

200141 - EDOS - Ordinary Differential Equations

Coordinating unit: 200 - FME - School of Mathematics and Statistics
Teaching unit: 749 - MAT - Department of Mathematics
Academic year: 2015
Degree: BACHELOR'S DEGREE IN MATHEMATICS (Syllabus 2009). (Teaching unit Compulsory)
ECTS credits: 7,5 Teaching languages: Catalan

Teaching staff

Coordinator: MARIA TERESA MARTINEZ-SEARA ALONSO

Others:

JOSE TOMAS LAZARO OCHOA - B
MARIA TERESA MARTINEZ-SEARA ALONSO - A, B
JORDI VILLANUEVA CASTELLTORT - A

Opening hours

Timetable: Send an e-mail to the professor to make an appointment.

Prior skills

Linear and multilinear algebra, differential and integral calculus, topology, physics, computer science, and one complex variable.

Degree competences to which the subject contributes

Specific:

1. CE-2. Solve problems in Mathematics, through basic calculation skills, taking in account tools availability and the constraints of time and resources.
2. CE-3. Have the knowledge of specific programming languages and software.
3. CE-4. Have the ability to use computational tools as an aid to mathematical processes.

Generical:

5. CB-1. Demonstrate knowledge and understanding in Mathematics that is founded upon and extends that typically associated with Bachelor's level, and that provides a basis for originality in developing and applying ideas, often within a research context.
6. CB-2. Know how to apply their mathematical knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader or multidisciplinary contexts related to Mathematics.
7. CB-3. Have the ability to integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgements.
8. CG-1. Show knowledge and proficiency in the use of mathematical language.
9. CG-2. Construct rigorous proofs of some classical theorems in a variety of fields of Mathematics.
10. CG-3. Have the ability to define new mathematical objects in terms of others already know and ability to use these objects in different contexts.
11. CG-4. Translate into mathematical terms problems stated in non-mathematical language, and take advantage of

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this translation to solve them.

12. CG-6 Detect deficiencies in their own knowledge and pass them through critical reflection and choice of the best action to extend this knowledge.

Transversal:

4. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

Teaching methodology

There are 3 hours per week of "magistral lectures" (exposition of theoretical aspects), and 2 hours per week of "problem solving."

Learning objectives of the subject

At the end of the course, students should be able: 1) To apply the fundamental theorems of ODEs; 2) To solve several simple ODEs (first-order linear ODEs, separable ODEs, Bernoulli, Ricatti, linear ODEs with constant coefficients, etc.); 3) To sketch the phase portrait of 2D and 3D systems of linear ODEs with constant coefficients; 4) To determine the stability of systems of linear ODEs with periodic coefficients; and 5) To determine the stability of some simple solutions of systems of nonlinear ODEs.

Study load

Total learning time: 187h 30m	Hours large group:	45h	24.00%
	Hours medium group:	0h	0.00%
	Hours small group:	30h	16.00%
	Guided activities:	0h	0.00%
	Self study:	112h 30m	60.00%

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Content

<p>Fundamental theorems</p>	<p>Learning time: 60h Theory classes: 18h Practical classes: 6h Self study : 36h</p>
<p>Description: Presentation and motivation. Geometric interpretation: vectorfields. Initial value problems (IVPs). Existence and uniqueness theorems. Maximal solutions. Regularity with respect to initial conditions and parameters.</p>	
<p>Solving simple ODEs</p>	<p>Learning time: 25h Theory classes: 0h Practical classes: 10h Self study : 15h</p>
<p>Description: First-order linear ODEs. Separable ODEs and integrant factor. Changes of variables. Homogeneous, Bernoulli, Ricatti, Lagrange, and Clairaut ODEs.</p>	
<p>Linear equations and linear systems</p>	<p>Learning time: 50h Theory classes: 10h Practical classes: 10h Self study : 30h</p>
<p>Description: Homogeneous systems: fundamental matrices and principal matrix. Non-homogeneous systems: variation of parameters. Liouville formula: evolution of a volume under a nonlinear flux. Systems of linear ODEs with periodic coefficients: Floquet theory. Linear ODEs: reduction of order, characteristic equation, oscillations, undetermined coefficients, and variation of parameters.</p>	
<p>Introdution to the qualitative theory of ODEs</p>	<p>Learning time: 27h 30m Theory classes: 11h Practical classes: 0h Self study : 16h 30m</p>
<p>Description: Classification of 2D and 3D systems of linear ODEs with constant coefficients. Stability of systems of linear ODEs with periodic coefficients. Stability of some simple solutions of nonlinear systems.</p>	

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Review	Learning time: 25h Theory classes: 6h Practical classes: 4h Self study : 15h
Description: This review is added to solve the discrepancy between the 75 presencial classes that appear in the year planning and the (approximately) 65 classes that are really given.	

Qualification system

A partial exam (P), and a final exam (F). The final grade is
$$N = \max(F, 0.3*P+0.7*F).$$

An extra exam will take place on July for students that failed during the regular semester.

Regulations for carrying out activities

Students can use a handwritten sheet of paper (DIN A4 size), except in the theoretical part of the exams.

Bibliography

Basic:

Meiss, J.D. Differential dynamical systems [on line]. 2007. Philadelphia: Society for Industrial & Applied Mathematics, 2007 Available on: <<http://epubs.siam.org/doi/book/10.1137/1.9780898718232>>. ISBN 9780898716351.

Tenenbaum, Morris ; Pollard, Harry. Ordinary differential equations : an elementary textbook for students of mathematics, engineering, and the sciences. New York: Dover Publications, 1985. ISBN 0486649407.

Teschl, Gerald. Ordinary differential equations and dynamical systems [on line]. Providence: Amer. Math. Soc, 2012 [Consultation: 22/11/2012]. Available on: <<http://www.mat.univie.ac.at/~gerald/ftp/book-ode/>>.

Sotomayor, Jorge. Lições de equações diferenciais ordinárias. Rio de Janeiro: Instituto de Matemática Pura e Aplicada (IMPA), 1979. ISBN 9216050624.

Arnol'd, V. I. (Vladimir Igorevich), 1937-. Ordinary Differential Equations. Cambridge (Massachusetts): The Mit Press, 1973. ISBN 0262010372.

Braun, Martin. Differential equations and their applications. 4a ed. Springer-Verlag, 1993. ISBN 0387978941.