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Continuous Assessment Test (CAT) – I – August 2018

Programme	: B. Tech	Semester	: Fall 2018-19
Course	: Calculus and Laplace Transforms	Code	: MAT1001
Faculty	: Dr. Anant Kant Shukla	Slot/Class No.	: B2+LB2+TB2/1076
Time	: 1 ½ hours	Max. Marks	: 50

Answer all the Questions

Q.No.	Question Description	Marks
1.	Show that the function $f(x, y) = \begin{cases} \frac{x^2 y^2}{x^4 + y^4}, & (x, y) \neq (0, 0) \\ 0, & (x, y) = (0, 0) \end{cases}$ is discontinuous at the origin and check if the partial derivatives with respect to x and y exist at the origin.	7
2.	Let $P = P(V, R, T)$ and is given by $P = RT/V$, where $R = R(t), T = T(t), V = V(t)$ then find dP/dt if at some $t > 0$, $R'(t) = 0.1, T'(t) = 0.1, V'(t) = 0.01, R = 2, T = V = 1$ units.	6
3.	Find $\partial w / \partial u$ and $\partial w / \partial v$ where $w = 0.5 (x^2 + y^2 + z^2)^{-1}, x = u^2 + v^2, y = u^2 - v^2, z = 2uv$.	7
4.	Prove the formula $\text{grad}(fg) = f \text{grad}(g) + g \text{grad}(f)$ for the functions $f = e^{xyz}, g = x + y$.	10
5.	Find the local extreme values of the function $f = \frac{y + x^2 y^2 + x}{xy}$ if exist.	10
6.	Find quadratic and cubic approximations of $f = \ln(2x + y + 1)$ near origin.	10

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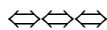
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Q.No.	Question Description	Marks
1.	Show that the function $f(x, y) = \begin{cases} \frac{x^4 - y^2}{x^4 + y^2}, & (x, y) \neq (0, 0) \\ 0, & (x, y) = (0, 0) \end{cases}$ is not continuous at the origin.	7
2.	The plane $y = 1$ intersects the surface $z = x^2 - xy + y^2$ in a parabola. Find the slope of the tangent to the parabola at point $(1, 1, 1)$.	7
3.	Let $w = f(x, y)$ and $x = r \cos \theta$, $y = r \sin \theta$ then prove that $(f_x)^2 + (f_y)^2 = (w_r)^2 + \frac{1}{r^2} (w_\theta)^2.$	7
4.	Find the directions of maximum and minimum change of the function $f = \frac{x}{y} - yz$ at the point $(4, 1, 1)$.	7
5.	Find the maxima, minima and saddle points of $f(x, y)$ if any, given that $f_x = 9x^2 - 9$ and $f_y = 2y + 4$.	7
6.	Find the level surface of $f = \frac{1}{x^2 + y^2 + z^2}$ and then find normal to that level surface at point $(1, 1, 1)$.	5
7.	Find the maximum and minimum values of $f = x - 2y + 5z$ on the sphere $x^2 + y^2 + z^2 = 30$.	10



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Q.No.	Question Description	Marks
1.	Find the normal to the surface $2z^3 - 3(x^2 + y^2)z + \tan^{-1}(xz) = 5$ at the point $(1,1,1)$.	7
2.	Show that the function $f(x, y) = \begin{cases} \frac{x^2 y^2}{x^4 + y^4}, & (x, y) \neq (0, 0) \\ 0, & (x, y) = (0, 0) \end{cases}$ is discontinuous at the origin and check if the partial derivatives with respect to x and y exist at the origin.	7
3.	Find an equation for the tangent plane on the surface $\cos(\pi x) - x^2 y + e^{xz} + yz = 4$ at the point $(0,1,2)$.	6
4.	Find the directional derivative of $f = xy^2 + yz^3$ at the point $(2,-1,1)$ in the direction of the normal to the surface $x \ln(z) - y^2 = -4$ at the point $(-1,2,1)$.	10
5.	Find the largest product the positive numbers x, y and z can have if $x + y + z^2 = 16$.	10
6.	Let $w = xy + yz + zx$, and $x = t, y = \cos t, z = \sin t$. Find dw/dt by direct substitution and by chain rule. Verify the results obtained.	10

