Final Exam Material and Expectations

For the final exam, you should be able to do the following things:

Chapter 2.

- Given a graph, find one-sided and two-sided limits
- Evaluate easy limits by plugging in the value
- Use limit laws to rewrite limits as necessary
- Evaluate harder limits by using some tricks, which include:
  - factoring polynomials and canceling common factors
  - expanding out polynomials, combining like terms, and refactoring
  - simplifying complex fractions by rewriting as a single fraction
- Given a graph, determine where a function is discontinuous
- Be able to state the limit definition of the derivative
- Know that the derivative gives the instantaneous rate of change, and also the slope of the tangent line to the graph
- Know the building block derivatives (full list of derivatives to know is at the end)
- Use the basic differentiation rules, including:
  - derivative of a sum is the sum of the derivatives
  - derivative of a constant multiple is constant multiple of the derivative
  - product rule
  - quotient rule
  - chain rule
- Find the equation of a tangent line to a curve
- Given a graph, determine where a function is not differentiable, or where the derivative is 0
- Compute second derivatives, and general higher derivatives
- Use f' to get where f is increasing or decreasing and find local maxima and minima
- Use f'' to get where f is concave up or concave down and find inflection points
- Given a graph, interpret the increasing/decreasing behavior and concavity behavior to make conclusions about f' and f''
- Solve applied optimization problems

Chapter 3.

- Interpret the definite integral as a measure of signed area between a curve and the x-axis
- Use knowledge of geometric shapes, like circles and trapezoids, to compute definite integrals
- Use basic integral rules, including:
  - integral of a sum is the sum of the integrals
  - integral of a constant multiple is the constant multiple of the integral
- By the Fundamental Theorem of Calculus, use antiderivatives to compute definite integrals and find indefinite integrals
- Know the building block antiderivatives (full list of antiderivatives to know is at the end)
- Interpret the definite integral of a rate of change as a measure of the net change, including in applications related to business and position/velocity/acceleration
- Use integration by substitution to solve definite and indefinite integrals
- Use a table of integrals to find antiderivatives
- Write a definite integral that gives the area between two functions
- Find the average value of a function on an interval

Chapter 4.

- Know basics about functions of several variables
- Interpret contour maps of level curves
- Compute partial derivatives and second partial derivatives, including mixed partial derivatives, of functions of several variables
- Know the different notations for partial derivatives (f_x vs $\frac{\partial f}{\partial x}$, etc)
- Use the partial derivatives of a function to estimate a nearby function value
- Find local extrema of a function of two variables by finding critical points and using the second derivative test

Derivatives and Integrals To Know.

- You should definitely have the following memorized:

(i) $\dfrac{d}{dx}\left(x^n\right) = nx^{n-1}$ $\qquad\qquad$ $\displaystyle\int x^n \; dx = \frac{x^{n+1}}{n+1} + C$

(ii) $\dfrac{d}{dx}\left(e^x\right) = e^x$ $\qquad\qquad$ $\displaystyle\int e^x \; dx = e^x + C$

(iii) $\dfrac{d}{dx}\left(\ln(x)\right) = \dfrac{1}{x}$ $\qquad\qquad$ $\displaystyle\int \frac{1}{x} \; dx = \ln(|x|) + C$