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MCH–014

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

Term-End Examination

June, 2025

MCH-014 : MATHEMATICS FOR CHEMISTS

Time : 1 Hour *Maximum Marks : 25*

Note : *Attempt any* ***five*** *questions. Usual notations are used. Use of calculator is not allowed.*

1. (a) In how many ways we can choose 5 courses out of 9 courses being offered by the department ? 1

   (b) 1.50 mol of $PCl_5(g)$ is decomposed into $PCl_3(g)$ and $Cl_2(g)$ at 250°C. Calculate the concentration of these substances at equilibrium. Given that : $k_c = 1.80$. 4

2. (a) Calculate the work done on the object, when force $\vec{F} = 5i - 13j + 2k$ is applied to move it from a point A(2, – 1, – 7) to point B(8, 3, 1). 3

   (b) Draw a Venn diagram showing the relationship between rational numbers, natural numbers and the irrational numbers. 2

3. (a) Find the asymptotes of the following function : 1

$$y = a - \frac{b}{x}$$

   (b) Find the equation of tangent and the normal at $\theta = \frac{\pi}{4}$ to the curve given by $x = r\cos\theta$ and $y = r\sin\theta$. 4

4. State the Euler's theorem and verify the following function using the theorem : 5

$$f(x, y) = x^4 y^2 \sin^{-1}\left(\frac{y}{x}\right).$$

5. (a) Multiply the following matrices : 2

$$A = \begin{bmatrix} 2 & -3 \\ 1 & 7 \end{bmatrix} \begin{bmatrix} 1 & -2 \\ -3 & 5 \end{bmatrix}$$

(b) Find the eigen vectors of the matrix : 3

$$A = \begin{bmatrix} 4 & 1 \\ 3 & 2 \end{bmatrix}$$

6. (a) Two companies X and Y produce similar switches on the monthly basis. X produces 2500 switches of which 45 are defective. In the same time period Y produces 3800 switches of which 42 are defective. If a switch is chosen randomly, then find the probability of getting a defective switch manufactured by Y. 2

(b) Solve the following differential equation : 3

$$\frac{dy}{dx} = \sqrt{\frac{y}{x}}$$

7. Define error and discuss different types of errors observed in the acid-base titrations giving examples. 5

8. (a) For the following functions : 3

$$f : \mathrm{R} \to \mathrm{R} : f(x) = x + 5$$

and $g : \mathrm{R} \to \mathrm{R} : g(x) = 5 - x$

Calculate $f + g$, $f - g$, fg and g/f.

(b) Draw a plot of the function 3^{-t}. 2

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