Fall 2003

Math 172
Course Description and Suggested Weekly Schedule

Math 172 is the second of a three semester beginning calculus sequence, which is taken, for the most part, by math, chemistry, and physics majors. The department expects that students passing Math 172 will be able to set up an appropriate definite integral to solve the applied problems (areas, volumes, arclength, work, and force) discussed in the course. Students must understand the relationship between definite integrals and Riemann sums, and be able to clearly state (write) this relationship. Regarding infinite series: students are expected to know what an infinite series is, how to use the convergence tests, be able to clearly state them, and explain (prove) why they work. Students are expected to know the alternating series test, including the error estimate for this test and the error estimate from the integral test for positive term series.

The instructor should not feel that he/she cannot test over topics which were covered in 171. For example, the Mean Value Theorem can be used to derive error estimates for some numerical integration techniques. Asking students to state this theorem, and perhaps apply it in a simple manner is entirely appropriate.

Students should become familiar with the standard notations of logic and set theory. Examples can be found at the end of this document.

Students should be required to demonstrate that they have learned the appropriate definitions and theorems. Keep these facts in mind when assigning homework, constructing quizzes or writing exams. (have link here to sample exam questions)

The priorities of this course are:

1. Ability to correctly solve problems,and write the solutions in a coherent fashion.
2. Conceptual understanding of material

The syllabus for this course does not leave much time for anything else. Instructors will have to take pains to stay on schedule. In order to ensure that conceptual ideas and computational techniques are covered and thoroughly discussed, the amount of time spent on Maple has to be carefully controlled. There are at least 13 class periods spent in a computer lab. It is suggested that only 2 or at most 3, of these days be used for Maple. This is not to say that Maple should not be used in the lecture. If the instructor feels that a Maple demo has pedagogical value, then he/she should feel free to present the demo. The question that needs to be addressed is what should a student learn about Maple. The answer, at least for Math 172 is,

- How to integrate.

The instructor needs to keep in mind that the department offers a sister sequence, which is taken by engineering majors. It is very common for students to start in one of these sequences and finish in the other. Because of this, it is imperative that ALL of the topics in the syllabus be covered.

Weekly Syllabus for Math 172

Week 1: Sections 6.1 – 6.5. Except for 6.5 this material has been covered in 171, and will be a review.

Week 2: Sections 6.6, 7.1, 7.2.

Week 3: Sections 7.3 – 7.5. Section 7.5 contains the mean value theorem for integrals, a result we expect students to know. Rather than relegate its proof to the exercises, it is suggested that the intermediate value theorem for continuous functions be used to prove this result. *Note: in the applications sections of Chapters 7 and 9, it is important for students to see the integrals derived from their underlying Riemann sums.*

Week 4: 8.1 – 8.4. Students should be able to derive the integration by parts formula. Do not spend a great deal of time in section 8.2. Students should learn how to integrate the following standard forms for small values of n:

$$\int \sin^n x\,dx\,, \qquad \int \cos^m x\,d,\,, \qquad \text{and} \int \sin mx\ \cos mx, dx$$

Students are expected to know the anti derivatives of all 6 trig functions, but don't get bogged down with all of the myriad possibilities. In particular don't worry about the $\sec^{-1}$ substitution in section 8.3. In section 8.4 don't ask students to do much more than

$$\int \frac{dx}{(x-a)(x^2+1)}\,.$$

Students of course should be able to transform integrals into the above or an equivalent form.

Week 5: Exam 1 (through section 8.4), then section 8.9, improper intergrals.

Week 6: Sections 8.8, 9.1, and 9.2. Section 8.8 is on numerical integration. Cover the trapezoidal rule and the error estimate. Simpson's rule does not have to be covered, and in the interest of time probably should not be.

Week 7: Sections 9.3 and 9.6.

Week 8: Section 10.1 Give exam 2 about now. It should cover the material through section 9.6.

Week 9: Sections 10.1 and 10.2. Spend some time in section 10.1. Be sure to prove some of the limit theorems, and show how the monotone convergence theorem is used. Students are expected to be able to state this theorem. The summation formulas, e.g., the series of a sum is the sum of the series, and similar algebraic properties of convergent series should be proven, and students held accountable for these proofs. Students are expected to know the summation formula for a geometric series, be able to derive it, and know where it is valid.

Week 10: Sections 10.3 and 10.4. The text discusses four tests for the convergence of a positive term series, comparison and limit comparison, integral, and ratio. Students should be able to state these tests in writing, and be able to use them. The same comments apply to the Alternating Series test. Students should know that the harmonic series diverges, and the alternating harmonic series converges, and be able to explain why.

Week 11: Sections 10.5 and 10.6.

Week 12: Section 10.7 and 10.9. Students should be able to use Lagrange's formulas for the remainder (error) term when approximating a function with its n^{th} order Taylor polynomial. The integral form for the remainder term could also be derived.

Week 13: Section 10.8 can be covered at the instructors discretion. In the Fall semester, Thanksgiving break occurs in week 13.

Week 14: Exam 3 and review.