300050 - TIQ - Quantum Information Technology

Coordinating unit: 300 - EETAC - Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit: 748 - FIS - Department of Physics
Academic year: 2018
Degree:
- BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING/BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2015). (Teaching unit Compulsory)
- BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
- BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
- BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING/BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2015). (Teaching unit Compulsory)
- BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING (Syllabus 2015). (Teaching unit Optional)
- BACHELOR'S DEGREE IN AIR NAVIGATION ENGINEERING (Syllabus 2010). (Teaching unit Optional)
- BACHELOR'S DEGREE IN AIRPORT ENGINEERING (Syllabus 2010). (Teaching unit Optional)
ECTS credits: 6
Teaching languages: Catalan, Spanish, English

Teaching staff
Coordinator: SANTIAGO TORRES GIL
Others: PERE BRUNA ESCUER

Degree competences to which the subject contributes

Transversal:
1. 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.
2. 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.
3. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.
4. 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.

Learning objectives of the subject
# Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group:</th>
<th>42h</th>
<th>28.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Guided activities:</td>
<td>24h</td>
<td>16.00%</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>84h</td>
<td>56.00%</td>
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</tbody>
</table>
### INTRODUCCIÓ A LA FISICA QUANTICA

<table>
<thead>
<tr>
<th>Learning time: 22h</th>
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</thead>
<tbody>
<tr>
<td>Theory classes: 7h</td>
</tr>
<tr>
<td>Guided activities: 3h</td>
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<tr>
<td>Self study: 12h</td>
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</tbody>
</table>

**Description:**
- Solid state applications of the quantum mechanics: semiconductors, superconductors and lasers.

### QUANTUM COMPUTING

<table>
<thead>
<tr>
<th>Learning time: 45h</th>
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<tbody>
<tr>
<td>Theory classes: 14h</td>
</tr>
<tr>
<td>Guided activities: 6h</td>
</tr>
<tr>
<td>Self study: 25h</td>
</tr>
</tbody>
</table>

**Description:**
- Definition of qubits. Bloch sphere.
- Basic applications with quantum circuits: non-cloning theorem, quantum parallelism, Bell state generators-measuremeters, superdense coding, teleportation.
## QUANTUM PROCESSORS

### Description:
- Quantum hardware. General requirements DìVincenzo criteria.
- General characteristics of alternative models: magnetic nuclear resonance, superconductor circuits, etc.

### Learning time:
- Theory classes: 11h
- Guided activities: 5h
- Self study: 22h

## QUANTUM COMMUNICATION

### Description:
- Criptografia Clàssica vs. Quàntica.
- Sessió de Distribució Quàntica de Clau. Protocols bàsics: BB84, B89 i E91.
- Elements clàssics de la teoria de la informació. Entropia de Shannon.
- Compressió quàntica de dades i correcció d’errors quàntics.

### Learning time:
- Theory classes: 10h
- Guided activities: 10h
- Self study: 25h
### Planning of activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
<th>Theory classes</th>
<th>Self study</th>
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</thead>
<tbody>
<tr>
<td><strong>(ENG) (AV1): CONTROL DE PROBLEMES DELS TEMES 1 I 2</strong></td>
<td>6h 30m</td>
<td>1h 30m</td>
<td>5h</td>
</tr>
<tr>
<td><strong>(ENG) (AV2): CONTROL DE PROBLEMES DELS TEMES 3 I 4</strong></td>
<td>6h 30m</td>
<td>1h 30m</td>
<td>5h</td>
</tr>
<tr>
<td><strong>(ENG) (AV3): ACTIVITATS DIRIGIDES D’APLICACIONS PRÀCTIQUES</strong></td>
<td>81h</td>
<td>21h</td>
<td>60h</td>
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<tr>
<td><strong>(ENG) (AV4): PROJECTE APLICACIÓ DE LES TECNOLOGIES DE LA INFORMACIÓ QUÀNTICA</strong></td>
<td>25h</td>
<td>2h</td>
<td>3h</td>
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<tr>
<td><strong>(ENG) (AV5): EXAMEN DE MIG QUADRIMESTRE</strong></td>
<td>1h 30m</td>
<td></td>
<td></td>
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<tr>
<td><strong>(ENG) (AV6): EXAMEN DE FINAL DE QUADRIMESTRE</strong></td>
<td>1h 30m</td>
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</table>
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Bibliography

Basic:


Complementary:

