**LSU Calculus Syllabus**

**Basic skills that students should acquire during this course**

1. Limits and Continuity
   1. Evaluate limits from a graph
   2. Evaluate limits at points of continuity
   3. Evaluate limits of indeterminate forms using algebraic simplifications and l’Hôpital’s rule
   4. Know what continuity implies about a graph and behavior of a function
   5. Determine points of discontinuity for functions defined as formulas or graphs
2. Differentiation
   1. Know the various interpretations of the derivative (velocity, rate of change, slope of tangent line)
   2. Evaluate the derivatives of simple functions using a difference quotient
   3. Evaluate the derivatives of combinations of the basic elementary functions
   4. Take the derivative using implicit and logarithmic differentiation
   5. Find tangent lines and be able to use them as linear approximations
   6. Find critical values, local extrema and the intervals of concavity for differentiable functions
   7. Find absolute extrema of constrained functions
   8. Solve problems involving related rates
   9. Solve basic optimization problems
   10. Understand the Mean Value Theorem for Derivatives
3. Integration
   1. Understand anti-derivatives and know the basic anti-derivative formulas
   2. Have an understanding of the Riemann Integral as a limit of Riemann sums
   3. Be able to use both parts of the Fundamental Theorem
   4. Evaluate definite integrals using substitution
   5. Find the area between two curves and the volumes of solids of revolution
   6. Find arc lengths and areas of surfaces of revolution
   7. Understand the Mean Value Theorem for Integrals

**Sections of book covered and comments**

**Chapter 1** is a pre-calculus review.

**Chapter 2**

1. **Limits, rates of change and tangent lines.** The author employs the notions of tangents and velocity to motivate the idea of a limit.
2. **Limits. A Numerical and Graphical Approach.** A non-rigorous approach to limits to develop intuition.
3. **Basic Limit Laws.** The standard theorems on limits of sums, differences, products, etc. are stated in this section. The proofs must be deferred until the rigorous definition of limits is covered in Section 2.8.
4. **Limits and Continuity.** Continuity is one of the most important ideas in the course. The text uses the sequential criteria for continuity at points and then expands the discussion to intervals. One-sided continuity is discussed.
5. **Evaluating Limits Algebraically.** The idea is that of two functions are defined on an open interval and if they agree at all points in that interval except one, then if one has a limit at that point, so does the other, and the limits are the same.
6. **Trigonometric Limits.** The first interesting limit.
7. **Intermediate Value Theorem.** We will prove this.
8. **The Formal Definition of a Limit.** For deep thinkers.

**Chapter 3**

1. **Definition of the Derivative.**
2. **Derivative as a Function.** This is the introduction to the derivative as limit of a difference quotient. The student should be made aware of the derivative as an instantaneous rate of change, a tangent line slope and the velocity of a particle.
3. **Product and Quotient Rules.**
4. **Rates of Change.** This section stresses the rate of change and velocity interpretation of the derivative and gives examples of derivatives in use in other fields.
5. **Higher Derivatives.**
6. **Trigonometric Derivatives.**
7. **The Chain Rule.**
8. **Implicit Differentiation.**
9. **Derivatives of Inverse Functions.**
10. **Derivatives of General Exponential and Logarithmic Functions.** This section produces the derivatives of exponential and logarithmic functions. This section also includes the derivatives of the hyperbolic functions and the inverse hyperbolic functions.
11. **Related Rates.** This topic gives the students some trouble because they do not understand the chain rule. The two basic guidelines for related rate problems are: 1) differentiate with respect to time and 2) never substitute numerical values until you have differentiated. These two rules should help most students.

**Chapter 4**

1. **Linear Approximation and Applications.** This section revisits the tangent line and refers to the linearization of functions; the geometric interpretations of *dy* and Δ*y*.
2. **Extreme Values.** This section includes the definitions involving local extrema, critical values, Fermat’s Theorem and Rolle’s Theorem.
3. **The Mean Value Theorem and Monotonicity.** The section includes the Mean Value Theorem, the implications of the sign of the first derivative and the first derivative test. The MVT is a building block for the proofs of many other theorems.
4. **The Shape of a Graph.** This section deals with concavity and inflection points and the second derivative test.
5. **Graph Sketching and Asymptotes.** This section summarizes graphing techniques and introduces limits at infinity. The author discusses horizontal and vertical asymptotes. The summary chart on page 255 is useful.
6. **Applied Optimization.**
7. **L’Hôpital’s Rule.**
8. **Newton’s Method.** A method of approximating roots.
9. **Antiderivatives.**

**Chapter 5**

1. **Approximating and Computing Area.** This section motivates the formal definition of the Riemann Integral in Section 5.2. This material is quite important, as it establishes the presence of sigma notation, left and right hand sums and the midpoint approximation.
2. **The Definite Integral.** The basic properties of the definite integral.
3. **The Fundamental Theorem of Calculus, Part I.** Part I of the Fundamental Theorem, the integral evaluation result, is given a standard presentation.
4. **The Fundamental Theorem of Calculus, Part II.** This second form shows the beautiful interplay between the derivative and the integral.
5. **Net or Total Change as the Integral of a Rate.**
6. **Substitution Method.** The idea of substitution is important in Calculus II.
7. **Further Transcendental Functions.** This section demonstrates the use of the integral to define certain non-algebraic functions. In particular, the natural logarithm is defined in the traditional manner in this section.
8. **Exponential Growth and Decay.** Optional. This section is devoted to the differential equation governing the law of growth and decay.

**Chapter 6**

1. **Area Between Two Curves.**
2. **Setting Up Integrals. Volume, Density, Average Value.**
3. **Volumes of Revolution.**
4. **The Method of Cylindrical Shells.**
5. **Work and Energy.**

**Chapter 8**

1. **Arc Length and Surface Area.** Be advised that many of these integrals will be too difficult, since we are skipping Chapter 7. Of course, even if we covered Chapter 7 many of these integrals are non-elementary.
2. **Fluid Pressure, Force.** These are standard topics from physics. The warning about troublesome integrals is again appropriate.
3. **Center of Mass.** More from physics.