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**MCH-014**

**MASTER OF SCIENCE IN  
CHEMISTRY/MASTER OF SCIENCE IN  
ANALYTICAL CHEMISTRY  
(MSCCHEM/MSCANCHEM)**

**Term-End Examination**

**December, 2025**

**MCH-014 : MATHEMATICS FOR CHEMISTS**

*Time : 1 Hour*

*Maximum Marks : 25*

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**Note :** (i) *Attempt any **five** questions.*

(ii) *Usual notations are used.*

(iii) *Use of calculator is not allowed.*

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1. (a) For  $X = \{x, y, z, v, w\}$ ,  $A = \{x, y\}$  and  $B = \{y, z, w\}$ , verify the De Morgan's law for the sets A and B. 3

- (b) Verify whether

$$dz = (51x^2y + 47y^4) dx + (17x^3 + 188xy^3) dy$$

is an exact differential or not. 2

2. (a) Prove that the points A (1, - 2, 3), B (2, 0, 4) and C (1, 2, 1) form a right-angled triangle. 3

- (b) Calculate the sum of the following series upto twenty terms : 2

$$(-3) + (-1) + 1 + 3 + 5 + \dots\dots\dots$$

3. Wave functions of a particle in a one-dimensional box of length  $a$  and infinite height is given as :

$$\psi_n(x) = \sqrt{\frac{2}{a}} \sin\left(\frac{n\pi x}{a}\right); n = 1, 2, 3, \dots\dots\dots$$

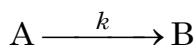
Show that the wave functions for  $n = 1$  and  $n = 2$  are orthogonal. 5

[Hint : for orthogonal condition

$$\int_0^a \psi_m^*(x) \psi_n(x) dx = 0]$$

4. (a) Find the maximum value of the function  $f(x) = x^3 - 3x$ . 3
- (b) If  ${}^nP_r = 3024$  and  ${}^nC_r = 126$ , find the value of  $r$ . 2
5. (a) The extent of dissociation of  $\text{PCl}_5$  at a certain temperature is 20% at 1.0 atm. pressure. Calculate the value of the equilibrium constant,  $K_p$ . 3
- (b) Show that the function  $z = \frac{x^2 + y^2}{x^3 + y^3}$  is homogeneous function. 2

6. Write the differential rate equation for the following first order reaction :



- (i) Solve this rate equation to get integrated rate equation. Plot a schematic graph between  $t$  and  $\frac{[A]}{[A]_0}$ ,

where  $[A]_0$  = initial concentration of A

$[A]$  = concentration of A at time

' $t$ ' and  $t$  = time 4

- (ii) Derive the expression for half life of the above reaction. 1

7. Solve the following set of equations, using the matrix method : 5

$$x + 3y + 2z = 6$$

$$-x + 4y + 5z = 8$$

$$2x + 5y + 3z = 10$$

8. (a) Define Binomial distribution and write the terms in the binomial expansion. 2
- (b) For a diabetes patient, the following levels of blood glucose are found at different times : 3

S. No.	Time	Glucose level (in g/L)
1	6 : 00 A.M.	1.013
2	7 : 00 A.M.	1.108
3	8 : 00 A.M.	1.201
4	9 : 00 A.M.	1.115
5	10 : 00 A.M.	1.075

Calculate the 95% confidence interval of the data at  $\sigma = 0.018$  g/L. [Given : the limit at 95% confidence level

$$= \pm \frac{1.96 \sigma}{\sqrt{7}} ]$$

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