Outcomes List for Math 122-200802 Final Exam

This has been updated for the final exam:

The purpose of the Outcomes List is to give you a concrete summary of the material you should know, and the skills you should acquire, by the end of this course. As an overall summary, you should be able to do the following, after completing this course:

- Given a function, integrate using the most appropriate technique.
- Be able to solve physical problems such as work and volume calculations by identifying the relevant function and range, and integrating.
- Model a system using information on the forces of change in that system: construct descriptive differential equations, and be able to find physically meaningful solutions.

The Outcomes List will be updated for each exam. Homework problems from the book, as well as relevant examples from the text itself, are included as a study guide below.

The following information is for reviewing for the material we have covered since Exam 3.

Section 8.3: Given a "trigonometric integral", which includes powers of sin, cos, tan, sec, be able to find its anti-derivative, particularly using reduction formulas and trig identities for rewriting the integrand.
In addition to reviewing homework problems assigned to 8.3, look at (all references to 8.3):
Example 2, Example 3, Regular Problem 55.

Section 8.8: Given an "improper integral", which either has an "infinite interval" of integration, or an "infinite height", be able to evaluate it using limiting processes (integrating over a finite interval, or integrating on an interval away from the points of "infinite height").
In addition to reviewing homework problems assigned to 8.8, look at (all references to 8.8):
Example 3, Example 5

Section 11.1: Be able to write curve equations in both polar and rectangular form, and be able to convert between them. Be able to work with the formula for basic shapes in polar
coordinates: circles, lines, limacons, cardioids, rose curves, spirals. In addition to reviewing homework problems assigned to 11.1, look at (all references to 11.1):
Regular Problem 12, 20.

Section 11.2: Be able to use polar formulas to compute slope of the tangent line, as well as arclength. In addition to reviewing homework problems assigned to 11.2, look at (all references to 11.2):
Example 6, Example 8.

Section 11.3: Be able to use polar formulas to find volumes contained in polar curves. Be able to use polar geometry to analyze the graphs of polar curves to set up correct integration intervals. In addition to reviewing homework problems assigned to 11.3, look at (all references to 11.3):
Example 3. Regular problems 39, 41, 43. (Note: these arclength problems were not covered in the homework, but you are responsible for them).

Section 7.4: Be able to compute arclength of graphs of functions and parameterized curves. In addition to reviewing homework problems assigned to 7.4, look at (all references to 7.4):
Example 1.

The preceding information is for reviewing for the material we have covered since Exam 3.

The following information is for reviewing for the material of Exam 3.

Sections 8.5 and 9.1: The material for Exam 3 essentially comes from these two sections. Section 8.5 is on integration of rational functions, with a large emphasis on the purely algebraic problem of decomposing a rational function into partial fractions. Section 9.1 introduces differential equations, with the two main types discussed being first order linear equations and separable equations. The notions of general solution, specific solution with initial conditions, and integrating factors are discussed. The two main examples discussed (which include setting up the differential equation, and then solving it) are mixing problems and particles moving in the presence of gravity and air resistance.

Section 8.5 Given a rational function p(x)/q(x), be able to write down the correct partial fraction guess for the rational function. In the simplest case (complete factorization of q(x) into distinct linear factors), be able to quickly compute the unknown coefficients in the partial fraction guess. For more complicated situations, be able to write down the (linear) equations which determine the unknown coefficients. Be able to do the integrations associated with the most basic partial fraction "components".
In addition to reviewing homework problems assigned to 8.5, look at (all references to 8.5):

Example 2, Example 3, Quick Exercises 4, 5.

Section 9.1  Given a differential equation, be able to describe its order, and to state whether it is separable, or linear (or possibly both). Be able to solve first order linear equations using the method of integrating factor. Be able to solve separable equations by separating and integrating. Be able to use the general solution to obtain a specific solution, using a given initial condition. Be able to set up and solve mixing problems and air resistance problems as examples of differential equations.

In addition to reviewing homework problems assigned to 9.1, look at (all references to 9.1):

Example 3, Example 4, Example 5, Example 7, problem 57.

The preceding information is for reviewing for the material of Exam 3.

The following information is for reviewing for the material of Exam 2.

Chapters 7 and 8. The material for Exam 2 covers a selection of applications and techniques from multiple chapters, chosen to lay the groundwork as quickly as possible for uses of calculus that arise in engineering, physics, economics, and similar settings.

7.1 Find the area between the graphs of two functions over an interval of interest - construct an approximating Riemann sum and explain how it relates to the resulting definite integral. Find the area enclosed by two graphs which intersect. Explain the physical meaning of such areas in terms of accumulated difference between two quantities.

In addition to reviewing assigned problems from 7.1, look at (all references to section 7.1):

Example 2; Quick Check Problem 3; Regular Problems 3, 4, 14, 18
7.2 Find the volume of a figure of known cross-sectional areas - construct an approximating Riemann sum and explain how it relates to the resulting indefinite integral. Find the volume of the solid of revolution the graph of a function over an interval of interest, rotated about a given axis. Find the volume of the solid between two such rotated graphs.

In addition to reviewing assigned problems from 7.2, look at (all references to section 7.2):

Examples 1,3,5; Quick Check Problem 1,4; Regular Problems 6, 36

7.7 Define work. Relate it to an object's energy of motion. Relate work to gravitational force (weight) and altitude. Calculate work done in different physical circumstances - by a varying force as a function of position in an interval; by constant forces acting over different distances in an extended body - by setting up an approximating Riemann sum, and evaluating the associated definite integral.

In addition to reviewing assigned problems from 7.7, look at (all references to section 7.7):

Examples 4,5,6; Regular Problems 16, 19, 22

8.2 State the rule for integrating functions by parts. Suggest some useful guidelines for choosing substitutions to use this rule. Integrate products of functions, isolated inverse trigonometric functions, and similar integrands by parts.

In addition to reviewing assigned problems from 7.2, look at (all references to section 7.2):

Examples 4,6; Quick Check Problem 3; Regular Problems 7, 12, 39

The preceding information is for reviewing for the material of Exam 2.

The following information is for reviewing for the material of Exam 1.

Chapter 6: The Integral. In this chapter we define the integral of a function and view it in several contexts: as the inverse of differentiation, as the area under a curve, and as an accumulation of changes in a quantity. We develop a set of techniques for integrating common functions.
6.2 Relate integration and differentiation as operations on functions. Given a differentiation rule, construct the associated indefinite integration rule. Quickly integrate powers, polynomials, exponentials, and basic trig functions.

In addition to reviewing assigned problems from 6.2, look at (all references to section 6.2):

Quick check problem 2; Regular problems 2b, 6, 10, 36.

6.3 Simplify a complicated integral to a known form by substitution of variables.

In addition to reviewing assigned problems from 6.3, look at (all references to section 6.3):

Examples 11, 12; Quick check problem 3; Regular problems 18, 24, 26

6.4 Understand and evaluate the summation notation

State the summation operation's basic properties and some useful summations and limits of summations. Approximate the area under a curve as such a sum. Find the net signed area under a curve as a limit of such approximations. Find the total area under the curve, and explain the difference.

In addition to reviewing assigned problems from 6.4, look at (all references to section 6.4):

Examples 2, 3, 5; Quick Check Problems 2, 3; Regular Problems 28, 29.

6.5 Given a function over an interval, construct the associated Riemann sum. Evaluate the definite integral of an integrable function over a given interval. Explain the geometric meaning of this quantity. Explain what it means for a function to be integrable, or not. Describe some useful properties of the definite integral.

In addition to reviewing assigned problems from 6.5, look at (all references to section 6.5):

Examples 1, 2; Quick Check Problems 2, 3; Regular Problems 6, 10, 30, 32

6.6 Relate definite and indefinite integrals. State the Fundamental Theorem of Calculus. Use this theorem to calculate areas under curves by integration. State the Mean-Value Theorem for integrals and discuss its meaning in terms of averaging. Track accumulation of changes in a system via integration.

In addition to reviewing assigned problems from 6.6, look at (all references to section 6.6):
Examples 3, 7, 8, 10, Regular Problems 18, 30, 56

6.8 Explain the effect of substitution of variables (from 6.3) on definite integration. Evaluate definite integrals using this technique.

In addition to reviewing assigned problems from 6.8, look at (all references to section 6.8):

Examples 3a, 3b; Quick Check Problem 2; Regular Problems 4, 10, 22, 36

The preceding information is for reviewing for the material of Exam 1.