Math 251:10–12 — Spring 1999
MW6 CHM-106
Prof. Bumby

Special announcement. Recitations normally meet on Thursday afternoon (period 4, 5, or 6) on the Douglass Campus as announced in the schedule, but all recitation classes on Thursday, January 21, will be held in the Loree PC Lab instead of the regular classroom.

Office hours. I will be holding office hours for about $\frac{1}{2}$ hour before class in the Math Department room on the second floor of the Douglass Chemistry building. Other office hours will be held in my regular office on Busch Campus — **Hill 438**. I expect to be there most of the day on Tuesday and Friday, but will set **Friday 2–3PM** as my *drop-in* office hours. Appointments may also be made for other times at that location. 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. You may also leave telephone messages, or catch my ear if I am in the office, by phoning 445-0277.

Textbook. The text for the course is James Stewart, *Calculus: early transcendentals*, Brooks-Cole, 1995 (ISBN 1-534-25158-7). This course covers chapters 11–14.

Final Exam. The official schedule says that the final exam for this lecture section will be given on Wednesday, May 12, 8–11 AM. It is likely to be in the regular lecture room, but changes may be announced within the last two weeks of the term. It will cover material from the whole course. It will contribute about $\frac{1}{3}$ of the course grade.

Class exams. There will be four exams, one at the end of each topic, during the term instead of the usual two. Since the exams cover less material, there will be a little time before each exam to allow everyone to get settled, during which there will be announcements and a brief description of what the next batch of lectures will cover. In order to do everything that is supposed to be in the course when more time is given over to exams, everything must be done on a rigid schedule. The exam dates are fixed as: Monday, February 08; Monday, March 01; Monday, March 29; and Monday, April 19. This leaves four lectures after the last exam, which allows for a detailed review of the course. If you must miss an exam, let me know immediately. The pace discourages the use of make-up exams, but an attempt will be made to find an equivalent of the scheduled exam. Note that the entire content of the course will be covered by these exams. The four class exams will contribute about $\frac{1}{3}$ of the course grade.

Recitation work. Only even numbered problems will be assigned. They are intended to illustrate possible exam questions. The solution of these assigned problems will be an important part of the recitation class. Your preparation for doing these problems may include doing some nearby odd numbered problems and checking your answers. The examples in the text should give you an idea of how the solution should be organized. The time between exams is short enough that you will need to work at solving problems as soon as a topic is introduced. A portion of each class will be devoted to "workshop" problems and discussion of the *Maple* projects. The remaining $\frac{1}{3}$ of the course grade will be based on these projects.

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Here are the topics to be covered in the lectures on Chapter 11 leading to an exam on February 08.

Date	Section	Page	Problems
January 20	11.1	668	6, 10, 14, 16
	11.2	675	12, 16, 20, 24
January 25	11.3	680	2, 6, 16, 22, 38, 42
	11.4	687	2, 6, 10, 20, 22, 26
January 27	11.5	696	2, 4, 14, 22, 28, 36
February 01	11.7	711	16, 42, 44
	11.8	719	2, 4, 12, 14, 16, 18
February 03	11.9	727	26, 28

Section 11.1 serves mainly to establish notation, but it introduces the distance formula in three dimensions. This leads to problems dealing with the various forms of the equation of a sphere, which are well suited for exam questions — just as similar problems about circles were popular in earlier courses. Questions dealing with graphing of equations and inequalities have been skipped, although they deal with important techniques, because they are not good examination questions.

The treatment of vectors in this course is more geometric than the treatment in a Linear Algebra course. In a sense, section 11.2 goes back to an old definition that says that vectors are objects having *length* and *direction*. In this context, the direction of a vector can be defined as a unit vector parallel to the given vector. Several notations for vectors are introduced, which will be used freely throughout the course.

Section 11.3 introduces the term *vector projection* of a vector **b** on the vector **a**, denoted $\operatorname{proj}_{\mathbf{a}} \mathbf{b}$, for the perpendicular projection of **b** on the direction of **a**. This is necessarily a vector parallel to **a**. A *scalar projection* of **b** on **a**, denoted $\operatorname{comp}_{\mathbf{a}} \mathbf{b}$ (the notation is derived from the alternate terminology *component* of **b** along **a**), is also introduced. The absolute value of $\operatorname{comp}_{\mathbf{a}} \mathbf{b}$ it the length of $\operatorname{proj}_{\mathbf{a}} \mathbf{b}$, and $\operatorname{comp}_{\mathbf{a}} \mathbf{b}$ is negative if the angle between **a** and **b** is obtuse. This construction is important, so you can expect to see it on the exam, expressed in this notation.

The cross product of section 11.4 is a construction that is peculiar to three dimensions, but it allows an efficient organization of many computation in a way that respects the underlying geometry. An important application produces a vector perpendicular to the plane containing two vectors.

Section 11.5 fixes the terminology associated with equations of lines and planes and contains many examples of how those equations are found from geometric information.

Many of the problems in section 11.7 are better suited to study with the help of Maple than to being used as exam questions. You can try to produce your own version of the illustrations in the text using *Maple*. The function you need is called `spacecurve` and it is part of the `plots` package.

Section 11.8 is the most significant section in this part of the course. The topic of *arc length* is so important that a great effort has been made in textbooks to locate examples that will lead to integrals that can be found in closed form — suitable for exams. Some of these are surprising. This section also gives several formulas for curvature, and it is important that you be able to use *all* of them. Concentrate on learning to *use* the formula, rather than memorize it. You will be given the arc length formulas on the exam, but no additional clues on using them. Although they are all equivalent, one formula may lead quickly to a more useful simplification. You should experiment with different formulas in *Maple*. It is often convenient to use one formula when talking about a quantity and a different formula when computing it.

Section 11.9 serves mainly to illustrate 11.8. No problems from sections 11.6 and 11.10 will be assigned at this time. These sections will appear later when we are ready to use the topics they contain. If there is time, there may be a brief discussion of these sections in a lecture devoted to a neighboring section.