Math. 302-01
Spring, 2005
R. B. Kearfott

Third Examination

Tuesday, February 22, 2005

Instructions: This exam should be done on your own paper. Your name should be on each sheet and on the back of the last sheet; the answers should appear written carefully and in order. If in doubt, show intermediate steps: Full credit may not be given, even for correct answers, unless work is arranged clearly and explained. This exam is closed book. You may leave after handing in your exam paper, but be sure to check your answers carefully. You may keep this exam sheet. Each entire problem is worth 30 points, while 10 points are free.

1. Write down all five first and second-order partial derivatives of $f(x,y) = x^2 \sin(x+y)$.

2. Compute the directional derivative of the function in problem 1 at $(x,y) = (\pi/2, \pi/2)$ in the direction $\vec{u} = (1/\sqrt{2}, -1/\sqrt{2})$.

3. Suppose the relative humidity H at a point x units to the right, y units forward, and z units up from a corner of a room, $x \in [0,20]$, $y \in [0,20]$, $z \in [0,12]$ is modelled by the equation

$$H(x,y,z) = 100\left(\frac{(z-6)^2}{72} + .5\right) e^{-\frac{x^2+(y-10)^2}{500}}.$$

A biologist has determined that a mosquito will fly in the direction of maximum increase in relative humidity. If a mosquito is at $(5,10,6)$, then:

(a) What is the relative humidity at the point where the mosquito is?

(b) In what direction will the mosquito fly? Give the direction as a vector.