

21-260 - Differential Equations

Fall 2017

General info

Contacts:

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Classes: classes will be on MWF 10:30-11:20 in DH 2302

Recitations: R - section D 9:30-10:30 in BH 255A
R - section E 12:30-1:30 in WeH 5304
R - section F 4:30-5:20 in WeH 8427

Office hours: TBD within the first week

Textbook: Zill, Wright - *Differential equations with boundary-valued problems*, 8th Edition
In particular, we will cover (all, or selected sections of) chapters 1,2,3,4,5,7,8,11,12.

Prerequisites:

- 21-122: **mandatory, cannot be void.** In particular, the students are supposed to know all the techniques for integrating functions of one variable
- 21-259 or 21-268 or 21-269 are recommended due to the use of partial differentiation and integration. A working knowledge of these concepts is sufficient.

What this course is about

The general topic: differential equations are ubiquitous in science, since they serve as the mathematical way we have to describe several physical phenomena. Examples of applications of differential equations of several different kind can be found everywhere, from Newtonian mechanics, to math biology, from engineering to finance. Thus, familiarity with the basic concepts of differential equations is something that can serve to every mathematician and scientist in order to have a better understanding of models used in her/his field or that can be the background for a deeper study of the subject in future.

Learning objective: students that will successfully pass the course should be able to:

- solve mathematical models by using differential equations,
- identify the type of a differential equation and use an appropriate method to solve it,
- interpret and analyze the results in the context of the problem,
- apply the concepts and techniques learned in class to new situations and problems

Course content:

- **First part:**
 - first order ODEs and applications (material for the first midterm),
 - linear higher order ODEs and applications (material for the second midterm),
- **Second part:** (material for the third midterm)
 - Laplace transform,
 - systems of ODEs (with the use of Laplace transform),
- **Third part:**
 - Fourier series,
 - introduction to PDEs (heat and wave equation).

How this course is set up

This course is a problem based course, in the sense that every topic will be introduced starting from a physical phenomena we would like to study (the so called applications). Then, the way of solving the kind of differential equation obtained in the model will be studied in its generality, allowing to consider also different models sharing the same mathematical description.

Of course the kind of practical problems used to introduce the course topics are chosen according to my personal preference, but in such a way to cover several area of applications (Newtonian mechanics, biology, chemistry, engineering,...) and to treat interesting situations.

Some words about general results (without any proof) on differential equation will be given, just as general useful information to keep in mind.

Learning opportunities: you should know that paying attention in class and reviewing the material afterward (both by reading the book and your notes. Additional notes will be provided for material not covered in the book.) are among the basic rules for learning. Also, taking advantage of the office hours (both mine and the TA's ones) is a good opportunity to clarify doubts you may have.

Please notice that, even if attending is not required, it is strongly suggested. If you fail to do so, then don't count on catching up by meeting during office hours, since our time is valuable, and we will not spend it on repeating a lecture that you decided to miss. Of course, if you could not attend for very good reasons, this is different; but in this case, please come prepared by having read the pertinent chapter of the book and obtained and studied the lecture notes from your classmates, so that we can directly focus on the part that might still be unclear.

Also, keep in mind that *collaborative study* is a very precious tool: it allows to discuss material and problems with others, testing what you studied and dealing with issues and points of view that are different from yours. I personally encourage students to study and to discuss homework together. Of course, this must not degenerate in *let me copy your homework* sessions. Meeting among yourselves is the simplest way to implement this strategy. Nonetheless, a virtual discussion board on piazza.com will be available in order to have open discussions about questions and homework problems (when necessary, the TA and I will participate to the discussion).

There will also be the opportunity of the EXCEL Collaborative Learning Group Support. More information will be given during the first week of the course.

Homework are a very good way to test what you studied and what you should study better. Relying too much on external help (Google or your friends) or doing homework at the last minute are not recommended, since the exams will have similar exercises (as well as new challenging ones). So that the ability of solving exercises of the homework is of capital importance in order to pass the course.

General suggestions for a wealth academic experience.

Learning is a very complex process and requires its time and its means. Although they are different from person to person, not giving enough time to study or doing it in a non proper way will reflect in having an useless and confused set of notions in your brain that will be of very poor use during the course and that you will forget as soon as the semester is over. Since 21-260 is an amazingly interesting course, I assume that is not what you want. So, studying and/or doing homework at the last minute is nothing but a waste of time.

Managing your time is one of the most important things you can (and should have to) learn in life. And academia is a good place to do so, since you have a lot of possibilities of trying and failing (even if you don't think so!). Thus, do your best to arrange your schedule in a way that allows you to have enough time to dedicate to each and every activity you plan to do.

And remember that it can be the case that you will have to renounce to some of them. That is not a big deal! There is no point in wanting to do lot of things without really doing none of them.

Of course, there are some activities that are more important than others. Among them there are: sleeping, eating and doing physical activity. Even if you think you are a superhero, trust me, you are not (and you don't have to be one!). So it doesn't matter how many things you have to do. You need to sleep! Your brain and your body need to rest in order to function at their best. Similarly, having a balanced and health diet (the best one would be the Mediterranean diet!) as well as doing physical activity (in the form you like the most) are fundamental parts of the balance that will keep you sane and in a health condition.

Last but not least, I would like you to know that instructors and TAs are here for you to teach you and to help you in your academic path (that includes also your personal health). If you have questions about the course and/or other issues (about you or others) you want to discuss, please feel free to talk with us. Don't be shy of asking 'stupid' or 'inadequate' questions.

A Psychological Services (CaPS) is also present on campus, that is here to help: you can call 412-268-2922 and visit their website at <http://www.cmu.edu/counseling/>. Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that can help.

If you or someone you know is feeling suicidal or in danger of self-harm, call someone immediately, day or night:

CaPS: 412-268-2922

Re:solve Crisis Network: 888-796-8226

If the situation is life threatening, call the police

On campus: CMU Police: 412-268-2323

Off campus: 911

Policies

The followings are policies about the course that serve to have an agreement on both sides on several everyday and special issues about the course.

You are responsible for reading them and behaving accordingly.

Grading: The final grades are based on the scores of the student on weekly homework, 3 midterm exams and 1 final exam. The mid-semester are based on the first two midterm exams and the homework done by then. **ALL exams are mandatory.**

The way the mid-semester grade will be computed is the following:

- 20%: homework (no score will be dropped from this computation)
- 30%: lower midterm exam
- 50%: higher midterm exam

The way the final grade will be computed is the following:

- 15%: homework (lowest score will be dropped from this computation)
- 10%: lowest score on midterms
- 20%: each of the remaining two midterms
- 35%: final exam

Mid-semester grade cut-offs:

$92\% \leq \text{grade} \leq 100\%$: A

$90\% \leq \text{grade} < 92\%$: A-

$88\% \leq \text{grade} < 90\%$: B+

$82\% \leq \text{grade} < 88\%$: B

$80\% \leq \text{grade} < 82\%$: B-

$78\% \leq \text{grade} < 80\%$: C+

$72\% \leq \text{grade} < 78\%$: C

$70\% \leq \text{grade} < 72\%$: C-

$68\% \leq \text{grade} < 70\%$: D+

$60\% \leq \text{grade} < 68\%$: D

$0\% \leq \text{grade} < 60\%$: R

Final grade cut-offs:

$90\% \leq \text{grade} \leq 100\%$: A

$80\% \leq \text{grade} < 90\%$: B

$70\% \leq \text{grade} < 80\%$: C

$60\% \leq \text{grade} < 70\%$: D

$0\% \leq \text{grade} < 60\%$: R

The following policies will be applied to grading:

- the above grade cut-offs might be lowered, but not increased,
- exam grades will not be curved unless the average and grade distributions justifies it,
- curving may be done for individual exams or at the end of the course, if the instructor thinks it is appropriate,
- after the last day of classes, no changes will be made to grades,
- errors in grading or recording must be addressed during the week when they occur,
- grades will not be changed based on the need of a better grade,
- for any issues/concerning about the grades, please contact the instructor.

Academic integrity:

- **Cheating is a serious offense and will be dealt with according to the University code,**
- if you need any clarification on what could potentially be considered cheating or plagiarism, please contact the instructor of the course,
- if you take the exam at a later date, obtaining information about the test from a student who already took it is considered cheating. Providing this information to another student is also considered cheating,
- the use of any unauthorized source of information during a test is considered cheating. This may include, but is not limited to, written, audio or electronic materials, writing on your hand, looking in somebody else's paper,
- more information can be found at: <http://www.cmu.edu/academic-integrity/index.html>,
- if you have information regarding cheating that you would like to share with the instructor, feel free to contact me either in person or via email.

Homework:

- **Homework will be assigned weekly, and will be posted online (Canvas and course webpage) approximately one week before the due date,**
- **all due dates will be posted online and on the actual homework,**
- your homework should be stapled and contain your **full name and recitation section**,
- if you don't submit your homework on time, that will count as **zero** credit,
- the solutions submitted for grading should be **complete**. Answers not supported by work will receive zero credit. Solutions that lack logical steps will only receive partial credit,
- solutions on homework have to be presented in a **clear** way. Points may be taken away from solutions that are not This is also part of the abilities you have to acquire in your academic path,
- **any material submitted for credit must be entirely your own. Failure to do so constitutes a violation of the University's Academic Integrity Policy and will be reported to the Division of Student Affairs,**
- exceptions are only for collaborative homework, where any help received and/or collaboration done must be acknowledged on the homework,
- the written homework will be collected in lecture on Fridays (this may change occasionally). If for a good reason (illness, unforeseen circumstances, etc.) you cannot turn it in lecture, you need the instructor's permission to turn it in before 4:00 pm of the day. Procedure on how to do that will be decided by the instructor case by case,
- do not turn your homework in the TA's or instructor mailbox without prior approval. If there is no way to verify when the homework was turned in and solutions are posted, the homework will receive zero credit,
- do not throw away your graded written homework until the semester is over. If grades happen to be mis-recorded, no change will be made without your actual homework,
- any issues regarding the grading of the homework must be resolved within a week from the return date. The re-graded written homework can be collected from the TA during office hours. If you have a zero recorded for a homework on Blackboard, this means that the TA did not receive a homework from you. Check your grades weekly on Blackboard,
- extensions are occasionally given for the homework if the student has a valid reason. If such an extension is granted, the solutions will not be made available until the end of the extension,
- if you have accommodations for a learning disability, be advised that extensions can be granted only very rarely, as the availability of the solutions for the whole class will be affected. If you have any concerns regarding this aspect, please consult with me as soon as possible.

Exams: The midterm exams will be in the following dates **during lecture time:**

- **First midterm:** October 2nd
- **Second midterm:** October 23rd,
- **Third midterm:** November 17th,

The final exam is scheduled by the University Registrar.

- if you miss an exam, you must contact the instructor right away,
- if you must travel for University business on the day of a midterm, you must contact the instructor AT LEAST one week prior to the exam day to make arrangements for a make up exam. Failing to do so may reflect in not having a makeup exam,
- **all four exams are mandatory.** The Final Exam is scheduled by the University Registrar, don't make travel plans until you know the date or make plans for AFTER

the last day of exams. Make up final exams are given **ONLY** for documented illness and exam conflicts,

- **you are not permitted to use ANYTHING during the exam other than writing tools,**
- **if you take an exam, there will be no retake given,** even if you have a serious reason, such as illness, or traumatic circumstances. You should discuss with me any problems you have **before** taking the exam,
- make up midterms will be given for reasons such as documented illness, University business, and other legitimate reasons that occur the day of the exam. Please discuss with me any issues you might have in this regard. Documentation will be required to schedule a make-up exam,
- make up exams will be scheduled in any available time slot that doesn't conflict with the students academic schedule and such that the student doesn't have three midterms in one day. Any request for a make-up exam must be done also by email and must be accompanied by a copy of the official schedule of the student (SIO, Scheduleman). The make-up exams will generally be scheduled as soon as possible after the in-class exam date,
- if you have three in-class midterms scheduled during the same day, please read the guidelines regarding such conflicts at the website below, and contact the appropriate instructor. Two midterms in one day may be inconvenient, but it doesn't constitute a conflict. <http://coursecatalog.web.cmu.edu/servicesandoptions/universitypolicies/#examconflictguidelines>,
- any (potential) errors in grading must be addressed **during the recitation or meeting when the exam is being returned.** It is your responsibility to collect the exam from your TA on time. Exams are scanned before being returned to students. If you made changes to your exam and you resubmit it for grading, it will be reported as an academic integrity violation,
- you may NOT discuss the exam with any student who didn't take it yet or with any student who took it before you. This constitutes a violation of the Academic Integrity Policy and will be reported to the Division of Student Affairs,
- if you have a learning disability and are registered with the EOS, you must notify me at least one week before the first exam to make arrangements,
- if you register later in the semester, this will not change grades obtained prior to notifying me of your accommodations.