34962 - HS - Hamiltonian Systems

**Coordinating unit:** 200 - FME - School of Mathematics and Statistics
**Teaching unit:** 749 - MAT - Department of Mathematics
**Academic year:** 2017
**Degree:** MASTER'S DEGREE IN ADVANCED MATHEMATICS AND MATHEMATICAL ENGINEERING (Syllabus 2010). (Teaching unit Optional)
**ECTS credits:** 7,5  
**Teaching languages:** English

### Teaching staff
**Coordinator:** MARCEL GUARDIA MUNARRIZ
**Others:** Segon quadrimestre:
AMADEU DELSHAMS I VALDES - A
MARCEL GUARDIA MUNARRIZ - A

### Prior skills
Knowledge of calculus, algebra and ordinary differential equations.

### Degree competences to which the subject contributes

**Specific:**
1. **RESEARCH.** Read and understand advanced mathematical papers. Use mathematical research techniques to produce and transmit new results.
2. **MODELLING.** Formulate, analyse and validate mathematical models of practical problems by using the appropriate mathematical tools.
3. **CALCULUS.** Obtain (exact or approximate) solutions for these models with the available resources, including computational means.
4. **CRITICAL ASSESSMENT.** Discuss the validity, scope and relevance of these solutions; present results and defend conclusions.

**Transversal:**
5. **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.
6. **EFFICIENT ORAL AND WRITTEN COMMUNICATION.** Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
7. **THIRD LANGUAGE.** Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
8. **TEAMWORK.** Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
9. **EFFECTIVE USE OF INFORMATION RESOURCES.** Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.

### Teaching methodology
Standard exposition in front of the blackboard, resolution of exercices, completion of a project and attendance to the JISD summer school [http://www.ma1.upc.edu/recerca/jisd](http://www.ma1.upc.edu/recerca/jisd)

### Learning objectives of the subject
To comprehend the basic foundations of the theory of Hamiltonian systems, and to understand its applications to Celestial Mechanics and other fields.

**Study load**

| Total learning time: 187h 30m | Hours large group: 60h 32.00% | Self study: 127h 30m 68.00% |
### Content

<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Hamiltonian formalism</strong></td>
<td>28h</td>
<td>Hamiltonian dynamical systems: symplectic maps, symplectic manifolds. Linear Hamiltonian systems and their application to the study of stability of equilibrium points. Canonical transformations.</td>
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<tr>
<td>Quasi-integrable Hamiltonian systems</td>
<td>Learning time: 26h</td>
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<td>Theory classes: 8h</td>
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<td>Self study : 18h</td>
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**Description:**

<table>
<thead>
<tr>
<th>Lagrangian systems and variational methods</th>
<th>Learning time: 12h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 4h</td>
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<tr>
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<td>Self study : 8h</td>
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**Description:**

<table>
<thead>
<tr>
<th>Hamiltonian Partial Differential Equations</th>
<th>Learning time: 4h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
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<tr>
<td></td>
<td>Self study : 2h</td>
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**Description:**

<table>
<thead>
<tr>
<th>- Interactions between Dynamical Systems and Partial Differential Equations</th>
<th>Learning time: 49h 30m</th>
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<tr>
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<td>Theory classes: 12h</td>
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<td>Self study : 37h 30m</td>
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**Description:**
Summer School and Research workshop on topics between Dynamical Systems and Partial Differential Equations.
### Planning of activities

#### JISD summer school

**Description:**
Attendance to the JISD summer school

**Specific objectives:**
To learn from outstanding researchers a view of the state of the art in several research topics, interacting with students of the rest of Spain and of the World.

### Bibliography

**Basic:**


**Others resources:**

**Hyperlink**

Grup de sistemes dinàmics [https://recerca.upc.edu/ sd](https://recerca.upc.edu/ sd)

Pàgina web del Grup de Sistemes Dinàmics de la UPC on es descriuen diversos projectes i els investigadors que hi treballen així com diverses activitats relacionades