ECE 420 – Analytical Methods in Power Systems

2012 Catalog Data: Fundamentals of power systems operation and planning. Economic operation of power systems with consideration of transmission losses. Design of reliable power systems, power systems security analysis, optimal scheduling of power generation, estimation of power system state. Prerequisite: [(ECE 319)] (3-0-3) (P)

Enrollment: Elective course for all ECE majors

Textbook: Class notes and handouts

Coordinator: Mohammad Shahidehpour, Professor of ECE

Course goals:
After completing this course, the student should be able to do the following:

1. Apply the per unit concept to power systems and draw the per unit diagram of a typical power system.
2. Solve the economic dispatch of power systems and consider the transmission networks for calculating losses.
3. Apply the concept of dynamic programming to real world problems. Solve the generation scheduling problem in power systems using dynamic programming.
4. Apply the linear programming concept to real world problems. Solve the optimal power flow problem in power systems using linear programming. Solve the state estimation problem in power systems using linear programming.
5. Apply the reliability concept to power systems and calculate reliability indices for interconnected power systems.
6. Understand the restructuring concept in power systems and be able to compare its merits with those of vertically integrated utility companies.

Prerequisites by topic:
1. Electrical Circuit Analysis
2. Power System Analyses

Lecture schedule: Two 75-minute sessions per week

Topics:
1. Review of power network fundamentals (2 week)
   Power equations, Per unit
2. Economic Dispatch (1 weeks)
   Economic dispatch
3. Unit commitment and power scheduling (2 weeks)
   Dynamic programming
   Generation scheduling
4. Linear programming (2 weeks)
5. Power systems optimal power flow (2 weeks)
   Load flow solution
   Real power optimization using linear programming
   Reactive power optimization using linear programming
6. Power systems state estimation (2 weeks)
   Power flow measurements
   State estimation using linear programming
7. Introduction to restructuring in electricity markets (1 week)

Computer usage: Students use MATLAB software for homework assignments.
Relationship of ECE 420 Course Goals to Student Outcomes:

<table>
<thead>
<tr>
<th>Student Outcomes</th>
<th>Course Goals</th>
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<tbody>
<tr>
<td>a. Apply knowledge of math, engineering, science</td>
<td>2,3,4,5,6,7</td>
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<td>b. Design and conduct experiments / Analyze and Interpret Data</td>
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<td>c. Design system, component, or process to meet needs</td>
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<td>d. Function on multi-disciplinary teams</td>
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<tr>
<td>e. Identify, formulate, and solve engineering problems</td>
<td>1,2,3,4,5,6</td>
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<td>f. Understand professional and ethical responsibility</td>
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<td>g. Communicate effectively</td>
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<td>h. Broad education</td>
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<td>i. Recognize need for life-long learning</td>
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<td>j. Knowledge of contemporary issues</td>
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<td>k. Use techniques, skills, and tools in engineering practice</td>
<td>3,4</td>
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**Prepared by:** Mohammad Shahidehpour  **Date:** October 20, 2013