Study Guide

Here is a study guide for the course. We may, as the course progresses, be emphasizing slightly different aspects. But for now, this is the trip we are embarking upon, with the local points of interest mapped out before us, serving to whet our appetite for discovery.

How should you use a study guide? Well, you should **not** ignore it until the night before an exam! You should be referring to it continually, *expanding* or *deleting* it as you see fit with details and worked examples. With this extra layer of detail you will then have excellent study notes for exams, and later reference.

Review Notes for Chapter 1 are available online. I will only give you these for Chapter 1 since a major benefit of review notes is gained from creating them yourself!

Mathematica

the library of *Mathematica* commands we understand will grow throughout the year
keep a list of the basic commands we use and practice!

Functions and Models

1.1 Four Ways to Represent a Function
the definition of a function
the four representations
definition of domain, range, increasing, decreasing
piecewise defined functions
even and odd functions
1.2 Mathematical Models
the modeling process
interpolation and extrapolation
classes of functions
1.3 New Functions from Old Functions
mechanics and geometry of transforming functions
adding, subtracting, multiplying and dividing functions
composition
1.5 Exponential Functions
properties
translation and reflection
exponential functions as models for growth and decay
growth rates of exponentials as compared to polynomials
1.6 Inverse Functions and Logarithms
logarithmic functions
one–to–one functions

Limits and Derivatives

2.1 The Tangent and Velocity Problems
the tangent line viewed as the limit of secant lines
average versus instantaneous
zooming in and local linearity
approximating the slope
2.2 The Limit of a Function
various meanings of limit
geometric and limit definitions of vertical asymptotes
can we numerically compute a limit?
2.3 Calculating Limits Using the Limit Laws
algebraic computation of limits

graphical evaluation
examples of when limits don't exist
computing limits when limit laws do not apply
2.5 Continuity
graphical and mathematical definitions of continuity
examples of discontinuity
The Intermediate Value Theorem
2.6 Limits at Infinity; Horizontal Asymptotes
geometric and limit definitions of horizontal asymptotes
computation of infinite limits
the danger of using computers to check limits
2.7 Tangents, Velocities, and Other Rates of Change
slope of tangent line as limit of slope of secant lines
instantaneous rate of change as limit of average rate of change
2.8 Derivatives
notation
equation of tangent line
discrete data approximation
units of the dertivative
2.9 The Derivative as a Function
differentiable functions
how a function fails to be differentiable
sketching derivative function from the graph of the original function

Differentiation Rules

3.1 Derivatives of Polynomials and Exponential Functions
the power rule
the definition of e
3.2 The Product and Quotient Rules
use of the rules
justification of the rules
3.3 Rates of Change in the Natural and Social Sciences
3.4 Derivatives of Trigonometric Functions
3.5 The Chain Rule
use of the chain rule
justification of the chain rule
3.6 Implicit Differentiation
implicit functions and implicit curves
the technique of implicit differentiation
the derivatives of inverse trigonometric functions
3.7 Higher Derivatives
second and higher derivatives
physical meaning of higher derivatives
3.8 Derivatives of Logarithmic Functions
logarithmic differentiation
the concept of e as a limit
3.10 Related Rates
concept of related rates
procedure for handling related rates
THE VALUE OF WELL LABELED DIAGRAMS AND GOOD NOTATION
3.11 Linear Approximation and Differentials
linearization
the differential

Application of Differentiation

4.1 Maximum and Minimum Values
intuitive and precise definitions of local and absolute extrema
The Extreme Value Theorem
critical values
4.3 How Derivatives affect the Shape of a Graph
first derivative: increasing or decreasing
tests for maxima and minima
second derivative: concavity and points of inflection
4.4 Indeterminate Forms and L'Hospital's Rule
types of indeterminate forms
use of L'Hospital's Rule
4.7 Optimization Problems
how to set up and solve optimization problems
first derivative test for absolute extrema
checking results graphically
useful techniques to solve problems
4.9 Newton's Method
Newton's method and its uses
Geometric interpretation
speed of approximation
4.10 Antiderivatives
antiderivatives with and without initial conditions
position, velocity, acceleration
direction fields

Integrals

5.1 Areas and Distances
area under a curve as the limit of a sum of areas of rectangles
distance in terms of the velocity curve
Riemann sums
approximating of areas using rectangles
5.2 The Definite Integral
the precise definition of a definite integral
the concept of area versus signed area
the geometric and comparison properties of definite integrals
5.3 The Fundamental Theorem of Calculus
FTC1
FTC2
5.4 Indefinite Integrals and Total Change Theorem
definitions
5.5 The Substitution Rule

Multivariable Calculus