NOTE: This syllabus is from Fall 2020. The Fall 2021 syllabus will be posted soon.

ECO 610
Offshore Wind Energy – Technology, Resources, Grid Integration, and Trends

Meeting Time:
Online, Asynchronous

3 Credits

Instructor:
Dwayne Breger, PhD
Joshua Watson, PhD Fall 2020

Weekly Online Synchronous Sessions:
Office hours, content review, guest speakers or on-line contact time

Course Description:

Offshore wind farms are engineering projects, and it is vital for all professionals who work in the wind energy industry to have an understanding of the underlying science and engineering considerations which drive the siting of offshore wind farms. This course is designed for students without an engineering or scientific background, but provides the engineering context and basic scientific concepts to explain, among other things, the sources of wind energy, how wind turbines work, and why wind farms are sited where they are.

The on-line course will consist of recorded lectures with slides, assigned readings, problem sets, and two exams. Students will engage with the instructor and fellow students through robust on-line discussion sessions and postings.

Learning Objectives:

This course will prepare students and professionals to understand the technical design and development of an offshore wind farm from an engineering perspective, from wind resource measurement and statistical modeling, through turbine and tower design, installation, electric grid integration, operation and maintenance, and on to the decommissioning process.

Upon successful completion of this module, students will understand:

- How offshore wind energy fits into the larger context of global, national, and regional energy development, use and resources;
- Location and source of offshore wind resources;
- How wind resources are measured and statistically modeled;
- Basic science and engineering of wind turbine blade design;
- Power curves and capacity factors;
- Major components of wind turbines;
- Varieties of foundations and substructures;
- Offshore wind generation characteristics;
- Array design and inter-array and export cables;
- Grid interconnection;

- Energy storage and other marine energy technologies and benefits to offshore wind; and
- Future trends and projections for offshore wind.

Reading Materials

All materials will be made available electronically and at no cost from UMass Libraries.

Wind Energy Explained: Theory, Design and Application: Manwell, McGowan, and Rogers, 2nd Ed., Wiley, 2009.

Wind Energy Fundamentals: Kalmikov, Massachusetts Institute of Technology, 2017.

Floating Offshore Wind Energy: The Next Generation of Wind Energy: Garrad & Atcheson, 2016.

Additional readings will be assigned from academic literature and professional and governmental reports on present-day offshore wind resources, technology and project development. Readings will draw from current activities pertaining to offshore wind development in Massachusetts and the eastern U.S. coast, and from a longer history of development in Europe.

Course Outline:

Week	Day/Date	Topic	Assignment	Due Date
1		Overview of energy use and resources, and the present state of the offshore wind energy	HW1	
2		Worldwide and local offshore wind resources; Wind resource measurement and modeling	HW2	
3		Wind power potential, limitations, and power curve specifications, blade testing	HW3	
4		Turbine design: blades, nacelle/generator	HW4	
5		Turbine design: substructure, fixed and floating	HW5	
6		Turbine design: electrical connection, balance of system	Exam 1	
7		Ocean transmission lines and interconnection with electric grid	HW6	

8	Design for array wakes, waves and fluid-structure interaction, storm events	HW7
9	Design consideration for project deployment	HW8
10	Operations, maintenance, and decommissioning	HW9
11	Wave, tidal, and energy storage	HW10
12	Future trends - turbine size, substructures, deployment	
13	Class review	Exam 2

Course Policy and Requirements:

This course does not have any predetermined scheduled meeting times and the course site and modules can be accessed at any time during the semester. A weekly course calendar is provided to suggest the reading and lecture schedule. However, homework assignments and exams will be subject to strict timeframes and due dates, and will not be accepted late without express advance permission from the instructor. Homework assignments will be graded with feedback provided.

There will be 5-10 homework sets given during the course of the semester. There also will be one mid-term exam, and one final exam. The exams will be taken on your own time but during a prescribed time period. All homework sets and exams will be subject to the UMass Academic Honesty Policy, and work is to be completed individually by each student.

Homework sets and exams are required to be submitted as PDF files through Moodle, and will undergo similarity checks.

Grading Scale and Criteria:

Individual letter grades for the course will be based on the following scale.

A	93-100%
A-	90-92%
B+	87-89%
B	83-86%
B-	80-82%
C+	77-79%
C	73-76%
F	Per policy of the Graduate School, grades below a C will result in a failing grade

Students who are taking the course as an elective graduate course, and who are not taking the course in fulfillment of the Offshore Wind Professional Certificate, may elect to take the course as an Optional Letter Grade (OPG).

The weights of course assignments and activities are as follows.

Exam 1	25%
Exam 2	25%
Participation*	10%
Homework	40%
Total	**100%**

*As an on-line course, participation will be evaluated based on 1) evidence (available from the on-line platform) that the students has spent the expected time engaged with each asynchronous module/lecture, 2) student engagement in accessing and contributing to on-line posts prompted throughout the course, and 3) active engagement of student in weekly real-time discussion sessions with instructor.

Academic Honesty Policy Statement:

The integrity of the academic enterprise of any institution of higher education requires honesty in scholarship and research, and academic honesty is required of all students at the University of Massachusetts.

Academic dishonesty is prohibited in all programs of the University. Academic dishonesty includes but is not limited to: cheating, fabrication, plagiarism, and facilitating dishonesty. Appropriate sanctions may be imposed on any student who has committed an act of academic dishonesty. Instructors should take reasonable steps to address academic misconduct. Any person who has reason to believe that a student has committed academic dishonesty should bring such information to the attention of the appropriate course instructor as soon as possible. Instances of academic dishonesty not related to a specific course should be brought to the attention of the appropriate department Head or Chair.

For more information about what constitutes academic dishonesty, please see https://www.umass.edu/honesty/.

The procedures outlined at the website listed above are intended to provide an efficient and orderly process by which action may be taken if it appears that academic dishonesty has occurred and by which students may appeal such actions. Since students are expected to be familiar with this policy and the commonly accepted standards of academic integrity, ignorance of such standards is not normally sufficient evidence of lack of intent.

Accommodations:

The University of Massachusetts is committed to making reasonable, effective and appropriate accommodations to meet the needs of students with disabilities and help create a barrier-free campus. If you are in need of accommodation for a documented disability, register with

Disability Services to have an accommodation letter sent to your faculty. It is your responsibility to initiate these services and to communicate with faculty ahead of time to manage accommodations in a timely manner. For more information, consult the Disability Services website at http://www.umass.edu/disability/.