COURSE: Math 302 - Differential Equations
INSTRUCTOR: Dr. Merv Newton
OFFICE: AC-131
OFFICE HOURS: Mon, 9 - 10, 11 - 12, 1 - 2
Tues, 2 - 3
Wed, 9 - 12, 1 - 2
Thur, 9 - 10, 2 - 3
Fri, 9 - 10, 11 - 12
Or by appointment

PHONE: 2035

REQUIRED MATERIALS:

Text: Guterman & Nitecki - *Differential Equations* 3rd Ed.
Calculator: HP-49G+

GRADING:

Test 1	Feb 3	Chapter 1	15%
Test 2	March 3	Chapter 2	15%
Test 3	March 31	Chapter 3	15%
Test 4	April 27 (10:30 AM)	5.1-5.7, 6.2, 6.3	15%
Total of special problems			15%
Total of regular homework			15%
Class participation			10%

HOMEWORK:

There are two types of homework in this course. On the pages below are lists of problems and the day they are due. These are "regular homework" which should be done with pencil and paper the way you have always done math homework.
On page 5 of this syllabus is a list of seven "special problems." Follow the instructions on that page.

SPECIAL NEEDS

It is the policy of Thiel College and its educational programs not to discriminate against qualified students with documented disabilities. Students desiring accommodation for a disability are responsible for providing evidence from a qualified professional confirming the disability and identifying appropriate interventions. This evidence should be taken to the Office for Special Needs AC-126 as early as possible in the semester. The Coordinator of the Office of Special Needs will develop a letter of accommodation to be sent to course instructors and other appropriate offices.

If documentation is already on file, the students with disabilities are responsible for visiting the Office for Special Needs to set up accommodations for EACH semester. They are also responsible for talking to their professors about their needs as early as possible for EACH semester.

Your primary tool for learning in this course will be your reading of the text. The lectures will hit only the highlights of the sections to be covered. Reading the section for the day before class is very important if you are to benefit from the presentation.

All of the class dates for this course are listed below. Under SECTION you will generally find the section of the text which you should read and be ready to discuss in class that day, and under PROBLEMS you will find a list of problems to be done for that section. The due-dates for these problems are specified in parentheses at the end of each list. The problems are due at the beginning of the period on the day indicated and must be turned in at that time for full credit. If there are some problems in the assignment which you were not able to do, they can be turned in at the beginning of the next class period (**BUT NO SOONER)** for partial credit The section numbers are generally from the main text for the course, but where you see CNAT, the material to be read is from *Complex Number and Trigonometry*. You can find it on the Web by going to the Department of Mathematics and Computer Science home page and clicking on "RESOURCE." Where you see Laptop on the schedule, you must bring your laptop to class on those days. RCP stands for "review, catch up, and problems." Those days will be used primarily to tidy up loose ends and to answer questions. You should prepare for those days by making a list of any questions you may have about what has been happening in the course the previous few days and/or any homework problems you have been unable to solve. You will note that there is always an RCP the day before a test. Before class on those days you should print a copy of the sample for the upcoming test from the Web to bring to the review. Do your best to solve the problems on the sample and be prepared to ask about the ones which gave you trouble. TEST obviously means a test will be given on that day.

Since this is a WIC (Writing Intensive Course), tests in this course are a bit different from what you are accustomed to seeing on math tests. You will be given a sheet with the test questions, a bluebook, and a supply of scratch paper. You are expected to do you scratch work on the scratch paper, then write a clear solution to the problems in the bluebook. The bluebook and all of the scratch paper (with your name on it) should be turned in.

DATE	SECTION	PROBLEMS
1/9	1.1	2, 6, 10, 17 (Due 1/11)
1/11	1.2	6, 8, 10, 14, 18 (Due 1/13)
1/12	Laptop	
1/13	1.3	4, 8, 16, 24 (Due 1/18)
1/18	1.4	5 (Due 1/20)
1/19	Discuss SP1	
1/20	1.5	2, 8, 10, 14 (Due 1/23)
1/23	1.6	6, 8, 12 (Due 1/25)
1/25	1.9	2, 3, 8, 12 (Due 1/27)
1/26	Discuss SP2	
1/27	2.1, 2.2	(From 2.2) 4, 8, 12 (Due 1/30)

DATE	SECTION	PROBLEMS
1/30	2.3	2, 3, 5 (Due 2/1)
2/1	2.4	2, 3 (Due 2/6)
2/2	RCP	
2/3	TEST 1	
2/6	CNAT Preface & Chap 1	3, 9, 16, 17 (Due 2/8) Do **NOT** use trigonometry to solve these problems, use only the plane geometry we reviewed in Chapter 1.
2/8	CNAT Chap 2, Sec 1 & 2	1, 4, 6, 18 (Due 2/10)
2/9	Discuss SP3	
2/10	CNAT Chap 2, Sec 3 - 5	1, 2, 6, 9, 11, 16, 24, 32, 37 (Due 2/13)
2/13	CNAT Chap 2, Sec 6 & 7	1, 5, 6, 8, 14 (Due 2/16)
	Chap 3, Sec 1	3, 4, 5, 6, 7, 9 For problem 7 and 9 read the instructions carefully. Show your work. (Due 2/16)
2/15	Laptop	
2/16	2.5	6, 8, 12, 16 (Due 2/17)
2/17	2.6	4, 8, 10, 14, 24 (Due 2/20)
2/20	2.7	4, 8, 12 (Due 2/22)
2/22	2.8	4, 8, 10, 12 (Due 2/24)
2/23	Discuss SP4	
2/24	3.1, 3.2	(From 3.2) 4, 6, 12, 13, 20 (Due 2/27)
2/27	3.3	4, 6, 8, 12 (Due 3/1)
3/1	3.4	4, 6 (Due3/13)
3/2	RCP	
3/3	TEST 2	
3/13	3.5	2, 10, 11 (Due 3/15)
3/15	3.6	6, 8, 22 (Due 3/17)
3/16	2.9/Laptop	
3/17	3.7	2, 8, 12 (Due 3/20)
3/20	3.8	2, 4, 10 (Due 3/22)
3/22	3.9	8, 12, 14 (Due 3/24)
3/23		
3/24	3.10	4, 10, 14 (Due 3/27)
3/27	3.11	6, 10, 13 (Due 3/29)
3/29	5.1 and 5.2	From 5.2 2, 8, 10, 20 (Due 4/3)
3/30	RCP	
3/31	TEST 3	

DATE	SECTION	PROBLEMS
4/3	5.3	16, 18, 20 (Due 4/5)
4/5	5.4	12, 26, 28 (Due 4/7)
4/6	Discuss SP6	
4/7	5.5	22, 24, 28 (Due 4/10)
4/10	5.6	14, 20, 22 (Due 4/12)
	5.7	6, 8, 14 (Due 4/13)
4/12	6.2	
4/13	6.2	2, 6, 10, 16 (Due 4/19)
4/19	6.3	
4/20	Discuss SP7	
4/21	6.3	2, 6, 14 (Due 4/24)
4/24	RCP	
4/25 (Friday)	RCP	

4/27(10:30AM) TEST 4

Special Problems

The following problems are to be written up using MSWord and submitted by e-mail (as an attachment) no later that 11:00 AM on the due date. My e-mail address is mnewton@thiel.edu. **Do not** put you name on the paper, but identify it by saving it with your initials followed by the problem number. For example, if I submitted Special Problem 1, the file name would be MEN1.doc. To accomplish this, you can not simply "SAVE", you must "SAVE AS", then enter the name you want the file to have; namely your initials and the problem number.

The papers will be written as English papers, with careful explanations of how to solve the problem in question. An example is given below.

Because this is a WIC, the total number of words must be **at least 2500.** I place no specification on the number of words in any one paper, but you need to average about 350 words per paper to reach the goal of **at least 2500** by the end of the term. If you do a good job with your explanations you should have no trouble meeting that goal.

EXAMPLE: Use partial fractions to evaluate $\int \frac{t+4}{t^2+2t}dt, \quad t>0.$ The solution is given on page 7 exactly as I would expect to receive it. Notice that the problem is restated, then the solution is given with a careful explanation in complete sentences. If the instructions are to solve a problem from the text, state the problem as written in the book so that your paper is self contained. In some cases, the instructions are to combine two problems form the text in a reasonable way. In such cases, restate the problem(s) to match the way you choose to combine them.

A few comments on mathematical writing:

All the variables are italicized.

Do not start a sentence with a variable.

Displayed equations should be centered and have a blank line above and below. Equations should be displayed if they need a caption because they will be referred to later in the paper, if they are very long, or they are very important to the paper. Captions should be in parentheses at the left margin.

In an equation like $x + 7 = 12$, there are spaces around symbols such as + and =.

In an exponent such as x^{a+b} there are no spaces around the + sign.

1. (Due January 17) Use integration by parts and the standard trick for integrating even powere of sines and cosines to evaluate $\int x^3 \cos^2(x^2)dx.$

2. (Due January 24) Do Problem 23 on page 10 and Problem 29 on page 18 but combine the two parts (a) as one part (a) and the two parts (b) as one part (b) For each part give a qualitative description of what the solution tells you about the behavior of the system. Also compare what the technical solutions tells you to what common sense and experience tell you about the behavior of the system.

3. (Due February 7) Do Problem 6 on page 38 with the following two parts added.
   (c) According to the solution the differential equation, when will the tea reach room temperature?
   (d) What will really happen? Explain.

4. (Due February 21) Create an image showing the relationship between the polar and rectangular for of a complex number using *u* and *v* for the ral and imaginary parts respectively, *r* for the magnitude, and *x* for the argument. Define sin(x) and cos(x) in terms *u*, *v*, and *r*. Develop Euler's formula in terms of these variables. Do Supplementary Problem number 6 on page 51 of CNAT.

5. (Due March 21) Do Problem 4 and part (i) of Problem 5 page 164 but treat it as one problem. Graph your solutions to the three initial value problems from $t = 0$ to $t = 10$ seconds. Give a qualitative description of what the solutions tell you about the behavior of the system. Compare that to what really happens in the long run.

6. (Due April 4) Do Problem 7 (b) page 204 and Problem 19 on page 321 with the following additions to Problem 19:
   (c) There is a "creatively lazy" solution to the problem as stated that requires virtually no work if you make the appropriate observation. Explain!
   (d) Repeat parts (a) and (b) with
      (i) $\alpha = 350$
      (ii) $\alpha = 300$
      (iii) $\alpha = 200$
      (iv) $\alpha = 150$
      (v) $\alpha = 100$
      (vi) $\alpha = 50$
   (e) Give a qualitative description of the behavior of each system, including long term behavior, for values above 250, between 100 and 250, and below 100. Give convincing arguments for your conclusions.
   WARNING: The answer in the back of the text for this problem is wrong.

7. (Due April 18) Do Problem 3 on page 410 and Problem 31 on page 454 but treat them as one problem. Plot the motion of the spring on a graph from $t = 0$ to $t = 8$. Give a qualitative description of the behavior of the system.

EXAMPLE: Use partial fractions to evaluate $\int \frac{t+4}{t^2+2t}dt, \quad t > 0.$

Solution: Since the denominator of the integrand factors into $t(t + 2)$, we can write the integrand as

$$\frac{t+4}{t(t+2)} = \frac{A}{t} + \frac{B}{t+2} = \frac{A(t+2)+Bt}{t(t+2)} = \frac{(A+B)t+2A}{t(t+2)}.$$

If we now equate the coefficients in the numerators of the first and last fractions in the above display, we obtain the system of linear equations:

$$\begin{aligned} A + B &= 1 \\ 2A &= 4. \end{aligned}$$

From the second of these equations we see that $A = 2$, and substituting that value into the first equations gives us $B = -1$. Thus, our integral is now

$$\int\left(\frac{2}{t} - \frac{1}{t+2}\right)dt = 2\ln(|t|) - \ln(|t+2|) + C.$$

Since it is given that $t > 0$, we can delete the absolute value signs. Finally we can use the properties of logarithms, $n\ln(a) = \ln(a^n)$ and ln(a) - ln(b) = ln(a/b), to obtain our solution:

$$\int \frac{t+4}{t^2+2t}dt = \ln\left(\frac{t^2}{t+2}\right) + C.$$

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