Reg. No.:

Name :

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 $f(x,y) = \begin{cases} \frac{x^2y^2}{x^4+y^4}, & (x,y) \neq (0,0) \\ 0, & (x,y) = (0,0) \end{cases}$ 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 $grad\,(fg) = f\,grad(g) + g\,grad(f)$ for the functions $f = e^{xyz}$, $g = x + y$.	10
5.	Find the local extreme values of the function $f = \frac{y+x^2y^2+x}{xy}$ if exist.	10
6.	Find quadratic and cubic approximations of $f = \ln(2x+y+1)$ near origin.	10

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Answer all the Questions

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 $$(f_x)^2+\left(f_y\right)^2=(w_r)^2+\frac{1}{r^2}\,(w_\theta)^2.$$	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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Time	: **1 ½ hours**	Max. Marks	: **50**

Answer all the Questions

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 $f(x,y) = \begin{cases} \frac{x^2y^2}{x^4+y^4}, & (x,y) \neq (0,0) \\ 0, & (x,y) = (0,0) \end{cases}$ 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 $\cos(\pi x) - x^2y + e^{xz} + yz = 4$ 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

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