Asignatura: Curso avanzado de EDP´s
Código: 30074
Centro: Ciencias
Titulación: Máster en Matemáticas y aplicaciones
Nivel: Máster M2
Tipo: Optativa
Nº de créditos: 8

ASIGNATURA / COURSE TITLE:

Curso avanzado en EDP´s / Advanced Course in Partial Differential Equations

1.1. Código / Course number

30074

1.2. Materia / Content área

Ecuaciones en derivadas parciales / Partial Differential Equations

1.3. Tipo / Course type

Formación optativa / Elective subject

1.4. Nivel / Course level

Máster/ Master (second cycle)

1.5. Curso / Year

2011-2012

1.6. Semestre / Semester

2º/ 2nd (Spring semester)

1.7. Número de créditos / Credit allotment

8 créditos ECTS / 8 ECTS credits

1.8. Requisitos previos / Prerequisites

We assume knowledge of the fundamentals of ordinary differential equations, measure theory, functional analysis (distributions, self-adjoint and compact operators in Hilbert spaces, Sobolev spaces and their embeddings, interpolation), and calculus of variations (minimizing of coercive, weakly lower semicontinuous functionals). Most of this material is covered in the courses *PDE´s in Science and Engineering* and *Fundamentals of Mathematical Analysis*, both of them corresponding to the first semester of this master programme.

1.9. Requisitos mínimos de asistencia a las sesiones presenciales / Minimum attendance requirement

The attendance to the course is compulsory

1.10. Datos del equipo docente / Faculty data

Docente(s) / Lecturer(s) **Fernando Quirós Gracián**
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Facultad / Faculty of Sciences
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Horario de atención al alumnado/Office hours: m-j 10-12 and 16-17

1.11. Objetivos del curso / Course objectives

The primary aim of the course is to introduce the students to the qualitative study of solutions of superlinear elliptic and parabolic partial differential equations, and in particular to the blow-up phenomenon. We intend to introduce the theory by emphasizing the methods while avoiding massive technical computations if possible. To reach this goal, we use simple model problems to illustrate the methods; these methods very often apply to more general equations.

As a second goal, we would like the students to get acquainted with some more advanced topics in this field which are the subject of current research.

1.12. Contenidos del programa / Course contents

1.- A review of linear theories

1. Elliptic theory.
2. Parabolic theory.

2.- Finite time blow-up for evolution equations

1. Kaplan's first eigenvalue method, Levine's concavity method, comparison method.
2. Fujita type results on unbounded domains.

3.- Steady state solutions

1. Existence: upper and lower solutions method.
2. The moving plane method (Gidas-Ni-Nirenberg).

4. – Blow-up rates, blow-up sets and blow-up profiles

1. Blow-up rates: Friedman-McLeod's method and scaling method.
2. Blow-up sets: single-point, regional and global blow-up.
3. Blow-up profiles: self-similar behaviour.

5. Continuation after blow-up

1.13. Referencias de consulta / Course bibliography

- de Pablo, A.; Ferreira, R.; Quirós, F.; Vázquez, J. L. *El problema matemático de explosión para ecuaciones y sistemas de reacción-difusión*. Bol. Soc. Esp. Mat. Apl. SeMA No. 32 (2005), 75--111.
- Galaktionov, Victor A.; Vázquez, Juan L. *The problem of blow-up in nonlinear parabolic equations. Current developments in partial differential equations* (Temuco, 1999). Discrete Contin. Dyn. Syst. 8 (2002), no. 2, 399--433.
- Bei Hu, "Blow-up Theories for Semilinear Parabolic Equations", Lecture Notes in Mathematics 2018, Springer-Verlag, Berlin, Heidelberg 2011, ISBN: 978-3-642-18459-8.
- Quittner, P.; Souplet, Ph., "Superlinear Parabolic Problems. Blow-up, Global Existence and Steady States". Birkhäuser Advanced Texts, Birkhäuser Verlag, Basel, 2007.
- Samarskii, Alexander A.; Galaktionov, Victor A.; Kurdyumov, Sergei P.; Mikhailov, Alexander P. "Blow-up in quasilinear parabolic equations". de Gruyter Expositions in Mathematics, 19. Walter de Gruyter & Co., Berlin, 1995.

2. Métodos docentes / Teaching methodology

The basic material will be covered in standard lectures. Part of the more advanced topics will be assigned to the students for individual study. There will be programmed tutoring sessions. The students are expected to present these topics in the classroom. Exercises will be assigned every week.

3. Tiempo de trabajo del estudiante / Student workload

		Nº de horas	Porcentaje
Presencial	Clases teóricas	42h (21%)	66 h (33%)
	Tutorías	14h (7%)	
	Seminarios y trabajos	8h (4%)	

	Examen final	2h (1%)	
No presencial	Elaboración de problemas	40h (20%)	134 h (67%)
	Estudio semanal	88h (44%)	
	Preparación de examen (presentación)	6h (3%)	
Carga total de horas de trabajo: 25 horas x 8 ECTS		200h	

4. Métodos de evaluación y porcentaje en la calificación final / Evaluation procedures and weight of components in the final grade

Final exam: 40%
Homework: 40%
Class presentations: 20%

EVALUACIÓN EXTRAORDINARIA / make up exam: Examen ante tribunal de Máster / examination by committee

5. Cronograma* / Course calendar

Semana Week	Contenido Contents	Horas presenciales Contact hours	Horas no presenciales Independent study time
1-2	First chapter	8	16
3-5	Second chapter	12	24
6-7	Third chapter	8	16
8-12	Fourth chapter	20	40
13-14	Fith chapter	8	18
15-16	Evaluation	10	20

*Este cronograma tiene carácter orientativo / Tentative