

MATH-3550-M01, Differential Equations, Spring 2018

Course Information.

Course name: Differential Equations
Course Number: MATH-3550
Course section: MO-1
Class Days: MWF, 10:00-10:50
Clasroom: PRH-7
Credit hours: 3
Prerequisite(s): MATH-2530-Calculus III

Instructor Information

Name: Ana Granados
Office hours: MTWF 11:30-12:30 and by appointment.
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Contact: ana.granados@slu.edu
Biography: Terminal Degree: Ph.D.Mathematics (Universidad Autónoma de Madrid)

Course Objectives

In sciences and engineering, problem solving consists in general in making a mathematical model of the physical system. This mathematical model often yields a system of differential equations. This course serves as a first treatment of ordinary differential equations. Students will develop the skills necessary to analyze the behavior of ODEs, to find exact solutions to a variety of equations, to find geometrical solutions and to approximate solutions numerically. The course will emphasize mathematical modeling of physical systems whenever possible to strengthen the connection to applications.

Course description:

Modeling. First order equations; separation of variables; slope fields and graphs of solutions; phase line, bifurcations; integrating factor. Systems of first-order equations and second order equations as systems. Elementary matrix algebra; eigenvectors and eigenvalues. Linear systems, both analytically and geometrically; phase plane. Linearization of non-linear systems and behaviour near the equilibrium points. Forced second-order equations. Laplace transforms. Discrete dynamical systems (the logistic equation); chaos. Numerical methods will be covered all along the course.

Mathematics Program Objectives

- A. Demonstrate the ability to solve a variety of mathematical problems (Learning outcomes 1, 2, 4, 5, 6, 7, 8 below).
- B. Demonstrate an ability to recall important mathematical definitions and results (for example, theorems) (Learning outcomes 1, 5, 6, 7, 8 below).
- C. Demonstrate an ability to apply mathematical reasoning, including formulating definitions (Learning outcomes all below).
- D. Demonstrate an ability to apply the methods of direct and indirect proof (Learning outcomes 3, 7, 8 below).
- E. Demonstrate an ability to communicate mathematical ideas and concepts clearly in written problem solutions (Learning outcomes 1, 4, 5, 6, 7, 8 below).
- F. Demonstrate an ability to perform statistical analyses (Learning outcome 4 below).
- G. Demonstrate an ability to write computer programs to analyze data and perform calculations (transversal Learning Outcome)

Learning Outcomes and Method of Assessment

1. Understand the concept of differential equations, classification, their solutions, and their applications, qualitative techniques for obtaining information about solutions to differential equations, and direction fields.
2. Analytical techniques for solving commonly occurring differential equations including numerical methods for finding approximate solutions to differential equations that cannot be solved analytically.
3. Understand the mathematical foundations of the techniques we study and why they are valid.
4. Formulate an appropriate differential equation to model and solve applied problems.
5. Find solutions to linear systems of equations and visualize them (phase plane).
6. Find solutions of forced harmonic oscillator equations for typical forcing functions. Understand its applications.
7. Understand the process of linearization in nonlinear systems. Combine linear techniques, linearization and additional qualitative methods (nullclines) to describe long term behaviour of nonlinear systems.
8. Find Laplace transforms and inverse transforms, and apply these to solve differential equations.

Text books

Required reading: *Differential equations*, by P.Blanchard-R.L.Devaney-G.R.Hall, 3rd edition, Ed. Thomson Brooks/cole, 2006.

Solution manual: *Student Solutions Manual* for Blanchard/Devaney/Hall's Differential Equations, 3rd edition

Required work

One in-class exam, two midterm exams and one comprehensive final will be given. They will emphasize the material presented in class but will also cover the reading assignments.

Homework will be assigned for every topic covered. The homework will not be graded, but solutions will be provided and students are expected to check their exercises and come to office hours with any difficulties encountered.

Late work:

Make up exams are not given. If an exam is missed due to an excused absence (see paragraph below), a make up exam will be given *the same day of the final exam*. Exams that are missed illegitimately result in a score of 0 in the final grade. Missing more than one exam results in an F grade for the entire course.

Excused Absences:

Legitimate conflicts and excuses require written documentation and are limited to death or near death instances in the immediate family, a student's illness that requires immediate doctor's care (with the corresponding doctor's note), a University sponsored event (not club sports) and regularly scheduled religious obligations. Documentation must be presented on the day the student returns to the university. Excuses that will NOT be considered include personal travel arrangements, non-University sponsored events, a conflicting appointment, an illness that does not prevent you from coming to the exam.

Attendance and punctuality:

Although not mandatory, I strongly urge you to attend all classes. On the other hand, you will be responsible for any announcements, information, problems or course changes that are made in all lectures. Students are expected to arrive on time to the lectures. Repeated lateness will not be tolerated. So, please come to class on time and do not leave early. Anything else is rude and disruptive.

If a class is not attended, it is the student's responsibility to find out what was covered in class and to secure notes from another student. Copies of my personal notes are not to be shared. During office hours, and after the student has read and worked on the notes on his own, specific questions regarding the material missed will be answered.

Grading system

The final grade will be obtained as follows:

- 15% in-class exam
- 25% first midterm exam
- 25% second midterm exam
- 35% final exam

Evaluation

- In-class exam: 50 minutes exam consisting of some problems related to the material covered in class.
- Midterm exams: up to 2.30 hour exams; they will be similar in form to the in-class exam.
- Final exam: The final exam is cumulative. It will cover the **entire semester's material**, will be a three hour exam, and will be similar in form to the in-class exam.
- A positive evolution in grades might have a positive impact in the overall grade.
- Active participation during the lectures by asking interesting questions will have a positive impact on the final grade, bringing up borderline grades.
- You are going to be evaluated not only on your knowledge of facts beyond the surface level, but also on your creative and critical thinking, your ability to draw conclusions and make connections, and to communicate information in a reasoning and organized way.

Remark: No complaints about the grade of an exam will be accepted two weeks after the results have been announced to the class.

Things that you should do in order to get a good grade in this class:

- Don't miss classes, but if you ever have to miss one, ask one of your classmates (not me) for the notes as soon as possible and go over them before the next lecture.
- Do as many as you need of the solved exercises recommended from the textbook until you feel you master the topic. I can't emphasize this enough. All math classes require a lot of practice and this is not an exception.
- Work every week, and if possible, every day. If you don't have an assignment or exercises to practice (that would be very rarely), review your class notes and go over the problems we have solved in class on your own one more time.
- Feel free to pass by my office to ask me if something is not clear from the lecture before the next lecture, you will probably have trouble understanding this otherwise.

- Form study groups and make sure that all members participate and learn from each other. Experience shows that math is more effectively learned when you work in groups.

Things that you shouldn't do in this class:

- Think that by just coming to class you have all the work done. No practice, no learning.
- Try to study everything two days before the test. It is impossible to really understand this topic by rushing over the material in a few hours.
- Skip homework.
- Copy the homework from someone else. It is completely useless. Its only purpose is to help you learn.
- Be late to the lectures, it is very disruptive to the other students and very disrespectful. Also, you miss the most important part of the lecture, where I say what we are going to do and sometimes do a short review of what we did in the previous class.
- Use your phone during the lectures, whether it is for texting or using internet or, obviously, talking, it is extremely disrespectful. I will not allow it and you will be invited to leave the room.
- Work on something else during classes. Again, you will be invited to leave the room.

Important Dates:

- **January:**
 - 10 Wed: First day of classes.
 - 21 Sun: Last day to DROP a class without a grade of "W" and/or add a class. Last day to choose audit (AU), or Pass/No Pass (P/NP) Options.
 - 26 Fri: No class. Application Deadline for Spring Semester Degree Candidates.
- **February:**
 - 9 Fri: First midterm exam (14:00-16:30).
 - 14 Wed: Registration for Summer 18 sessions begins.
 - 22-23 Th-Fri: No classes (Winter break).
- **March:**
 - 9 Fri: Last day to drop a class and receive a "W".
 - 14 Wed: In-class exam (classtime).
 - 15 Th: Last day to submit Transfer Application for fall semester.
 - 26-30 Mon-Fri: Semana Santa (University closed).
 - 20 Mon: Holiday (University closed).
- **April:**
 - 4 Wed: Registration for Fall 2018 semester begins.
 - 13 Fri: Second midterm exam (14:00-16:30).
- **May:**
 - 1 Tue: Holiday (University closed).
 - 2 Wed: Holiday (University closed).
 - 3 Th: Final day of classes.
 - 7 Mon: Final exam (8:30-11:30).

For other important dates, visit

<http://www.slu.edu/madrid/academics/registrar/academic-calendar/spring-2018>

Course Outline

1. First order differential equations
2. First order systems
3. Second order differential equations
4. Resonance
5. Matrix algebra
6. Linear systems
7. Nonlinear systems
8. Laplace transforms
9. Discrete dynamical systems

This outline is due to change depending on time. Numerical methods will be covered transversally during the course.

Academic Honesty Policy Statement:

Academic integrity is honest, truthful and responsible conduct in all academic endeavors. The mission of Saint Louis University is "the pursuit of truth for the greater glory of God and for the service of humanity." Accordingly, all acts of falsehood demean and compromise the corporate endeavors of teaching, research, health care and community service via which SLU embodies its mission. The University strives to prepare students for lives of personal and professional integrity, and therefore regards all breaches of academic integrity as matters of serious concern.

The governing University-level Academic Integrity Policy can be accessed on the Provost's Office [website](#). Additionally, SLU-Madrid has posted its academic integrity policy online: <http://www.slu.edu/madrid/academics>. As a member of the University community, you are expected to know and abide by these policies, which detail definitions of violations, processes for reporting violations, sanctions and appeals.

The professor will review these matters during the first weeks of the term. Please direct questions about any facet of academic integrity to your faculty, the chair of the department of your academic program, or the Academic Dean of the Madrid Campus.

Only **non-graphic** scientific calculators may be used in tests or in the final examination. Other calculators and devices will be taken from students during the exam and students may not be allowed to continue the exam. Not following this regulation will be considered a violation of the academic honesty code.

Accommodation Statement

In recognition that people learn in a variety of ways and that learning is influenced by multiple factors (e.g., prior experience, study skills, learning disability), resources to support student success are available on campus. Students who think they might benefit from these resources can find out more about:

- Course-level support (e.g., faculty member, departmental resources, etc.) by asking your course instructor.

- University-level support (e.g., tutoring/writing services, Disability Services) by visiting the Academic Dean's Office (San Ignacio Hall) or by going to <https://www.slu.edu/madrid/academics/student-resources>.

Students with a documented disability who wish to request academic accommodations must contact Disability Services to discuss accommodation requests and eligibility requirements. Once successfully registered, the student also must notify the course instructor that they wish to access accommodations in the course. Please contact Disability Services at disabilityservices-madrid@slu.edu or +915 54 58 58, ext. 230 for an appointment. Confidentiality will be observed in all inquiries. Once approved, information about the student's eligibility for academic accommodations will be shared with course instructors via email from Disability Services. For more information about academic accommodations, see "Student Resources" on the SLU-Madrid webpage.

Note: Students who do not have a documented disability but who think they may have one are encouraged to contact Disability Services.

Student Outcome Assessment:

In order to maintain quality academic offerings and to conform to accreditation requirements, SLU-Madrid regularly assesses its teaching, services and programs for evidence of student learning. For this purpose, SLU-Madrid keeps representative examples of student work from all courses and programs on file, including assignments, papers, exams, portfolios and results from student surveys, focus groups and reflective exercises. Copies of your work for this course may be kept on file for institutional research, assessment and accreditation purposes. If you prefer SLU-Madrid not to retain your work for this purpose, you must communicate this decision in writing to your professor.

Title IX

Saint Louis University and its faculty are committed to supporting our students and seeking an environment that is free of bias, discrimination, and harassment. If you have encountered any form of sexual misconduct (e.g. sexual assault, sexual harassment, stalking, domestic or dating violence), we encourage you to report this to the University. If you speak with a faculty member about an incident of misconduct, that faculty member must notify SLU's Title IX deputy coordinator, Marta Maruri, whose office is located on the ground floor of Padre Rubio Hall, Avenida del Valle, 28 (mmaruri@slu.edu; 915-54-5858, ext. 213) and share the basic fact of your experience with her. The Title IX deputy coordinator will then be available to assist you in understanding all of your options and in connecting you with all possible resources on and off campus.

If you wish to speak with a confidential source, you may contact the counselors at the SLU-Madrid's Counseling Services on the third floor of San Ignacio Hall (counselingcenter-madrid@slu.edu; 915-54-5858, ext. 230) or Sinews Multipletherapy Institute, the off-campus provider of counseling services for SLU-Madrid (www.sinews.es; 917-00-1979). To view SLU-Madrid's sexual misconduct policy and for resources, please visit the following web address: <http://www.slu.edu/Documents/Madrid/campus-life/SLUMadridSexualMisconductPolicy.pdf>.