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| | Dr. Pankaj Shukla, Dr. Abhishek Kumar Singh, Dr Dhansekhar, Dr Berin Greeni A , Dr. Kirti Aarya, Dr Kalyan Manna, Dr Vijay Kumar Poshala, Dr. Sandeep Saha,Dr David Raj Michel,Dr Ankit Kumar | | | B1+1B1 |
| Time | : One and half Hours | Max. Marks | : | 50 |

**Answer all the Questions**

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| 1. | (i) Find all critical points of the function $f(x,y) = x^4 + y^4 - 2x^2 - 2y^2 + 4xy$ and check whether the function attains maximum or minimum at each of these points.<br>(ii) Show that point $(0,0)$ is neither a point of local minimum nor a point of local maximum for the function given by $f(x,y) = 3x^4 - 4x^2y + y^2$ for $(x,y) \in R^2$. | 10 |
| 2. | (i) If $x, y$ and $z$ are positive real numbers, then find the minimum value of function $x^2 + 8y^2 + 27z^2$, where $\frac{1}{x} + \frac{1}{y} + \frac{1}{z} = 1$.<br>(ii) Find the Taylor series expansion of $f(x,y) = \sin xy + x^2y + e^x$ in the power of $(x-1)$ and $(y-\pi)$ up to second degree terms. | 10 |

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| 3. | | (i) Find the value of integral by using the polar coordinates.<br>$I = \iint_D \sqrt{x^2+y^2}\, dydx$ *where* $D = \{(x,y) \in R^2 : x \le x^2+y^2 \le 2x\}$<br>(ii) Find the value of integral by changing the order of integration<br>$I = \int_0^4 \int_{(4-x)^{\frac{1}{2}}}^{2} e^{y^3} dydx$ | 10 |
| 4. | | Using multiple integrals, find the volume of the solid region bounded above by hemisphere $z = 1+\sqrt{1-x^2-y^2}$ and bounded below by the cone $z = \sqrt{x^2+y^2}$. | 10 |
| 5. | | Solve the following integrals by using Beta and Gamma Function:<br>(i) $I = \int_0^{\infty} \frac{e^{-\frac{k}{x^2}}}{x^6} dx$ *where* $k \neq 0$<br>(ii) $I = \int_0^1 x^4 \sqrt{1-x^2}\, dx$ | 10 |