University of Victoria Engineering

Faculty of Engineering
Department of Mechanical Engineering
COURSE OUTLINE

MECH 444/547 – Wind Power Systems

Term – Summer 2016 (201605)

Instructor	**Office Hours**
Dr. Curran Crawford	Days: Thursday
Phone: 250 721 7960	Time: 1500-1600
E-mail: curranc@uvic.ca	Location: EOW 537

List all prerequisites and co-requisites: MECH 220, 330, 345, 380, CSC 349A, ELEC 365

LECTURE DATE(S)

Section: CRN30593/31593	Days: Mon/Thurs	Time: 1600-1720	Location: ECS 116

TUTORIAL SECTIONS

Section: T01	Days: Mon	Time: 1430-1600	Location: ELW B215

TA Name	**E-mail**	**Office**
Meysam Karimi	mkarimi@uvic.ca	ELW A102

Optional Texts	
Title: Wind Energy Handbook, 2nd Ed.	Title: Aerodynamics of Wind Turbines, 2nd Ed.
Authors: T. Burton, D. Sharpe, N. Jenkins, and E. Bossanyi	Author: M. Hansen
Publisher/Year: John Wiley & Sons, 2011	Publisher/Year: Earthscan, 2008
Title: Wind Energy Explained: Theory, Design and Application	Title: Wind Power
Authors: J. F. Manwell, J. G. McGowan, and A. L. Rogers	Author: P. Gipe
Publisher/Year: John Wiley & Sons, 2002	Publisher/Year: James & James, 2004
Reference Materials: As provided on CourseSpaces	

COURSE OBJECTIVES: This course will provide an overview of wind resources and the technologies for conversion of wind power into useful work. As wind power is a very broad topic involving many disciplines, this course will present the key technical concepts and methods involved including meteorological, aerodynamic, structural, controls, optimization and electrical aspects. Emphasis will be placed on understanding why wind energy harvesting devices look and operate as they do, the challenges associated with their design and integration, and acquisition of skills and tools for carrying out analysis and design of various parts of wind power systems.

Learning Outcomes next page

As there is no single textbook for the course, students are highly recommended to attend all lectures. Lecture notes will be provided, so students should only concern themselves with recording relevant details delivered orally and through workings drawn on the board. The course is supported by a CourseSpaces website where all course materials will be made available.

LEARNING OUTCOMES: At the end of this course, students will be able to:

1. Compute yearly energy yield for a given turbine specification given site wind-speed characteristics
2. Derive the basic aerodynamic equations governing rotor aerodynamics
3. Discuss the aerodynamic challenges inherent in wind turbines
4. Explain the design rationale behind the standard 3-bladed Danish concept machine
5. Compute an optimal rotor configuration
6. Carry out a detailed unsteady wind turbine simulation
7. Post-process wind turbine simulation results and extract fatigue loads and unsteady power production values
8. Compute the safety margins against extreme and fatigue failure of rotor blades and towers
9. Conduct trade-off studies of drivetrain configurations including gearboxes and various types of generators
10. Design a simple rotor speed and pitch controller
11. Perform a levelized cost of energy calculation for a wind farm
12. Discuss the challenges associated with integrating wind energy into grids and remote-locations

The philosophy of the course assessment is to avoid overloading students with work, while at the same time ensuring that key concepts and methods are understood and practiced, and also allowing students the opportunity to pursue individual interest areas in wind power. Peer-aided learning through discussion is encouraged throughout the course, as is an excellent learning method, however final deliverables must be carried out and documented by the individuals named as authors on each deliverable. Any form of plagiarism will not be tolerated. All deliverables will be graded based on the accuracy and depth of their technical content, as well as the style of their presentation.

Weight & Date(s) of Assessments:	**Weight**		**Date**
	MECH 444	**MECH 537**	
Assignment (4)	75%	70%	As below
Final project	25%	30%	Scoping doc: June 13; Final report: August 15
Project group members	2	1	

ASSIGNMENTS (Include Assignment Schedule) (Description & Method of Delivery) (remove example text)

Five assignments are to be completed over the term. Hard-copies are to submitted to the course drop-boxes. Assignments are to be done individually. The tutorial will be used to introduce the use of the various computational tools used in the course.

Assignment #	**Topic**	**Start**	**Due (9 am)**
1	Wind energy basics; wind fields	05.09	05.23
2	Steady aerodynamics; rotor performance	05.23	06.13
3	Aeroelastic simulation	06.13	07.04
4	Deflections & loads; control	07.04	08.05

PROJECTS: (Description & Method of Delivery)

Project deliverables are discussed in a separate document.

The final grade obtained from the above marking scheme for the purpose of GPA calculation will be based on the percentage-to-grade point conversion table as listed in the current Undergraduate Calendar.

COURSE LECTURE NOTES

Unless otherwise noted, all course materials supplied to students in this course have been prepared by the instructor and are intended for use in this course only. These materials are NOT to be re-circulated digitally, whether by email or by uploading or copying to websites, or to others not enrolled in this course. Violation of this policy may in some cases constitute a breach of academic integrity as defined in the UVic Calendar.

There will be no supplemental examination for this course.

GENERAL INFORMATION

Note to Students:

Students who have issues with the conduct of the course should discuss them with the instructor first. If these discussions do not resolve the issue, then students should feel free to contact the Chair of the Department by email or the Chair's Secretary to set up an appointment.

"**Attendance**

Students are expected to attend all classes in which they are enrolled. An academic unit may require a student to withdraw from a course if the student is registered in another course that occurs at the same time….

An instructor may refuse a student admission to a lecture, laboratory, online course discussion or learning activity, tutorial or other learning activity set out in the course outline because of lateness, misconduct, inattention or failure to meet the responsibilities of the course set out in the course outline. Students who neglect their academic work may be assigned a final grade of N or debarred from final examinations.

Students who do not attend classes must not assume that they have been dropped from a course by an academic unit or an instructor. Courses that are not formally dropped will be given a failing grade, students may be required to withdraw and will be required to pay the tuition fee for the course." UVic Calendar, (2015) http://web.uvic.ca/calendar2015-09/FACS/UnIn/UARe/Atte.html

Accommodation of Religious Observance (AC1210)
http://web.uvic.ca/calendar2015-09/GI/GUPo.html

Discrimination and Harassment Policy (GV0205)
http://web.uvic.ca/calendar2015-09/GI/GUPo.html

Faculty of Engineering, University of Victoria
Standards for Professional Behaviour

"It is the responsibility of all members of the Faculty of Engineering, students, staff and faculty, to adhere to and promote standards of professional behaviour that support an effective learning environment that prepares graduates for careers as professionals…."

You are advised to read the Faculty of Engineering document Standards for Professional Behaviour which contains important information regarding conduct in courses, labs, and in the general use of facilities.
http://www.uvic.ca/engineering/current/undergrad/index.php#section0-23

Cheating, plagiarism and other forms of academic fraud are taken very seriously by both the University and the Department. You should consult the Undergraduate Calendar for the UVic policy on academic integrity.

Policy on Academic Integrity
http://web.uvic.ca/calendar2015-09/FACS/UnIn/UARe/PoAcI.html

Course Schedule

Module	Topics	Week
1	Wind energy overview	1
2	The wind resource	1/2
3	BEM theory	3
4	Sectional aerodynamics	4/5
5	Unsteady aerodynamics	6
6	Aeroelastic simulation & design cases	7
7	Control	8
8	Generators & electrical integration	9
9	Component design	10
10	Balance of Plant & system cost of energy	11
11	Wind farms	12
12	Advanced concepts	13