Section A (2×5 = 10 Marks)

1. Find whether the following function is continuous at $x = 1$:

$$f(x) = \begin{cases} \frac{x^2-1}{x-1}, & x \neq 1 \\ k, & x = 1 \end{cases}$$

2. If $f(x) = |x - 2| + |x + 2|$, find the points where $f(x)$ is not differentiable.

3. Find the particular solution of the differential equation:

$$\frac{dy}{dx} + y = e^x$$

Given that $y = 0$ when $x = 0$.

4. Find $\frac{dy}{dx}$ if $y = \frac{x^2+1}{x-1}$ using the chain rule.

5. Evaluate:

$$\int \frac{x^2 + 1}{x - 2} \, dx$$

Section B (4×3 = 12 Marks)

6. Evaluate:

$$\int \frac{2x + 1}{x^2 + x + 1} \, dx$$

7. Find the points of local maxima and minima for:

$$f(x) = x^3 - 12x + 5$$

8. Solve the differential equation:

$$(x + y + 1)dx - (x + y - 1)dy = 0$$

Section C (5×2 = 10 Marks)

Question 9:

A box with a square base and an open top must have a volume of 1000 cubic cm. Find the dimensions that minimize the cost of making the box if the base costs Rs. 2 per sq. cm and the sides cost Rs. 1 per sq. cm.

Question 10:

Find the area bounded by the curves $y = x^3$ and $y = x$. Also, find the points of intersection of these curves.

Section D (6×3 = 18 Marks)

Question 11: A manufacturer finds that the cost C (in rupees) of producing x units is:

$$C = x^2 + 36x + 360$$

Find: a) The average cost function b) The marginal cost function c) The minimum average cost and the corresponding number of units

Question 12: Solve the differential equation:

$$(y - x)\, dy = (x + y)\, dx$$

with the initial condition $y(0) = 1$. Verify your solution by substitution.

Question 13: Using integration, find the area between the curves $y = x^2$ and $y = |x|$ in the interval $[-1, 1]$. Draw a rough diagram to show the region clearly.