230679 - PVS - Photovoltaic Systems

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering
Academic year: 2019
Degree: MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2009). (Teaching unit Optional)
ECTS credits: 5
Teaching languages: English

Teaching staff
Coordinator: SANTIAGO SILVESTRE, LUIS CASTAÑER
Others: PABLO ORTEGA, SANDRA BERMEJO

Degree competences to which the subject contributes

Transversal:
1. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
2. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

Teaching methodology

- Lectures
- Application classes
- Laboratory practices
- Individual work (distance)
- Exercises
- Oral presentations
- Short answer test
- Extended answer tests (two in the semester and a Final Exam)

Learning objectives of the subject

Learning objectives of the subject:

The aim of this course is to train students in photovoltaic systems. First, we consider the building blocks and describe them taking into account state of the art solar cells and PV modules and the characteristics dependence with irradiance and temperature. Then, using this knowledge, sizing criteria will be described as well as the operating yields. Power electronics components will also be described.

Learning results of the subject:

- Ability to specify and design PV systems for stand alone, grid connected and water pumping applications.
- Ability to calculate the energy performance analysis, return of investment and system reliability.
- Ability to understand operation of state of the art solar cells in flat panel or concentrating systems.
- Ability to develop techniques for the design, analysis and evaluation of electronic systems in applications such as automation, aerospace, energy distribution and generation, consumer electronics, biomedicine, etc.
230679 - PVS - Photovoltaic Systems

- Ability to analyze, design and evaluate electronic systems for power control and energy conversion.
- Ability to understand a photovoltaic system and its components as long as the criteria used to size such systems.

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours large group:</th>
<th>Hours small group:</th>
<th>Self study:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total learning time:</strong> 125h</td>
<td>26h</td>
<td>13h</td>
<td>86h</td>
</tr>
<tr>
<td></td>
<td>20.80%</td>
<td>10.40%</td>
<td>68.80%</td>
</tr>
</tbody>
</table>
## Content

<table>
<thead>
<tr>
<th>Section</th>
<th>Learning time</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction: Solar energy and PV systems</td>
<td>16h</td>
<td>- Solar energy and renewable sources&lt;br&gt;- Solar energy availability&lt;br&gt;- Building blocks of a PV system</td>
</tr>
<tr>
<td>2. Photovoltaic cells and modules</td>
<td>20h</td>
<td>- Solar cell operation and main characteristics&lt;br&gt;- PV modules and PV plants&lt;br&gt;- Available technologies</td>
</tr>
<tr>
<td>3. Main components of a PV system</td>
<td>20h</td>
<td>- Modules, batteries, DC/DC converters and DC/AC converters&lt;br&gt;- Safety and monitoring components and measuring systems&lt;br&gt;- Simulation models</td>
</tr>
<tr>
<td>4. Stand-alone and water pumping PV systems</td>
<td>24h</td>
<td>- Sizing, best practice recommendations&lt;br&gt;- Applications&lt;br&gt;- Available technologies</td>
</tr>
</tbody>
</table>

**Learning time:**
- Theory classes: 4h
- Self study: 12h

**Description:**
- Solar energy and renewable sources
- Solar energy availability
- Building blocks of a PV system
- Solar cell operation and main characteristics
- PV modules and PV plants
- Available technologies
- Modules, batteries, DC/DC converters and DC/AC converters
- Safety and monitoring components and measuring systems
- Simulation models
- Sizing, best practice recommendations
- Applications
- Available technologies
### 5. Grid connected PV systems

**Description:**
- Inverters characteristics and guidelines for sizing and design
- Long term simulations
- Operation and performance parameters

**Learning time:** 26h
- Theory classes: 5h
- Laboratory classes: 6h
- Self study: 15h

### 6. PV Market analysis and legal incentives for PV expansion

**Description:**
- Grid parity and feed-in tariff
- Global market analysis and worldwide trends

**Learning time:** 19h
- Theory classes: 4h
- Self study: 15h
### Planning of activities

#### EXTENDED EXERCISES

**Description:**
Exercises to strengthen the theoretical knowledge and to work in depth in some subject

#### ORAL PRESENTATION

**Description:**
Presentation of a topic.

#### LABORATORY PRACTISES

**Description:**
Simulations of Stand-alone and Grid connected PV systems

#### EXTENDED ANSWER TEST (TOW DURING THE SEMESTER AND A FINAL EXAMINATION)

**Description:**
Final examination.

### Qualification system

Final examination: 50%
Laboratory practises: 25%
Individual assessments: from 25%

### Bibliography

**Basic:**