Mathematics 25 Review for Midterm II
October, 2009

Basic scientific calculators may be used, but no calculators with symbolic and graphic capabilities. The exam will emphasize Chapter 3, through 3.9 (excluding 3.7).

Methods of differentiation: You should be able to use (and recognize when to use) the following general rules and techniques for differentiation:

1. Sum rule, constant multiple rule, power rule, product rule, reciprocal rule, quotient rule.
2. Chain rule.
3. Rule for inverse functions.
4. Implicit differentiation.
5. Logarithmic differentiation.

Basic differentiation formulas. You should know the formulas for the derivative of:

1. e^x, $\ln(x)$, a^x, $\log_a(x)$, x^a.
2. $\sin(x)$, $\cos(x)$, and the remaining trigonometric functions.
3. $\arcsin(x)$, $\arccos(x)$, $\arctan(x)$, $\text{arccot}(x)$.

Special limits you should know:

1. $\displaystyle\lim_{x\to 0}\frac{\sin(x)}{x} = 1$.
2. $\displaystyle\lim_{x\to 0}\frac{\cos(x) - 1}{x} = 0$.
3. $e = \displaystyle\lim_{x\to 0}(1 + x)^{1/x} = \lim_{n\to\infty}(1 + 1/n)^n$

Sample questions:

1. State the chain rule for the derivative of $f(g(x))$. Find the derivative of $\sin(\sqrt{x^2 + 1})$ and of $\sin^3(x^2 + 1)$.

2. Compute the derivatives of the following functions: (a) $\dfrac{4 - x^3}{3 + x}$ (b) $x^2\tan(x)$ (c) $\sqrt[5]{x} + \sec(x)$

3. Find the points on the hyperbola $x^2 - y^2 = 1$ where the tangent line has slope 2.

4. Find a formula for the nth derivative of $f(x) = \dfrac{1}{3 - x}$.

5. A 6 ft. tall man walks away from a 20 ft. tall light standard at a rate of 5 ft. per second. At what rate is his shadow lengthening when he is 20 ft. from the lamp post?