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>Total learning time: 150h</th>
<th>Hours large group:</th>
<th>65h</th>
<th>43.33%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Self study:</td>
<td>85h</td>
<td>56.67%</td>
</tr>
</tbody>
</table>

Last update: 30-03-2017
# Content

## 1. Complements of tensor algebra and differential geometry.

**Description:**

**Learning time:** 47h 20m
- Theory classes: 10h
- Practical classes: 10h
- Self study: 27h 20m


**Description:**


**Learning time:** 7h
- Theory classes: 2h
- Practical classes: 1h
- Self study: 4h


**Description:**

**Learning time:** 3h 30m
- Theory classes: 1h
- Practical classes: 1h
- Self study: 1h 30m
### 4. The equations of General Relativity.

**Learning time:** 11h 50m  
Theory classes: 3h 20m  
Practical classes: 1h 40m  
Self study: 6h 50m

**Description:**  

### 5. Kinematics in General Relativity.

**Learning time:** 6h 30m  
Theory classes: 2h  
Practical classes: 1h 40m  
Self study: 2h 30m

**Description:**  


**Learning time:** 16h 20m  
Theory classes: 4h  
Practical classes: 3h  
Self study: 9h 20m

**Description:**  
### 7. Experimental tests of General Relativity.

**Learning time:** 7h 10m  
Theory classes: 2h  
Practical classes: 1h  
Self study: 4h 10m

**Description:**  

### 8. Space-time diagrams in Schwarzschild coordinates.

**Learning time:** 11h 50m  
Theory classes: 3h  
Practical classes: 2h  
Self study: 6h 50m

**Description:**  

### 9. Maximal extension and conformal compactification.

**Learning time:** 11h 40m  
Theory classes: 3h  
Practical classes: 2h  
Self study: 6h 40m

**Description:**  

### 10. The Vaidya metric.

**Learning time:** 11h  
Theory classes: 2h  
Practical classes: 2h  
Self study: 7h

**Description:**  
External spacetime of a spherically symmetric and nonrotating star which is either emitting or absorbing null dust: Vaidya metric. Flux of radiation. Stress-energy-momentum tensor. Radiating black holes. Penrose diagrams of Vaidya metric. Radiating collapse of a spherically symmetric space-time: Matching conditions. Dominant energy conditions in a radiative collapse.

Description:

Learning time: 15h 50m
- Theory classes: 4h
- Practical classes: 3h
- Self study: 8h 50m

Qualification system
Two partial exams (P1 and P2). Final exam (F).
Final qualification: The best of (P1 + P2) / 2 and F.

Bibliography

Basic: