Revised: Jan 28, 2008

56:155 Wind Power Management

http://www.icaen.uiowa.edu/~ie_155/

Spring 2008

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: S. Mathew, *Wind Energy: Fundamentals, Resource Analysis, and Economics*, Springer 2006.

References: J.F. Manwell, J.G. McGowen, and A.L. Rogers, *Wind Energy Explained: Theory, Design, and Application*, Wiley, 2002 (on reserve in the Engineering Library).
T. Ackermann, *Wind Power in Power Systems*, Wiley, New York, 2005.
P. Kruger, *Alternative Energy Resources*, Wiley**,** New York, 2006.
Research papers and reports posted on the course website.

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Class Time: 9:30AM – 10:45AM, TTh
Classroom: 3231 Seamans Center

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

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 11
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 energy	16

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

Course grading scheme

Homework and quizzes	20%
Mini project	10%
Semester Project	30%
Midterm Exam	20%
Final Exam	20%

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

Exams: Two exams (midterm and final) will be given.

Quizzes: A number homework assignments and quizzes will be given in preparation for the two exams. The quizzes will be announced.

MINI PROJECT

In preparation for the semester project a mini project is required. The topic of the mini project will be specified in class. The project material is due on ICON by 5:00 PM on Feb 27. The mini project presentation date is scheduled Th, Feb 28.

SEMESTER PROJECT

There are three components to the semester project:

1. Project Proposal — DUE: Th, March 13
   Submit the proposal to ICON
2. Project Report — DUE: T, May 6
   Submit the project report and your Power Point presentation to ICON
   (Look under "Project report" for submission details)
3. Project Presentations — In class: May 6, and May 8

⇒ *The project content used in this class can not 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. 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.

C. 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.

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. **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

C. **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.

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 team (student) should upload the following items to ICON:

Project report file and your class presentation Power Point slides. For software development projects, submit also the source code, executable, and specify the computer hardware and software needed to run your program. Before uploading, compress the folder with all files and name it with your name and course number, e.g., Smith_56_155_Project.

University Information

This course is given by the College of Engineering. This means that class policies on matters such as requirements, grading, and sanctions for academic dishonesty are governed by the College of Engineering. Students wishing to add or drop this course after the official deadline must receive the approval of the Dean of the College of Engineering. Details of the University policy of cross enrollments may be found at
http://www.uiowa.edu/~provost/deos/crossenroll.doc