** 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): EE 218V    ___ Undergraduate    X___ Graduate    ___ Professional

Title/subtitle: _Power System Steady State and Market Analysis_

Effective: _Spring 2016_ (Quarter and Year)

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

Instructor(s): _Nanpeng Yu_

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

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):** _EE 155, EE 132 AND (ENGR 160 OR EE231) _
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: Introduces power system steady state and market analysis. The topics include system security criteria and security assessment, state estimation, automatic generation control, contingency screening and security constrained optimal power flow, the electricity market structure, security constrained economic dispatch and unit commitment, financial transmission rights, forward markets, and market power.

<table>
<thead>
<tr>
<th>Grading</th>
<th>X. Letter Grade or petition for Satisfactory/No Credit (S/NC)</th>
<th>Letter Grade only</th>
<th>In Progress (IP)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Letter Grade or S/NC; no petition required</td>
<td>S/NC only</td>
<td></td>
</tr>
</tbody>
</table>

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.
- X 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 ___

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

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: __________

If the course affects degrees, minors, and/or programs, list the affected degrees, etc. and explain how they are affected: __________

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

Justification for establishing the course (insert or attach):

This course is needed because it will be used as part of the MSOL online degree program that the BCOE and the ECE department intend to offer. This V version of the course involves the following six components: a) a course management system, e.g., UCR's iLearn (BlackBoard) system, which UCR has been using for many years and with which most UCR faculty are already familiar; b) for online consultation with TAs and faculty, a web-based meeting system that includes shared desktop, audio, and possibly video communication. c) Remotely available online video recordings of classroom lectures (e.g., Flash 7.0+) with accompanying presentation graphics (e.g., PowerPoint slides). d) Remotely proctored exams, for which we will initially follow UCLA's policies and protocols. e) Lectures are online and would be a direct 1:1 "contact" as in a regular course. For the consultation, faculty members should be available for 1 hour/week to interact with the student via Skype (or other). f) In the evaluation, homework and other assignments are submitted via e-mail (or within iLearn). All exams are proctored. For remotely proctored exams, UCR intends to initially follow UCLA's policies and protocols.

Syllabus (insert or attach and include the information below): __See attached__

Course requirements (e.g., term papers and examinations)

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
EE 233V    Power System Steady State and Market Analysis   Syllabus

Course Purpose:
This graduate level class covers power system steady state and market analysis. In the steady state analysis section, system security criteria and security assessment, state estimation, automatic generation control, contingency screening and security constrained optimal power flow will be covered. In the market section, the electricity market structure, security constrained economic dispatch and unit commitment, financial transmission rights, forward markets, and market power issues are covered.

Textbook:

Course Topics:

- Introduction to Power System Operation and Control [Chapter 1 W&W]:
  o Power System Operation and Control Under a Vertically Integrated Utility
  o Power System Operation and Control Under Competitive Market Structure

- Optimal Power Flow and State Estimation [Chapters 4 and 12 W&W]
  o AC Optimal Power Flow Analysis
  o DC Optimal Power Flow Analysis
  o Power System State Estimation Problem

- Power System Security Assessment [Chapter 11 W&W]:
  o Introduction to Power System Security
  o Power System Security Criteria
  o Power System Security Assessment
  o Contingency Analysis

- Automatic Generation Control [Chapter 9 W&W]:
  o Overview of Generation Control Problem
  o Generator Model, Load Model
  o Prime-Mover Model, Governor Model
  o Generation Allocation

- Electricity Market [Chapters 1, 3 and 5 K&S]:
  o Electricity Market History
  o U.S. Electricity Market Structure
• Market Products
  • Market Implementation and Operations

• Economic Dispatch and Security Constrained Unit Commitment [Chapters 3, 5 W&W]
  • Economic Dispatch Problem
  • Security Constrained Unit Commitment Problem
  • Unit Commitment Solution Methods

• Financial Transmission Rights and Forward Markets [Chapters 2 and 8 K&S]:
  • Financial Transmission Rights (FTR)
  • FTR Auction and Congestion Risk Hedging
  • Electricity Related Forward Market

• Market Power and Manipulation in Electricity Market [Chapter 2 K&S]:
  • Market Power in Electricity Market
  • Historical Market Manipulation Events
  • Design Market Power Mitigation Rules

Weekly Schedule:

• Week 5-6: Automatic Generation Control: Generation Control Problem, Models for Generation, Load, Prime-Mover, Governor and Generation Allocation.

Prerequisites:

EE 155, EE 132 AND (ENGR 160 OR EE 231)

Grading (Percentage):

  Homework – 25%
  Midterm Exam: 25%
  Final Exam – 25%
  Final Project and Term Paper – 25%