Fall 2022 Syllabus

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

Course Instructor: Ramon Rosquete, Director of Operations, CREADIS (rrosquete@umass.edu)
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 Moodle course site for Zoom info and access to all course modules:
https://umass.moonami.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 Moodle site. Students will engage with the instructor and fellow students through synchronous Zoom lectures and asynchronous discussion boards.

Attendance at the course Zoom lectures and course 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 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
- 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.

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

Week 1: Sept. 5-9 Wind Farms as Power Plants	Intro to the class, offshore wind, history, electricity basics, wind energy potential, generation, and transmission
Week 2: Sept. 12-16 Energy in the Wind *Labor Day - Office hours held at usual time. Additional hours by appointment.*	Understanding energy, wind atlases and energy demand maps, basic wind resource calculations, wind category ratings
Week 3: Sept. 19-23 Measuring the Power of the Wind	Statistical modeling, basic Excel modeling and wind resource calculations, wind farm design
Week 4: Sept. 26-30 Power Curves and Production	Blades and controls, power curves, advanced modeling, modeling wind data in Excel
Week 5: Oct. 3-7 Wind Turbine Industry Breakdown	Materials science and manufacturing, major industry players/employers, wind turbine costs, projects and leases
Week 6: Oct. 10-14 The Rotor/Nacelle Assembly *Indigenous Peoples Day - Office hours held at 6PM on Tuesday, Oct. 11. Additional hours by*	Gear boxes and gearing, drivetrain, brakes, nacelle components

appointment.	
Week 7: Oct. 17-21 The Tower, Substructures, and Transition Pieces	Introduction to substructures, installation vessels, transition pieces, installation, and staging at port
Week 8: Oct. 24-28 Substructures	Group assignment: Fact sheets for major substructure categories: monopile, jacket, gravity, floating
Week 9: Oct. 31 - Nov. 4 TBA (Guest Speaker)	Industry Guest Speaker - Matt Palmer, Wood Thilsted Substructures, Monopile Foundations
Week 10: Nov. 7-11 Getting Power Ashore	Industry Guest Speakers - Lawrence Mott, Mayflower Wind, Peter Montalvo, Atlantic Shores Transmission, financial impacts and risk, levelized cost of energy (LCOE)
Week 11: Nov. 14-18 Keeping the Turbines Running	Industry Guest Speaker - Rahul Yarala, Wind Technology Testing Center Blade testing, hurricane and typhoon proofing, fatigue, operations and maintenance
UMass Fall Break - No class Nov 21-25)	
Week 12: Nov. 28 - Dec. 2 Keeping the Turbines Running	Final Exam assigned - due Dec. 19th by Midnight Operations and maintenance, vessels and costs, health and safety.
Week 13: Dec. 5-8 The Future of Wind	Industry Guest Speaker (TBA) Energy storage, wake modeling, training and certifications
Week 14: Dec. 12-16 Course Wrap-Up	Happy Hour on Wednesday Dec. 14 (last day of classes) ALL assignments due Sunday, Dec. 19th by Midnight EST **(non-flexible deadline, grades due!)**

Course Policy and Requirements:
The course site and modules can be accessed at any time during the semester. All assignments have deadlines indicated to suggest the reading and assignment schedule, but all deadlines are flexible up until Sunday, December 19th.

All assignments will be completed and submitted through the Moodle 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.

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 Moodle page may be revoked after all courses are completed and you finish your UMass enrollment.

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:
Projects and Group Assignments: 50%
Participation via Moodle Discussion Boards, Lectures, and/or Office Hours: 10%
Homework Assignments: 40%
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/.