Math 138: 10–12 — Spring 1997
MW6 HCK–138
Prof. Bumby

My other class meets MW5 on this Campus, so I will be holding office hours in the Math Department outpost on the second floor of the Chemistry building during the fourth period on those days. You may also make an appointment to meet me at other times at my regular office, Hill 438, on Busch Campus. I read electronic mail almost every day, so that is the most reliable way to contact me: the address is *bumby@math* from any machine in the *rutgers.edu* domain. There is also an answering machine on my phone, so you may leave a telephone message by phoning 445-0277.

The texts for the course is Roland E. Larson, Robert P. Hostetler and Bruce H. Edwards, *Calculus of a Single Variable: Early Transcendental Functions*, D. C. Heath and Co., 1995 [ISBN 0-669-39346-7], which you should have from Calculus 135, and various supplements. These supplements replace some parts of a traditional second semester calculus course with topics from linear algebra and elementary differential equations. Not enough calculus is covered to serve as a prerequisite to a third semester calculus course. Furthermore, there is significant overlap with the Linear Algebra course 250, and the Differential Equations courses 244 and 252. If your plans call for taking additional mathematics, it is likely that you should take 152 instead of this course and prepare to take a second year of Calculus. If you are not sure that you belong in this course, consult a Mathematics Department advisor.

The greatest temptation in this course is to put off study until an exam is seen on the horizon. However, the only way to learn the subject is by regular practice. Although the department does not use this system generally, I have adopted a policy of giving frequent examinations. In particular, I am planning to give four exams (I gave six exams in 135), all in lecture. Since the recitations for this course meet on Tuesday, exams should be scheduled for Wednesday. The dates (and subject matter) are February 05 (integration), March 05 (differential equations), April 02 (linear algebra), and April 30 (population models). No books or papers may be used for reference during any exam. However, since graphing calculators have been required in this sequence of Calculus courses, their use on exams is expected.

These exams are designed to take less than a full period, so there will be some time at the beginning of the period for a brief lecture indicating where the course is going next and to distribute a printed guide to the next segment of the course.

The job of the recitation instructor is to get you ready for exams using any method that works. No recitation grades will be part of the total on which grades for the course are based, although homework or quizzes may be graded as an indication of preparation for the exams. The time between exams is so short that all class time will be needed to prepare for exams.

I will circulate a sign-up sheet at every lecture. If you are not listed on the sheet, write your name (neatly) at the end. The official roster uses only a simplified representation of names. You should correct any errors that I have made in transcribing your name. Also, the appearance of your name on these sheets can be customized to agree with the way it is usually written, restoring correct capitalization, punctuation and accents. A note in the margin next to your name should suffice to allow corrections to be made in future lists. Each sign-up sheet will include all those who have attended a previous class as well as those on the original roster. Appearance on this list is no guarantee that you are properly registered, but section numbers will appear only for names on the most recent official roster. If you require special permission to register for this course, you should use the form available in the Department Office. I will not sign individual add-slips. **The Mathematics Departments encourages students to attend class pending completion of registration.**

Here are the details of the sections of the textbook to be covered in the first segment of the course.

section	lecture date	page	problems
4.5	January 22	313	8,16, 30, 36, 44
5.1		341	2, 4, 6, 8, 10 ,20, 22, 26, 28, 34
5.2	January 27	348	10, 12, 18, 26, 28, 30, 36, 58
5.5		377	12, 16, 18, 22, 28
4.6	January 29	323	NONE
5.6		386	2, 6, 10, 16, 22, 26, 28, 34
7.1	February 03	476	16, 18, 20, 22, 30, 42
7.2		486	10, 14, 18, 26, 28, 30

These problems should be done promptly after the lecture, allowing the most interesting problems to be discussed in the following recitation. I realize that this is a little hurried. The material in the whole course has been arranged to group similar topics together and this favors an early exam on this material.

Much of the material here is only a slight extension of topics covered in 135. The exception is section 7.2 on *Integration by parts*. This is a new technique and somewhat confusing as it is usually presented. The statement of theorem 7.1 (page 479) looks easy enough. It just says

$$\int u\,dv = uv - \int v\,du, \qquad (IP)$$

and the proof (which precedes the statement) consists of rewriting the product rule of Differential Calculus. However, this can only be used by identifying functions in a given expression that will play the roles of u and v. One wrong guess and the formula will tell you something which, while true, is totally useless. For this reason, I rarely use this rule myself. It is acceptable for examples that can be handled with a single application of formula (IP), but too much can go wrong when you need to use the formula repeatedly, as in Example 4 (p. 482) or (especially) Example 5 (p. 483). Indeed, you can get a parody of Example 5 by using substitutions leading to the *same* function in the role of uv, but making a mistake in one of the calculations. Any method that encourages such sloppy work should not be encouraged.

What is really going on here is that you are looking for the pattern $u\,dv$ and using it to find a function uv whose derivative will have some relation to the quantity that you want to integrate. It is clearer to build a table of such functions uv and their derivatives, allowing you to examine these formulas before committing yourself to using them as a step in the solution of the given problem.

Differential Calculus thrives on symbolic methods. The Integral Calculus is not like that at all. The only real method is to guess the antiderivative and then check your guess. The method of substitution, and (to a lesser extent) the method of integration by parts, allows you to replace the problem of evaluating one integral by that of finding a simpler integral. To the extent that this works, it involves recognizing patterns arising from the use of the Differential Calculus.

The place where Integral Calculus shines is in the use of numerical methods to find definite integrals (section 4.6). Don't be misled by the fact that no exercises have been assigned from this section, and that, with few exceptions, only indefinite integrals are assigned in the other sections. Your calculator can use Simpson's rule to approximate any definite integral, so you can check any of your answers by inventing definite integrals with the same integrand and comparing the values obtained from your claimed indefinite integral with the approximations given by the calculator. If you cannot explain a discrepancy between these answers, then you have made a mistake. You are encouraged to make mistakes in private, and even when discussing the problem in the recitation class, in order to correct the causes of the errors before you need to use these methods to get correct answers.