820153 - IRXPE - Renewable Integration in Electrical Grids

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 709 - EE - Department of Electrical Engineering
Academic year: 2016
Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional) BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Optional) BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional) BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Optional)
ECTS credits: 6 Teaching languages: Catalan, Spanish, English

Teaching staff
Coordinator: Heredero Peris, Daniel
Others: Heredero Peris, Daniel
Prieto Araujo, Eduardo

Opening hours
Timetable: Preferably, an appointment by email.

Prior skills
Basic knowledge on electrical systems, power generation, energy resources, control theory and energy transport.

Requirements
Electrical Machines and Power Generation
Electric power system or power transmission and distribution II
Energy Control Systems

Degree competences to which the subject contributes
Specific:
1. Understand the applications of power electronics.
2. Understand the applications of renewable energies.
3. Understand electrical power systems and their applications.
4. Explain the operating principles of power conversion systems and their application to transport and distribution systems.
5. Explain the operating principles of fluid, gas and vapour, and electricity transport and distribution systems and understand their respective models.
6. Assess and compare the energy capacitance and potential of the energy resources available.
7. Analyse and simulate specific energy systems.

Transversal:
8. 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.

9. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

10. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.

**Teaching methodology**

The subject is based on the theoretical explanation of a different renewable technologies and their integration to the utility from the point of view of the system control. The theoretical part is complemented with basically a series of practices with MATLAB.

The course uses approximately methodology exhibition / participation 30%, individual 60 % and group working in 10%. The practical implementation is basic to better understand the concepts worked.

**Learning objectives of the subject**

The main of the course is to study the various methodologies for integration of photovoltaic and wind power into the utility, considering their behavior from small to large powers. Also will be explained the implications in the electrical system of the electrical vehicle and will be announced the problematics to take care in micro-grids, both AC and DC.

**Study load**

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 45h</th>
<th>30.00%</th>
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</thead>
<tbody>
<tr>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td>Hours small group:</td>
<td>15h</td>
<td>10.00%</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td>Self study:</td>
<td>90h</td>
<td>60.00%</td>
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# Content

**Integration of PV at the utility**

<table>
<thead>
<tr>
<th>Learning time: 60h</th>
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<tbody>
<tr>
<td>Theory classes: 18h</td>
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<tr>
<td>Laboratory classes: 6h</td>
</tr>
<tr>
<td>Self study: 36h</td>
</tr>
</tbody>
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**Description:**
Introduction to Photovoltaic Systems, Solar Radiation, Photovoltaic modules, Solar plants, Introduction to photovoltaic converters, Power semiconductors, Pulse Width Modulation (PWM), filters, Grid connected inverter, Introduction to system dynamics and control of discrete and continuous systems, Clarke and Park Transforms, Synchronism, Current loop network side, Loop voltage, Algorithms maximum power point tracking Island Detection Systems, Efficiency of inverter equipment

**Related activities:**
Classroom theoretical sessions. Practical examples and MATLAB in classroom and autonomously

**Specific objectives:**
At the end of the activity students will be able to:
- Understand the scope and content of the course and details of teachers, dedication weekly practices, evaluation and bibliography.
- Understand the implications of a control system AC grid side to manage renewable resources

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**Grid integration of wind power**

<table>
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<th>Learning time: 40h</th>
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<tbody>
<tr>
<td>Theory classes: 12h</td>
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<tr>
<td>Laboratory classes: 4h</td>
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<tr>
<td>Self study: 24h</td>
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**Description:**

**Related activities:**
Classroom theoretical sessions. Practical examples and MATLAB in classroom and autonomously

**Specific objectives:**
At the end of the activity students will be able to:
- Understand the scope and content of the course and details of teachers, dedication weekly regimen practices, evaluation and bibliography.
- Understand the implications of a control system for AC machine side to manage a wind generator
Electric vehicle in the utility

Learning time: 32h
- Theory classes: 9h 36m
- Laboratory classes: 3h 12m
- Guided activities: 19h 12m

Description:

Related activities:
Classroom theoretical sessions. Practical examples and MATLAB in classroom and autonomously

Specific objectives:
- Understand the scope and content of the course and details of teachers, dedication weekly regimen practices, evaluation and bibliography.
- Understand the implications of the EV integration to the grid.

Basic concepts of micro-grids

Learning time: 18h
- Theory classes: 10h 48m
- Guided activities: 5h 24m
- Self study: 1h 48m

Description:
The microgrid. Elements of the microgrid. Sources of energy. Paralelization of AC / DC systems

Related activities:
Classroom theoretical sessions. Practical examples and MATLAB in classroom and autonomously

Specific objectives:
- Understand the scope and content of the course and details of teachers, dedication weekly regimen practices, evaluation and bibliography.
- Understand the implications of the EV integration to the grid.

Qualification system

The evaluation will be conducted by the assessment of the teacher. Partial checks account for 30%, exercises-problems and practical 30% and 40% a final control.
Regulations for carrying out activities

The use of scientific calculators are allowed on exams.
You can not make use of any notes in the controls.

Bibliography

Basic:


