Find the unit vector  $u$  in the direction of the vector from  $P_1(1,0,1)$  to  $P_2(3,2,0)$   
[CO3,Remember]
8. (a) Define a vector  
(b) Define length of a vector  
[CO3,Remember]
9. Compute the component form the vector with initial point  $P(-3,4,1)$  and terminal point  $Q(-5,2,2)$   
[CO3,Apply]
10. Compute the velocity and acceleration vectors at  $t=1$ , given  $r(t) = (t+1)i + (t^2-1)j$   
[CO4,Apply]

## Part B

Answer any 2 questions from the bunch of CO1. Each question carries 5 mark.

(5x2=10)

11.
  1. Determine the order and degree of  $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = xyz$
  2. Give the PDE,  $z = x + y + f(xy)$   
[CO1,Apply]
12. (a) Discuss the exactness of  $(x^2 + y) dx + (y^2 + x) dy = 0$   
(b) Find the Integrating factor of  $(xy - 1) dx + (x^2 - xy) dy = 0$   
[CO1,Understand]
13.
  - (a) Determine the order and degree of  $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = xyz$
  - (b) Give the PDE,  $z = x + y + f(xy)$   
[CO1,Apply]

## Part B

Answer any 2 questions from the bunch of CO2. Each question carries 5 mark.

(5x2=10)

14. Compute the solution of  $p\sqrt{x} + q\sqrt{y} = \sqrt{z}$  [CO2,Apply]
15. Solve  $yzp + zxq = xy$  [CO2,Apply]
16. Write the PDE by eliminating arbitrary constants,  $z = ax + by + a^2 + b^2$  [CO2,Apply]

**Part B**

Answer any 2 questions from the bunch of CO3. Each question carries 5 mark. (5x2=10)

17. Express  $v$  as a product of its speed times a unit vector in the direction of motion, if  $v = 3i - 4j$  is a velocity vector. [CO3,Understand]
18. Compute the volume of the box determined by  $u=i+2j-k$ ,  $v=-2i+3k$ ,  $w=7j-4k$  [CO3,Apply]

19.

$$\begin{vmatrix} -5 & 3 & 1 \\ 2 & 1 & 1 \\ -4 & 3 & 1 \end{vmatrix}$$

1. Compute the determinant
2. Calculate  $u \times v$  and  $v \times u$  for  $u = 2i + 3j$ ,  $v = -i + j$

[CO3,Apply]

**Part C**

Answer any 1 question from the bunch of CO4. Each question carries 10 mark. (10x1=10)

20. Calculate T and N for the circular motion  $r(t) = (\cos 2t)i + (\sin 2t)j$ . [CO4,Apply]
21. Determine  $\kappa$  and  $\tau$  for the helix,  $r(t) = (a \cos t)i + (a \sin t)j + btk$ ,  $a, b \geq 0$ ,  $a^2 + b^2 \neq 0$ . [CO4,Apply]