Fall 2023 Syllabus

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

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Course Administrator: Max Dilthey (mdilthey@umass.edu)

Lectures: Wednesdays 6:00-7:00pm EST via Zoom:
https://umass-amherst.zoom.us/my/maxzoomclassroom
Office Hours: Mondays 6:00-7:00pm EST via Zoom:
https://umass-amherst.zoom.us/my/maxzoomclassroom

Visit the Canvas course site for Zoom info and access to all course modules. Navigate to **ECO 610 FA23**: https://umamherst.instructure.com/

Course Description:
Utility-scale offshore wind installations are engineering projects of enormous scale and scope. It is vital for all professionals who work in the wind energy industry to understand the underlying science and engineering considerations that drive the siting and construction 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 the source of wind energy, how wind turbines work, and why wind farms are sited where they are. Additionally, this course will provide students with perspective into the decisions made by developers and manufacturers in the emergent US wind industry.

The on-line course will consist of synchronous lectures that are recorded for asynchronous viewing and review. All assignments, course readings, and projects will be accessed through the course Canvas site. Students will engage with the instructor and fellow students through synchronous Zoom lectures and asynchronous discussion boards.

Attendance at both the Wednesday Zoom lectures and Monday Office Hours is ***strongly* encouraged** for your own learning, but synchronous attendance is not a requirement to complete this course.

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, operation and maintenance, and on to the decommissioning process.

Upon successful completion of this course, students will understand:

- How offshore wind energy fits into the larger context of global, national, and regional energy development, use and resources
- The present and future of global energy needs and the role of offshore wind
- The location and source of offshore wind resources
- The present state of global energy transition, electrification and grid

modernization, and the emergent industry of offshore turbine manufacturing and deployment
- How wind resources are measured and statistically modeled
- The aerodynamics of wind turbine blades
- Power curves and capacity factors
- The components of wind turbines
- The design and construction of foundations and substructures
- Offshore wind generation characteristics
- Wind farm array design
- Types of inter-array and export cables and the physics of electricity transmission
- Grid interconnection
- Types and benefits of energy storage
- Costs, performance measurements, and levelized-cost-of-energy analysis

Reading Materials:
Readings will be assigned from academic literature and applied professional reports on present-day offshore wind developments. There is no textbook required for this course.

Course Outline:
Course outline subject to change; refer to the course Canvas site for updates throughout the semester.

Week 1: Sept. 6 Wind Farms as Power Plants	Intro to the class, offshore wind, history, electricity basics, wind energy potential, generation, and transmission
Week 2: Sept. 13 Wind Resource Assessment	Understanding energy, wind atlases and energy demand maps, basic wind resource calculations, wind category ratings
Week 3: Sept. 20 Power Curves and Production	Blades and controls, power curves, capacity factors
Week 4: Sept. 27 Wind Resource Modeling	Industry Guest Speaker Statistical modeling, basic Excel modeling and wind resource calculations, wind farm design
Week 5: Oct. 4 Wind Turbine Industry Breakdown	Materials science and manufacturing, major industry players/employers, wind turbine costs, projects and leases
Week 6: Oct. 11 The Rotor/Nacelle Assembly (RNA)	***Indigenous People's Day Observed*** *- Office Hours on Tuesday* Gear boxes and gearing, drivetrain, brakes, nacelle components
Week 7: Oct. 18 Floating Wind	Floating wind foundations, engineering considerations for deep water offshore wind farms

Week 8: Oct. 25 The Tower, Substructures, and Transition Pieces	Introduction to substructures, installation vessels, transition pieces, installation, and staging at port. **Group assignment:** Fact sheets for major substructure categories: monopile, jacket, gravity, floating
Week 9: Nov. 1 Guest Speaker - Substructures	Industry Guest Speaker Substructures, Monopile Foundations
Week 10: Nov. 8 Offshore Wind Transmission	Industry Guest Speaker Transmission, financial impacts and risk, levelized cost of energy (LCOE)
Week 11: Nov. 15 Keeping the Turbines Running	Industry Guest Speaker Blade testing, hurricane and typhoon proofing, fatigue, operations and maintenance
UMass Fall Break - No class or office hours Nov 20-26	
Week 12: Nov. 29 The Future of Wind	Industry Guest Speaker Networking Activity **Final Exam assigned** - all outstanding assignments due Dec. 17th by Midnight
Week 13: Dec. 6 Keeping the Turbines Running	Operations and maintenance, vessels and costs, health and safety.
Week 14: Dec. 13 Course Wrap-Up	No Wed. Class (Office hours will be held Monday Dec. 11) ALL assignments due Sunday, Dec. 17th by Midnight EST **(non-flexible deadline, grades due!)**

Course Policy and Requirements:
All assignments will be completed and submitted through the Canvas course site. All readings should be treated as resources for completing homeworks - reading guides will be provided to help you manage your time for each assignment. Where possible, additional readings are provided as a resource for deeper learning.

Please download and save all readings and course materials to your own computer or cloud storage - course materials are yours to keep for future reference. Your access to the Canvas page will be revoked after each course is completed.

Grading Scale and Criteria:
Individual 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. The weights of course assignments and activities are as follows:

Grade Weighting:
Individual Assignments and Final: 60%
Group Assignment: 20%
Forum Posts: 20%
Total 100%

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/.