

## Exam # 3 Topics (Lessons 25 - 38)

1. Limits of functions of several variables:  $\lim_{(x,y) \rightarrow (x_0,y_0)} f(x,y)$ , etc.
2. Partial derivatives, mixed partials:  $f_{xxy}$ ,  $\frac{\partial^2 f}{\partial y \partial x}$ ,  $f_{yxy}$ , etc.
3. The **Chain Rule**; Tree diagrams; **Implicit Differentiation** for functions defined implicitly by  $f(x,y) = 0$  or  $f(x,y,z) = 0$ , etc .
4. Gradients  $\nabla f$ , properties of gradients ( $\nabla f \perp$  level curves/surfaces, etc); Rate of change of  $f$  along a curve  $C : \mathbf{r}(t)$ ; directional derivative  $D_{\mathbf{u}}f$ .
5. Equation of tangent plane to surfaces defined as level surfaces  $f(x,y,z) = C$  or surfaces which are graphs of  $z = f(x,y)$ ; equation of normal line to surfaces; linearization  $L(x,y)$  of  $f$  at a point say  $(x_0, y_0)$ ; estimating changes in  $f$  using total differential of  $f$ .
6. Local/Relative max and min and saddle points of  $f(x,y)$ ; Hessian;  $2^{nd}$  **Derivative Test**.
7. Absolute max and min over closed and bounded (compact) regions.
8. Max and min of functions with a constraint; **Method of Lagrange Multipliers**.
9. Taylor's Formula for functions of several variables (recall **Basic Five Maclaurin Series**); Quadratic and Cubic Approximations.
10. Partial derivatives with a constraint:  $\left(\frac{\partial x}{\partial z}\right)_{t,y}$ ,  $\left(\frac{\partial w}{\partial t}\right)_x$ , etc.
11. Double integrals over regions  $D \subset \mathbb{R}^2$ ; Iterated integrals; Fubini's Thm;  $V$ -type and  $H$ -type regions; Change Order of Integration; areas and volumes using double integrals; the average of  $f(x,y)$  over a region  $D$  (i.e.,  $f_{av}$ ); **Change of Variables Formula in Polar Coordinates**.
12. Triple integrals over solid regions  $D \subset \mathbb{R}^3$ ; Iterated integrals; Projections of solid region  $D$  onto  $xy$ ,  $yz$ ,  $xz$ - planes; change order of integration; volumes using triple integrals; the average of  $f(x,y,z)$  over a solid  $D$  (i.e.,  $f_{av}$ ).
- 13.
- 14.
- 15.