[This question paper contains 4 printed pages.]

Sr. No. of Question Paper : 6007 **D** **Your Roll No...............**

Unique Paper Code : 235164

Name of the Course : **B.Sc. (Hons.) Chemistry**

Name of the Paper : Mathematics–I (MACT–101)

Semester : I

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. There are 3 Sections in this question paper.
3. Attempt any **two** questions from each Section.
4. Student are allowed to use scientific calculator without programming.

SECTION – I

1. (a) (i) The number a = 1.234 and b = 3.468 have been rounded to 4 significant figures. Determine the error bound for a – b. (2.5)

(ii) Show that $\ln(y) = (2.302585\ ...)\log_{10}y$. (2.5)

(b) (i) Solve the quadratic equation $x - 2\sqrt{x} = 3$. (2.5)

(ii) For which value of m will the equation $9x^2 - (m - 3)x + 1 = 0$ have real and unequal roots ? (2.5)

2. (a) Evaluate $\int_0^6 \frac{dx}{1 + x^2}$ by using sinpson's 1/3 rule. (5)

(b) The determination of the dipole moment of hydrogen chloride gas gave the following values

1.048, 1.047, 1.053, 1.048, 1.051, 1.053, 1.045, 1.051, 1.047, 1.047

Calculate the arithmetic mean, median and standard deviation of these values. (5)

3. (a) Evaluate $\lim_{x\to 0} \frac{1-\cos x^2}{x^2 \sin x^2}$. (5)

(b) Find the roots of the equation $x^3 + x^2 + 3x + 4 = 0$ up to four decimal places by Newton Raphson method. (5)

SECTION – II

4. (a) Use differential, Estimate the change in the pressure of 1.000 mole of an ideal gas at 0°C when its volume changed from 22.4141 to 21.4141. (6)

(b) Find the interval of convergence of the series

$$S(x) = \sum_{n=1}^{\infty} \frac{x^n}{n2^n} \qquad (6.5)$$

5. (a) Evaluate the integral

$$I = \int_0^{\pi} \cos^2\theta \sin\theta \, d\theta \qquad (6)$$

(b) Find the Maclaurin series and interval of convergence for $f(x) = e^{2x}$. (6.5)

6. (a) Find the n^{th} derivative of $\frac{1}{(ax+b)^2}$. (6.5)

(b) Define inflection point. Find local Extrema and inflection points of $f(x) = x^3 - 3x + 1 = 0$, over the entire x-axis. (6)

SECTION – III

7. (a) Show that the function $\psi = \psi(x) = A\sin(kx)$ satisfies

the equation $\frac{d^2\psi}{dx^2} = -k\psi$, where A and k are constants. (5)

(b) Evaluate (4)

$$\lim_{x\to\infty} \frac{\ln x}{\sqrt{x}}$$

(c) Find the second derivative of the function

$f = f(v) = ce^{-mv^2/2kt}$, where m, c, k and t are constants. (6)

8. (a) If $V(x, y, z) = (x^2 + y^2 + z^2)^{-1/2}$, show that

$V_{xx} + V_{yy} + V_{zz} = 0$. (5)

(b) Define exact differential. Show that the differential,

$du = \left(2xy + \frac{9x^2}{y}\right)dx + \left(x^2 - \frac{3x^2}{y^2}\right)dy$ is exact. (5)

(c) Find the value of the line integral,

$\int_C dF = \int_C [2x + 3y]dx + [3x + 4y]dy$. Where C is the straight line segment given by $y = 2x + 3$ from (0, 2) to (2, 7). (5)

9. (a) Show that $\frac{C_p}{C_v} = \frac{K_T}{K_S}$.

Where C_p: is a heat capacity at constant pressure.

C_v: is heat capacity at constant volume.

K_T: is isothermal compressibility.

K_s: is adiabatic compressibility. (5)

(b) Draw a graph of the function $y = e^{-|x|}$. Is the function differentiable at $x = 0$? Draw a graph of the derivative of the function. (5)

(c) Use Trapezoidal rule,

to evaluate $\int_1^5 \frac{1}{x}\,dx$ by dividing 1 to 5 into 8 equal parts. (5)