22M:034 Section 101 and Section 121
Engineering Mathematics IV: Differential Equations
3 s.h. Spring 2004

Instructor: Professor P. Jorgensen
25B MLH
Office hours: Th, F 2:30-3:30 p.m. or by appointment
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Section 101: MWF 10:30-11:20 AM, 218 MLH; Section 121: MWF 12:30-1:20 PM, 213 MLH
Prerequisites: 22M:22 or 22M:26 or 22M:32 or 22M:36
Co requisite: 22M:40

Book: Elementary Differential Equations by Boyce & DiPrima (7^{th} ed.), published by Wiley, available in both the book stores, Iowa Book and Supply and University Book Store in the IMU.

Textbook Material Covered: The sections to be covered are given below. It is strongly recommended that you read the sections before they are covered in class. The instructor may cover new material in ways which complement rather than duplicate the information in the textbook. Thus the instructor may elaborate on and clarify the concepts and examples in the textbook or present other examples. This syllabus may be modified by the instructor during the semester. Such modifications will be announced in advance during class periods; students are responsible for keeping abreast of such changes.

Goals and Objectives: The general goal of this modeling course is to develop the student's ability to investigate solutions of ordinary differential equations by analytical and graphical methods, and to become confident in their use. One objective is to have the student be familiar with the standard methods available for finding explicit solutions of linear, constant coefficient differential equations, and linear systems of differential equations. Another objective is to introduce the student to the qualitative analysis of nonlinear differential equations. A final objective is to help the student understand the formulation of engineering, physics, and biological problems as mathematical models.

Problems and Concerns: I hope that you enjoy this course and I am looking forward to meeting each of you and to talking with you about any concerns you might have. Information concerning "Student complaints about Faculty Actions" is found in the Spring Schedule of Classes. The Department of Mathematics has offices in 14 MLH. To make an appointment to speak with the chair of the department, call 335-0714 or contact the Departmental Secretary in 14 MLH.

Note: Students with disabilities are invited to discuss possible accommodations with me after class or during office hours.

Examinations and Grading: Course grades will be computed as follows: 40% will be based on two in-class midterm exams, 30% on a comprehensive final exam (given as scheduled in the Schedule of Courses except for evening students, whose final shall be held the last day of classes) and the remaining 30% homework and/or quizzes and attendance.

Expectations: Attendance, homework, quizzes every week, 2 computer projects, 2 midterms in class, final exam.

This course plan may be modified during the semester. Such modifications will be announced in advance during class periods; the student is responsible for keeping abreast of such changes.

Exams, homework, computer assignments, and grading: There will be two 50-minute **midterm exams** (100 course points each) **Wednesday, March 3rd and Wednesday, April 14th,** and a 2-hour final (200 course points). The **final** is tentatively set for **Wednesday, May 12, 2004**; see details in the Final Exam Schedule on the web.

There is a **homework assignment due every Wednesday**, and there is also a **15 minute quiz** at the end of each Wednesday lecture.

There will also be **2 computer projects**, each of which will be due 1 to 2 weeks after the day on which it is assigned. It is not assumed that you are an expert in any particular operating system or computer algebra software in advance. Class handouts connected with the computer assignment will offer help with the machines in the Mathematics Department's Computer Lab (B5 MLH), which run Linux. Things should look roughly the same on the machines in the Engineering labs 1220 and 1241 SC. You are free to use another platform (e.g. PC, Macintosh) and/or computer algebra package (e.g. Mathematica) if you wish; however, there will be no support on these.

Attendance and Absences: Students are expected to attend the lecture and to read the textbook for comprehension. It is recommended that you read the sections to be covered in class before the lecture. You are responsible for material covered in the lecture as well as material from the text which is assigned but not covered in class. Lecture time is at a premium. You cannot be taught everything in class. It is your responsibility to learn the material; the instructor's job is to guide you in doing your learning. Students are also responsible for changes to the syllabus (such as changes in exam dates) announced in class. As a general rule, you will find that you must spend at least one hour of study for each hour in class and additional time for quiz and exam preparation. It is strongly advised that you start working on this course and use the Math Lab (314 MLH) from the very beginning. The importance of doing homework cannot be overemphasized. You are also responsible for announcements made during class; these may include changes in the syllabus. Absences from exams will require a compelling reason, and must be arranged with your instructor in advance.

Tutoring: There is an engineering tutoring program available. For more information visit http://www.engineering.uiowa.edu/~sdcnet/ or contact Angel Jordan at 319-335-5763. You are encouraged to contact Ms. Jordan early to let her know that you are interested.

Sections to be covered: Some topics in the course take more time than others, so one line in the following list does not represent any specific number of class minutes. The reading given below will occasionally be supplemented with extra material (handouts) given in class. The assignment given at the end of class will usually be a list of problems. The reading assignment may not be mentioned explicitly, but you should read the passages in the text corresponding to the problems assigned.
In the problem lists below, (usually) only the first page of the problem set in the book is listed. Thus, for example, P.183, #31 is actually on page 185. These are some of the main sections that will be covered during the semester, and more will be added as the course progresses. The problems represent only a sample. There will be more.

First-order methods

TOPIC	READING	PROBLEMS
Generalities; direction fields	Secs. 1.1, 1.3, 1.4	p.8: #1, 2, 11, 14, 21, 22
Exponential growth and decay; related problems	Sec. 1.3, Sec. 2.3: Example 2	p.14: #1, 6, 7, 8, 12, 13; p.57: #6, 7, 9, 10, 18
Separable equations	Sec. 2.2	p.45: #1, 2, 7, 8, 13, 14, 25
Linear equations	Sec. 2.1	p.38: #1, 2, 5-8, 18, 19, 30
Bernoulli and logistic equations	Sec. 2.4, Sec. 2.5: through p. 80	p.72: #27-31; p.84: #15, 22b
Reduction of order; gravitation	p. 137, paragraphs "Equations...missing;" p. 56, Example 4	p.136: #29-31, 34, 39, 40, 43; p. 57: (21-25)a, 29, 30

Second-order methods

TOPIC	READING	PROBLEMS
Mechanical and electrical oscillation	Sec. 3.8 through Example 1, and from p.195 (Electric Circuits) to end	p.197: setup only on #5, 7, 8, 11, 12; and # 15
Linear, constant coefficient equations; complex exponentials, operator methods	Secs. 3.1, 3.4, 3.5 (except pp.165-166, "Reduction of Order")	p.136: #2, 5, 8, 11, 14, 17; p.158: #1-6, 9, 12, 15, 18, 21, 29, 32; p.166 #3, 6, 9, 12
Undetermined coefficients	Sec. 3.6	p.178: #3, 6, 9, 10, 19a, 21a, 22a, 24a, 25a, 32-36
Oscillation and resonance	Secs. 3.8, 3.9	p.197: #5, 7, 8, 11, 12, 14, 19; p.205: #1, 2, 7, 8

The Laplace transform

TOPIC	READING	PROBLEMS
The Laplace transform **L**	Sec. 6.1	p.298: #2, 3, 13-15, 18
Solving initial value problems using **L** and $\mathbf{L}^{-1}$	Sec. 6.2	p.307: #2, 5, 8, 11, 14, 20, 21
Discontinuous inputs and **L**	Secs. 6.3, 6.4	p.314: #8-10, 12, 15, 24, 25, 28, 29; p.321: #2-4, 10
Impulse functions	Sec. 6.5	p.328: #2, 5, 8, 11, 17, 18
Convolution, impulse response, transfer function	Sec. 6.6	p.335:#8, 9, 13, 15, 17

More second order

TOPIC	READING	PROBLEMS
Linearity; the Wronskian	Secs. 3.2, 3.3	p.145: #2-4, 6, 13-15, 19; p.152: #1-8, 15-18, 27
Variation of parameters	pp.165-166, "Reduction of Order;" Sec. 3.7	p.166: #24, 27, 29, 31; p.183: #5, 7, 14, 15, 17, 19, 28, 29, 31

Nonlinear equations and systems

TOPIC	READING	PROBLEMS
Systems: generalities	Sec. 7.1	p.344: #3-5, 7, 18-20

Plus: As time allows, material from Sec. 7.5-7.9 on constant-coefficient linear systems. As we get closer to the end of the semester, we'll see how much of this we can do.