Course guide  
230489 - RELG - General Relativity

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 749 - MAT - Department of Mathematics.
               748 - FIS - Department of Physics.

Degree: BACHELOR'S DEGREE IN ENGINEERING PHYSICS (Syllabus 2011). (Optional subject).
Academic year: 2022  ECTS Credits: 6.0  Languages: Spanish

LECTURER
Coordinating lecturer: Consultar aquí / See here:
https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/responsables-assignatura

Others: Consultar aquí / See here:
https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/professorat-assignat-idioma

PRIOR SKILLS
Knowledge on classical Mechanics and classical Electromagnetism acquired in the previous subjects of the Degree; in particular, it is advisable to have studied the subject "Mechanics" (2A, Degree on Physics Engineering), or "Mathematical Models of Physics" (3B, Degree on Mathematics).

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
3. Knowledge of the scientific method and its applications in physics and engineering. Ability to formulate hypotheses and make critical analysis of scientific problems in the field of physics and engineering. Ability to relate the physical reality with their mathematical models and vice versa.
MAT1. Ability to solve math problems that may arise in engineering. Ability to apply knowledge about linear algebra, geometry, differential geometry, differential and integral calculus, ordinary and partial differential equations, probability and statistics.
FG2. Ability to solve basic problems in mechanics, elasticity, thermodynamics, fluids, waves, electromagnetism and modern physics, and its application in solving engineering problems.

Generical:
2. ABILITY TO IDENTIFY, FORMULATE, AND SOLVE PHYSICAL ENGINEERING PROBLEMS. Planning and solving physical engineering problems with initiative, making decisions and with creativity. Developing methods of analysis and problem solving in a systematic and creative way.

Transversal:
1. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

TEACHING METHODOLOGY
Lectures with interaction with students
LEARNING OBJECTIVES OF THE SUBJECT

The aims of this course are to provide sufficient training to students in order to advance the knowledge of the Theory of General Relativity (TRG). After introducing the basic mathematical tools and reviewing the minkowskian formulation of the Theory of Special Relativity, we want to describe the conceptual progress that led Albert Einstein to formulate the TRG and we state this theory, its current relevance, the experimental tests that support it and the main contributions in the subject of the external field and stellar collapse, generation of black holes and the origin and evolution of the universe: cosmological solutions.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>65.0</td>
<td>43.33</td>
</tr>
<tr>
<td>Self study</td>
<td>85.0</td>
<td>56.67</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

1. Complements of tensor algebra and differential geometry.

Description:

Full-or-part-time: 47h 20m
Theory classes: 10h
Practical classes: 10h
Self study : 27h 20m


Description:


Full-or-part-time: 7h
Theory classes: 2h
Practical classes: 1h
Self study : 4h

**Description:**

**Full-or-part-time:** 3h 30m  
Theory classes: 1h  
Practical classes: 1h  
Self study : 1h 30m

### 4. The equations of General Relativity.

**Description:**

**Full-or-part-time:** 11h 50m  
Theory classes: 3h 20m  
Practical classes: 1h 40m  
Self study : 6h 50m

### 5. Kinematics in General Relativity.

**Description:**

**Full-or-part-time:** 6h 30m  
Theory classes: 2h  
Practical classes: 2h  
Self study : 2h 30m


**Description:**

**Full-or-part-time:** 16h 20m  
Theory classes: 4h  
Practical classes: 3h  
Self study : 9h 20m
7. **Experimental tests of General Relativity.**

**Description:**

**Full-or-part-time:** 7h 10m  
Theory classes: 2h  
Practical classes: 1h  
Self study : 4h 10m

8. **Black holes.**

**Description:**

**Full-or-part-time:** 11h 50m  
Theory classes: 3h  
Practical classes: 2h  
Self study : 6h 50m

9. **Maximal extension and conformal compactification.**

**Description:**

**Full-or-part-time:** 11h 40m  
Theory classes: 3h  
Practical classes: 2h  
Self study : 6h 40m

10. **Radiation modeling and collapse: Vaidya solution**

**Description:**

**Full-or-part-time:** 11h  
Theory classes: 2h  
Practical classes: 2h  
Self study : 7h

Description:

Full-or-part-time: 15h 50m
Theory classes: 4h
Practical classes: 3h
Self study: 8h 50m

GRADING SYSTEM

Two partial exams (P1 and P2). Final exam (F) (optional).
Final qualification: (P1+P2)/2 or F.
Extraordinary exam (E): it will be carried out only in the case that the subject is not approved in the ordinary call and will include all the contents of the course. The final qualification of the subject will be E.

BIBLIOGRAPHY

Basic: