Revised: Jan 19, 2015

IE:4550 (56:155) Wind Power Management

Spring 2015

Objectives: The course introduces principles of wind power production, design of wind turbines, location and design of wind farms, control of turbines and wind farms, predictive modeling, diagnostics, operations and maintenance, condition monitoring, health monitoring and of turbine components and systems, wind farm performance optimization, and integration of wind power with a grid. The modeling and analysis aspect of the topics discussed in the class will be illustrated with examples and case studies.

Textbook: A. Vieira Da Rosa, Fundamentals of Renewable Energy Processes, Elsevier, San Diego, CA, 2013.

References: V. Lyatkher, *Wind Power: Turbine Design, Selection, and Optimization*, Wiley, 2014.
JF Manwell, JG McGowan, and AL Rogers, Wind Energy Explained: Theory, Design and Application (Second Edition), Wiley, New York, 2010.
J.W. Tester *et al*., Sustainable Energy: Choosing Among Alternatives, MIT Press, Cambridge, MA, 2012.
L. Freris and D. Infield, *Renewable Energy in Power Systems*, Wiley, New York, 2008.

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Class Time: 9:30AM – 10:45AM, TTh

Classroom: 2217 SC

TA: Sammy Gordon
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TA's Office Hours and Place
3221 Seamans Center
Tuesday: 8:30-9:20, Wednesday 2:30-3:20 or by appointment

Useful Wind Energy Websites

Wind basics	http://www.nrel.gov/learning/re_wind.html
Wind energy tutorial	http://www.awea.org/faq/
Wind resource maps	http://www.nrel.gov/wind/resource_assessment.html
Wind energy technology	http://www.world-wind-energy.info/
Wind energy manual	http://www.energy.iastate.edu/renewable/wind/wem/wem-02_toc.html
Wikipedia	http://en.wikipedia.org/wiki/Wind_power
Small wind	http://www.awea.org/smallwind/
Wind energy for kids	http://www.alliantenergykids.com/stellent2/groups/public/documents/pub/phk_ee_re_001502.hcsp
Iowa Wind	http://www.iawind.org

Useful Renewable Energy Websites

Biomass	http://www.nccc.gov.sg/renewables/biomass.shtm
Solar	http://www.nccc.gov.sg/renewables/solar.shtm
Hydrogen/Fuel Cells	http://www.nccc.gov.sg/renewables/fuelcell.shtm

Journals

IEEE Transactions on Energy Conversion	http://ieeexplore.ieee.org
Wind Energy	http://www3.interscience.wiley.com/journal/6276/home/EditorialBoard.html
International Journal of Energy Research	http://www3.interscience.wiley.com/journal/3343/home/EditorialBoard.html

Course Contents:	**Topic**	**Week**
1:	Why energy from alternative sources	1
2:	Wind turbine design I	2
3:	Wind turbine design II	3
4:	Wind as a fuel	4
5:	Turbine siting	5
6:	Energy output	6
7:	SCADA systems	7
	Midterm Exam	March 12
8:	Modeling wind turbines	8
9:	Verification of dynamic models	9
10:	Power systems dynamics	10
11:	Design of wind farms	11
12:	Wind farm operations	12
13:	Predictive engineering	13
14:	Fault prediction	14
15:	Innovation on wind power production	15
16:	The future of wind energy	16

Final Exam (Time and date are provided at http://www.registrar.uiowa.edu/exams/single.aspx)

Course grading scheme

Homework and quizzes	25%
Semester Project	35%
Midterm Exam	20%
Final Exam	20%

Check your grade at ICON http://icon.uiowa.edu/index.shtml

Exams: Two exams (midterm and final) will be given. The final exam week schedule may be found on the Office of the Registrar's website at http://www.registrar.uiowa.edu by selecting "Exam Information" under the "Faculty/Staff" or "Student" menu tabs.

Quizzes: A number homework assignments and quizzes will be given in preparation for the two exams. The quizzes will not be announced.

SEMESTER PROJECT

There are three components to the semester project:

1. Project Proposal DUE: Fr, March 13
   Submit the proposal to ICON
2. Project Report DUE: T, April 28
   Submit the following three files to ICON folder: the project report, Power Point presentation, and am e-poster. The e-poster template is posted on ICON and its format needs to be observed)
3. Project Presentations In class: Apr 23, 28, 30, and May 5 and 8.
   ⇒ *The project content used in this class cannot be used for credit in other courses*

Project grading scheme

- ✓ 30% project presentation
- ✓ 60% project content
- ✓ 10% attendance of discussion meetings and project presentations

SEMESTER PROJECT

THE SEMEXTER PROJECT MAY TAKE ONE THE FOLLOWING THREE FORMS:

A. Application Project (Teams of two students are allowed)
You need to describe the problem considered for your project and propose a solution approach. Ideally, the project should be based on an existing application. The solution approach could be based on an existing freeware that could be found on the web.
Hint: To identify software (freeware) tool to be used for solving the selected problem (application) you may follow the following steps:

- ✓ Search the web.
- ✓ Identify a software tool (and/or a data set) related to wind farm operations. The software and the data may come from independent websites
- ✓ Apply the tool to the data set.
- ✓ Prepare project report according to the format presented in this syllabus
- ✓ Prepare Power Point presentation
- ✓ Demonstrate the application of the tool to your dataset in class

B. Software Development Project (Teams of two students are allowed)
The student(s) will be responsible for the development of software for some of the topics discussed in class. The code should be written in a modern language, e.g., C, C++, Visual Basic, ASP and a user-friendly interface should be developed. Web implementation of the software is encouraged.

C. Research Paper (Teaming is not encouraged)
You may choose a specific wind energy related topic, develop a model, and solve it. As a new and fast growing area, wind energy offers vast opportunities for modeling projects, e.g., optimization of turbine siting, reliability, maintenance scheduling. This type of project should survey the existing literature, formulate a research problem, present existing methods for solving similar problems, formulate a new solution approach, and report computational results.

D. Hardware Development Project (Teams of two students are allowed)
A wind turbine or a subsystem of the wind turbine may be developed and demonstrated in class.

PROJECT REPORT FORMAT

The project report should be prepared on a word processor and should contain figures and tables that are necessary to make the report complete. Be concise in your writing and consult technical writing references as needed.

The semester project report should be prepared in the following format:

A. **Application Project**

1. Introduction
2. Problem definition
3. Project goals
4. Model formulation
5. Solution approach
6. Computational study
7. Conclusions

B. **Software Development Project**

1. Introduction
2. Algorithm description
3. User's manual
4. Example problems (2)
5. Computer code description

The developed software should run on the College of Engineering network.

C. **Research Paper**

1. Abstract (approximately 100 words)
2. Statement of the problem
3. Literature review
4. Existing models and solution approaches
5. Proposed model and/or solution approach
6. Examples
7. Conclusions

D. **Hardware Development Project**

1. Hardware description
2. Novel concepts
3. Literature

REFERENCES ON TECHNICAL WRITING

[1] Hacker, D., *A Writer's Reference*, Bedford/St. Martin's, 1999.
[2] Markel, M., *Technical Communication*, Bedford/St. Martin's, 2001.

Semester Project Guidelines

Time estimate

It is expected that each student should spend not less than 30 hours on the project.

Project presentation

Each project proposal and project results are to be presented in class.

Project report

Each project team (student for individual projects) should upload the following items to the course ICON website:

Project report file, Power Point slides presented in class, and e-poster as independent submissions. For software development projects, submit a folder with source code, executable, and specify the computer hardware and software needed to run your program.

Regulations Dealing with Academic Misconduct

The College of Engineering endorses the policies and rights of students as printed in the *Policies and Regulations Affecting Students* of The University of Iowa. Under Section 1 in the Code of Student Life, which appears in the above publication and has been adopted by the College of Engineering Faculty, the College has the authority to handle acts of academic misconduct, which are defined in Section 1 as:

"Academic dishonesty, including the acquisition of honors, awards, certification or professional endorsements, degrees, academic credits, or grades by means of cheating, plagiarism, or falsification with respect to any examination, paper, project, application, recommendation, transcript, or test, or by any other dishonest means whatsoever, or aiding or abetting another student to do so."

The academic misconduct policy is outlined at:
http://www.engineering.uiowa.edu/ess/current-students/academic-policies-standards/academic-misconduct