APPLIED DIFFERENTIAL EQUATIONS in Fall 2019 (MA3100)

Course Code	MA3100	**Professor(s)**	Ruth Corran
Prerequisites	None	**Office Number**	PL-17
Class Schedule	TF: 10:35-11:55 in PL-1	**Office Hours**	by appointment
Credits	4	**Email**	rcorran@aup.edu
Semester	Fall 2019	**Office Tel. Ext.**	

Course Description

MA 3100 Applied Differential Equations takes the study of differential equations (DE's), begun in Calculus I, to the next level. The course deals with: linear and non-linear DE's; first and higher-order DE's; single-variable DE's and systems of DE's; ordinary DE's and partial DE's. Examples come from dynamics of motion, population dynamics, the heat equation, wave equations. A comprehensive list of topics is given below.

STUDENT LEARNING OUTCOMES:

- LO 1: Know and use appropriately introductory techniques to solve ordinary differential equations, systems of differential equations and some partial differentiation equations
- LO 2: Recognize qualitative properties of solutions to DE's (such as stability, long term behaviour) even when exact solutions are not available
- LO 3: Develop mathematical maturity in terms of ability to make and prove conjectures, and improved problem-solving skills.

The Mathematics Department supports the mission of the University by providing quality education in Mathematics to help our students excel and succeed in their chosen academic and career goals. In particular, MA 3100 Applied Differential Equations is an elective course in the Mathematics and Computer Science major and the Applied Mathematics minor, and as such students will meet the following learning outcomes.

1. **Mathematical Knowledge.** Students will demonstrate concept knowledge of facts, formulas, and definitions for each respective topic.
2. **Solving Skills**. Students will be able to apply appropriate techniques and tools to solve problems, including those in a real-life situation.
3. **Modeling Skills**. Students will be able to translate various real-world scenarios into mathematical models.
4. **Technological Skills**. Students will be able to effectively use computer software packages to solve problems and support conjectures.
5. **Skilled use of Methods of Proof**. Students will be able to make rigorous mathematical arguments including how to both prove and disprove conjectures.

6. **Communication Skills**. Students will communicate (both in writing and orally) using appropriate mathematical notation and vocabulary. These can be both mathematical and logical.
7. **Mathematical maturity**. Students will be confident to utilize problem-solving skills appropriately and show the maturity to undertake higher level studies in mathematics, statistics and related fields.

MA 3100 Applied Differential Equations is a higher level mathematics course, and consequently students will arrive at a high level of effectiveness in the above goals, apart from goals 4 and 5 for which a medium level of effectiveness can be expected.

Course Learning Outcomes

General Education

While this course does not directly participate in the AUP core curriculum, you can expect to make progress on the following learning objectives at a high level:

- **Develop a positive approach to mathematics and to appreciate its use in modeling the world**
- **Reason with quantitative information – in words, numbers and graphs and charts**
- **Clearly communicate quantitative information in words, in numbers and with graphs**
- **Develop strategies for solving problems**

Course Outline

Preliminary class schedule:

Class	Day	Date	Kreyszig chapters / E&P chapters	
1	Tuesday	3/9/19	1.1 Modeling, DE's and solutions, solutions by integration, initial value problems	Chapter 1: intro

2	Friday		1.2 Direction fields and Euler's method	and 1st order DE's
3	Tuesday	10/9/19	1.3 Separable ODE's, modeling applications	
4	Friday		1.4 Exact ODE's, integrating factors	
5	Tuesday	17/9/19	1.5 Linear ODE's, population Dynamics	
6	Friday		1.6 Existence & uniqueness theorems, revision	
7	Tuesday	24/9/19	Test on chapter 1.; 2.1 Homogeneous linear ODE's of second order	Chapter 2: 2nd order linear DE's
8	Friday		2.2 Homogeneous linear ODE's of second order with constant coefficients	
9	Tuesday	1/10/19	2.4/2.5 applications, 2.6 Existence & Uniqueness, Wronskian	
10	Friday		2.7 Nonhomogeneous ODE's & 2.8 Application	
11	Tuesday	8/10/19	3.1 Generalisation to homogeneous linear ODE's of higher order, revision	
12	Friday		Test on chapter 2; 11.1 Intro to Fourier series	chapter 11: Fourier series
13	Tuesday	15/10/19	11.2 more on Fourier series	
14	Friday	Midsem grades due	11.2 continued, applications of Fourier series (11.3?)	
15	Tuesday	22/10/19	12.1 Intro to PDE's, 12.2 wave equation	Chapter 12: Partial DE's
16	Friday		12.3 Solution to wave equation by Fourier series and 12.4 d'Alembert's solution	
17	Tuesday	29/10/19	12.5 Heat Equation and 12.6 Solution to Heat equation by Fourier series	
FALL BREAK	Friday		Matrices and complex numbers project	
18	Tuesday	5/11/19	Summarising chapters 11 and 12	
19	Friday		Test on chapters 11 and 12; matrices and complex numbers project outlined	Chapter 4 of Kreyszig
ARMISTICE BREAK	Tuesday	12/11/19	Matrices and complex numbers project (4.0)	
20	Friday		Introduction to (nonlinear) systems of ODEs, examples of applications	Chapter 7 of Edwards

21	Tuesday	19/11/19	7.1 Equilibrium solutions and stability,	& Penney
22	Friday		7.2 Stability and the phase plane	
23	Tuesday	26/11/19	7.3 Linear and almost linear systems	
24	Friday		7.4 Ecological models: Predators and competitors	
25	Tuesday	3/12/19	Revision	Revision
26	Friday		Revision	
STUDY DAYS	Tuesday	10/12/19		
	Friday	13/12/19	FINAL EXAM 8h30	Final

Textbooks

This course doesn't have any textbook.

Attendance Policy

Students studying at The American University of Paris are expected to attend ALL scheduled classes, and in case of absence, should contact their professors to explain the situation. It is the student’s responsibility to be aware of any specific attendance policy that a faculty member might have set in the course syllabus. The French Department, for example, has its own attendance policy, and students are responsible for compliance. Academic Affairs will excuse an absence for students’ participation in study trips related to their courses.

Attendance at all exams is mandatory.

IN ALL CASES OF MISSED COURSE MEETINGS, THE RESPONSIBILITY FOR COMMUNICATION WITH THE PROFESSOR, AND FOR ARRANGING TO MAKE UP MISSED WORK, RESTS SOLELY WITH THE STUDENT.

Whether an absence is excused or not is ALWAYS up to the discretion of the professor or the department. Unexcused absences can result in a low or failing participation grade. In the case of excessive absences, it is up to the professor or the department to decide if the student will

receive an “F” for the course. An instructor may recommend that a student withdraw, if absences have made it impossible to continue in the course at a satisfactory level.

Students must be mindful of this policy when making their travel arrangements, and especially during the Drop/Add and Exam Periods.

Grading Policy

- Assignments, homework, participation: 30%
- Tests/midterms/quizzes 40%
- Final examination 30%

Other