DS-209

Roll No. .....
1000 -/-/30/40

February 2019

M. Sc. 1st Semester Examination

CHEMISTRY

Paper V (a) : Mathematics for Chemists (MCH-405)

Time 3 Hours] [Max. Marks : Regular 85 / Private 100
[Min. Marks : Regular 28 / Private 33

Note : This question paper is meant for all Regular and Private students. Answer all five questions. All questions carry equal marks. The blind candidates will be given 60 minutes extra time.

1. (a) If $r = 2\sin t\,\hat{i} + 3\cos t\,\hat{j} + t\,\hat{k}$ find :

   (i) $\frac{dr}{dt}$ (ii) $\frac{d^2r}{dt^2}$.

   (b) Prove the following :

   (i) div $r = 3$ (ii) curl $r = 0$

   Where $r = x\,\hat{i} + y\,\hat{j} + z\,\hat{k}$.

OR

(a) If $A = \begin{vmatrix} 1 & 0 & 2 \\ 0 & 2 & 3 \\ 1 & 2 & 3 \end{vmatrix}$ and $B = \begin{vmatrix} 3 & 1 & 1 \\ 1 & 2 & 3 \\ 0 & 1 & 2 \end{vmatrix}$ find $3A + 6B$.

(b) Find the inverse of the following matrices :

$$\begin{vmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 5 & 6 \end{vmatrix}$$

2. Solve any two of the following :

(a) If $y = \sqrt{\frac{1-x}{1+x}}$, prove that :

$$(1-x^2)\frac{dy}{dx} + y = 0.$$

(b) If $x = at^3$ and $y = a(5 + t^2)$ then find dy/dx.

(c) Find minimum and maximum value of the following function :

$3x^4 + 8x^3 - 18x^2 + 60$.

(d) In ideal gas equation $PV = RT$ find $\left(\frac{\partial V}{\partial T}\right)_P$ and $\left(\frac{\partial T}{\partial P}\right)_V$.

3. Evaluate any three of the following integrals :

(a) $\int \frac{(x+a)^3}{2\sqrt{x}}\,dx$ (b) $\int \frac{\tan x}{\sec x + \tan x}\,dx$ (c) $\int x \sin x^2\,dx$ (d) $\int \frac{x^5}{1+x^{1/2}}\,dx$.

4. Find the differential equation for bimolecular reaction :

$A + B \rightarrow P$.

OR

(a) Find the differential equation of the family of curves :

$y = e^x (A\cos x + B\sin x)$

where A and B are arbitrary constant.

(b) Verify that $y = 4\sin 3x$ is a solution of the differential equation :

$$\frac{d^2y}{dx^2} + 9y = 0.$$