

UNIVERSITY OF
WATERLOO



Department of Electrical & Computer Engineering

E&CE 467: POWER SYSTEMS ANALYSIS, OPERATIONS AND MARKETS

Course Outline

Winter 2021

<http://learn.uwaterloo.ca/>

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Lectures: Wednesdays and Thursdays 1:00-2:20 AM @
<https://uwaterloo.webex.com/uwaterloo/k2/j.php?MTID=tefd315cb8d7495ad8782765556ddb70>, password f37JpkJg2an

Tutorials: Fridays 5:00-6:00 pm @
<https://uwaterloo.webex.com/uwaterloo/k2/j.php?MTID=t86e0c7d9f126863f2d140ea4826b410d>, password VuxSJJMN447
Start the week after lectures start.

Objectives:

Gain an understanding of the operation and management of power systems considering the main technical and economic issues.

Content:

Estimated Lectures	Topics (Textbook Chapters)	Sub-Topics (Textbook Sections)	Assignments
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6	Review (Chaps. 1 & 2)	<ul style="list-style-type: none"> Power systems overview (1.2). Modeling: per unit (2.2); lines (2.3); transformers (2.4); synchronous machine (2.5); induction machine (2.6); loads (2.7). 	TBA
6	Power System Economic Operations (Chap. 5 & App. B)	<ul style="list-style-type: none"> Economic load dispatch (5.2): Kuhn-Tucker's conditions; marginal costs; limits; losses. Unit commitment problem (5.3) and solution (B.2). 	TBA
6	Power System Operation Analysis (Chaps. 3 & 6, App. B)	<ul style="list-style-type: none"> Power flows: equations (3.2 & 3.3); solutions (3.4-3.5); fast decoupled method (3.6); dc power flow model (3.8); matrix analysis (3.9). Contingency analysis (6.3). Optimal power flows (6.4) and solution (B.3-B.5). 	TBA
6	Electricity Markets (Chaps. 1 & 5)	<ul style="list-style-type: none"> History and structure (1.3 & 1.4). Fundamentals (5.4). Auction mechanisms (5.5). 	TBA
6	Fault Analysis (Chap. 7 & 8)	<ul style="list-style-type: none"> Symmetrical components (7.2). Sequence models (8.2). Balanced and unbalance faults (8.4 & 8.5) 	TBA
6	Power system stability and control (Chaps. 9 &10)	<ul style="list-style-type: none"> Definitions (10.1). Angle stability (10.2). Voltage stability (10.3). Voltage control (9.4). Frequency stability (10.4). Frequency control (9.3). 	TBA

Textbook:

A. Gómez-Expósito, A. J. Conejo, and C. A. Cañizares, Editors, *Electric Energy Systems: Analysis and Operation*, 2nd edition, CRC Press, June 2018, ISBN 9781315192246.

First edition covers the main topics too.

Assignment References:

1. A. R. Bergen and V. Vittal, *Power Systems Analysis*, Second Edition, Prentice-Hall, 2000.
2. A. J. Wood and B. F. Wollenberg, *Power Generation, Operation and Control*, 2nd ed., John Wiley & Sons, 1996.
3. Course slides available at course website: <http://learn.uwaterloo.ca/>

Requisites:

Basic knowledge of power systems components, modeling and analysis is required (ECE 361), as well as some familiarity with numerical methods (ECE 204).

Assignments:

There will be five *individual optional* assignments comprised of various examples from the textbook and problems from the references books. Due dates will be provided with the assignment description; if due dates are missed, zero marks will be assigned. Submission will be online at the course website <http://learn.uwaterloo.ca/>. Exam questions will be similar to the assignment questions.

Project:

There will be a *group (2 people)* project consisting on simulating and analyzing various electricity market auctions on a 6-bus system using AMPL/GAMS. The due date will be provided with the project description; if the due date is missed, zero marks will be assigned. Submission will be online at the course website <http://learn.uwaterloo.ca/>.

Marking:	Project	→	40 % (deadline TBA)
	Midterm Exam	→	10 % (time and link TBA)
	Final Exam	→	50 % (time and link TBA)
	Assignments	→	+10 % (optional)

Important Notes:

- Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility For more information visit www.uwaterloo.ca/academicintegrity/
- Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, at www.adm.uwaterloo.ca/infosec/Policies/policy70.htm. When in doubt please be certain to contact the department's administrative assistant for further assistance.
- Discipline: A student is expected to know what constitutes academic integrity, as explained in detail at www.uwaterloo.ca/academicintegrity/, to avoid committing an academic offence, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline, at www.adm.uwaterloo.ca/infosec/Policies/policy71.htm. For typical penalties check Guidelines for the Assessment of Penalties at www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.
- Appeals: A decision made or penalty imposed under Policy 70 (Student Petitions and Grievances) or Policy 71 (Student Discipline) may be appealed. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals) at www.adm.uwaterloo.ca/infosec/Policies/policy72.htm.
- Students with Disabilities: The Office for Persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.