** Place your pointer on the underlined fields and start typing to fill in text, **
or use an X or a number to fill in “check-box” or numbered fields.

Provide information requested below that is not contained in the syllabus.
Please note the guidelines in the boxes.

Number (if known): ___  ___ Undergraduate  ___ Graduate  ___ Professional

Title/subtitle:  __Introduction to Smart Grid__

Effective:  __Winter 2014__ (Quarter and Year)

Offered: ___ Fall  ___ Winter  ___ Spring  ___ Summer  ___ Once Only  ___ Other ___

Instructor(s):  __Dr. Hamed Mohsenian-Rad__

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**Hours per week per unit of credit may not be less than but may exceed those listed below.**

• One unit for each hour per week (1:1) of colloquium, consultation, discussion, lecture, seminar, or workshop

• One unit for each three hours per week (1:3) of activity, clinic, extra reading, fieldwork, individual study, internship, laboratory, practicum, research (scheduled and outside), screening, term paper, thesis, tutorial, written work, and similar assigned problems

• One unit for each two to three hours per week (1:2-3) of studio

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Units:  ___ 4___

**Activities and hours per week:** Indicate below the number of hours per week that students will spend in the activities listed (leave blank those that do not apply).  

<table>
<thead>
<tr>
<th>Activity</th>
<th>Internship</th>
<th>Seminar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinic</td>
<td>Laboratory</td>
<td>Studio</td>
</tr>
<tr>
<td>Colloquium</td>
<td>Lecture</td>
<td>Term Paper</td>
</tr>
<tr>
<td>Consultation</td>
<td>Practicum</td>
<td>Thesis</td>
</tr>
<tr>
<td>Discussion</td>
<td>Research (outside)</td>
<td>Tutorial</td>
</tr>
<tr>
<td>Extra Reading</td>
<td>Research (scheduled)</td>
<td>Workshop</td>
</tr>
<tr>
<td>Field</td>
<td>Screening (outside)</td>
<td>Written Work</td>
</tr>
<tr>
<td>Individual Study</td>
<td>Screening (scheduled)</td>
<td>Other: ___</td>
</tr>
</tbody>
</table>

Prerequisite(s):  ___None___
Read the guidelines in this box before writing the Catalog description.
Write the description in the present tense and limit it to 50 words (do not count grading information, repeatability information, or a list of E-Z subtitles). If possible, do not use complete sentences. However, use sentences that contain more than a list of items or topics.

Examples:
Instead of "This course will introduce students to the history of . . .," use one of the following formats:
  Introduces the history of . . .
  An introduction to the history of . . .
  Introduction to the history of . . .

Instead of “Functions, equations, and graphs,” use a format similar to one of the following examples:
  Explores functions, equations, and graphs . . .
  Topics include functions, equations, and graphs . . .
  A study of functions, equations, and graphs . . .

Catalog description:  An introduction to smart power grid, covering basics of power systems, definition and applications of smart grid, demand response and demand side management, renewable power generation and integration, smart grid communications, wide area measurement, smart grid cyber security and privacy, and economics and market issues.

Grading  __ Letter Grade or petition for Satisfactory/No Credit (S/NC)  __ X, Letter Grade only  __ In Progress (IP)  __ Letter Grade only or S/NC; no petition required  __ S/NC only

The statements selected below will be added to the Catalog description by the Catalog office:

Grading statement (if required):
  __ Satisfactory (S) or No Credit (NC) grading is not available.
  __ Graded Satisfactory (S) or No Credit (NC).
  __ Normally graded Satisfactory (S) or No Credit (NC), but students may petition the instructor for a letter grade on the basis of assigned extra work or examination.
  __ May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.
  __ May be taken Satisfactory (S) or No Credit (NC) by students advanced to candidacy for the Ph.D.
  __ Students who submit a term paper receive a letter grade; other students receive a Satisfactory (S) or No Credit (NC) grade.
  __ Students who present a seminar receive a letter grade; other students receive a Satisfactory (S) or No Credit (NC) grade.
  __ Students who present a seminar or submit a term paper receive a letter grade; other students receive a Satisfactory (S) or No Credit (NC) grade.
  __ Other: ___

Repeatability statement (if required):
  __ Course is repeatable.
  __ Course is repeatable to a maximum of ___ units.
  __ Course is repeatable as content changes.
  __ Course is repeatable as content changes to a maximum of ___ units.
  __ Course is repeatable as topics change.
  __ Course is repeatable as topics change to a maximum of ___ units.
  __ Other: ___

If the course is repeatable, may a student take more than one section of the course in a single quarter?  __ Yes  __ No

Cross-listing statement:  Cross-listed with  __ NA __

Credit statement (to limit credit when course content overlaps):
Credit is awarded for only one of ___

Breadth statement (for CPAC, ETST, FVC, HASS, or WMST courses only):
  __ Fulfills the Humanities requirement for the College of Humanities, Arts, and Social Sciences.
  __ Fulfills the Social Sciences requirement for the College of Humanities, Arts, and Social Sciences.
  __ Fulfills either the Humanities or Social Sciences requirement for the College of Humanities, Arts, and Social Sciences.
  __ See the Student Affairs Office in the College of Humanities, Arts, and Social Sciences.
Does not fulfill the Humanities or Social Sciences requirement for the College of Humanities, Arts, and Social Sciences.

Other: ___

If the course content overlaps or duplicates the content of another course, describe the overlap or duplication: NA

If the course affects degrees, minors, and/or programs, list the affected degrees, etc. and explain how they are affected: This course is approved to be an "advanced course" for the Intelligent Systems track at the Department of Electrical Engineering. It is likely to soon become also an "advanced course" for Control Systems track.

If the course affects the prerequisites and/or descriptions of other courses, list the affected courses and explain how they are affected: NA

Justification for establishing the course (inserts or attach): There is currently no graduate level course related to energy and power systems at the Department of Electrical Engineering. This course will provide an overview to a variety of topics that can help graduate students initiate their research along the line of energy and smart grid.

Syllabus (insert or attach and include the information below): The syllabus is attached.

Course requirements: Final Exam, Homework, Term Paper

If an activity selected above under “Activities and Hours” does not involve faculty contact (e.g., extra reading, individual study, and outside research), describe the activity and explain how it will be evaluated.

If one of the activities selected above is consultation hours, explain how these hours will be implemented and monitored.

For further information about course guidelines, see the General Rules and Policies Governing Courses of Instruction at senate.ucr.edu/Committees/courses/guidelines.pdf
**Instructor:**

Dr. Hamed Mohsenian-Rad  
Assistant Professor, Department of Electrical Engineering  
Office: WCH 436  
Email: hamed@ee.ucr.edu

**Course Purpose:**

An introduction to smart power grid, covering basics of power systems, definition and applications of smart grid, demand response and demand side management, renewable power generation and integration, smart grid communications, wide area measurement, smart grid cyber security and privacy, and economics and market issues.

**Course Topics:**

- **Basics of Power Systems:** [2 lectures]  
  - Load and Generation  
  - Power Flow Analysis  
  - Economic Dispatch and Unit Commitment Problems

- **Smart Grid:** [1 lecture]  
  - Definition  
  - Applications  
  - Government and Industry  
  - Standardization

- **Demand Response** [4 lectures]  
  - Definition, Applications, and State-of-the Art  
  - Pricing and Energy Consumption Scheduling  
  - Controllable Load Models, Dynamics, and Challenges  
  - Electric Vehicles and Vehicle-to-Grid Systems  
  - Demand Side Ancillary Services

- **Renewable Generation:** [3 lectures]  
  - Carbon Footprint  
  - Renewable Resources: Wind and Solar  
  - Microgrid Architecture  
  - Tackling Intermittency  
  - Stochastic Models and Forecasting  
  - Distributed Storage and Reserves

- **Wide Area Measurement:** [2 lectures]  
  - Sensor Networks
- Phasor Measurement Units
- Communications Infrastructure
- Fault Detection and Self-Healing Systems

- Security and Privacy: [3 lectures]
  - Cyber Security Challenges in Smart Grid
  - Load Altering Attacks
  - False Data Injection Attacks
  - Defense Mechanisms
  - Privacy Challenges

- Economics and Market Operations [2 lecture]
  - Energy and Reserve Markets
  - Market Power
  - Generation Firms
  - Locational Marginal Prices

**Prerequisites:**

There is no official pre-requisite at the time of enrolment. However, basic knowledge of power systems, basic knowledge of computer and communications networks, and some background in probability and random variables, linear algebra, and convex optimization will be helpful.

**Textbooks:**


**Other References:**

Class handouts provided by the instructor. The students will also need to read several recent papers in the field of smart grid, e.g., in the *IEEE Transactions on Smart Grid*, the *IEEE Innovative Smart Grid Technologies Conference*, and the *IEEE Conference on Smart Grid Communications*.

**Grading (Percentage):**

  - Homework – 50%
  - Final Exam – 30%
  - Final Project Report and Presentation – 20%