[AE/ME 4701] Syllabus

Wind Engineering, AE/ME 4701, Sections A and Q, 3-0-3

Instructor Information

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General Course Information

Description

An introductory course on wind energy and its potential; modeling and design of wind turbines; analysis of the economic benefits of wind turbine systems. Credit will not be awarded for both AE/ME 4701 and AE/ME 6701

Course Learning Outcomes

Goal: Learn to analyze and design horizontal axis wind turbine systems, from Power production, levelized cost of energy, and environmental and societal impact perspectives.

Learning Outcomes: Upon successful completion of this course, students would be able to

1. Assess the wind potential, energy needs and associated cost of energy for a given region.
2. Assess the impact of environmental (noise, avian) and societal factors on the selection and sizing of a wind turbine site.
3. Numerically model a horizontal axis wind turbine and predict the power production as a function of wind speed, rotor RPM, and blade pitch setting.
4. Perform conceptual design of wind turbines that have maximum efficiency over a range of wind speeds.
5. Estimating the levelized cost of energy production for a given wind turbine configuration.
6. Document the site selection, design, and cost analysis in oral and written form.

Required Course Materials

Textbook

None.

Course notes

Lecture notes will be provided on the following topics. Additional DoE publications, related journal articles and conference publications, and required software will be posted on Canvas.

- Overview of wind engineering
- Benefits of wind energy.
- Assessment of wind resources.
- Assessment of means of energy production, consumption, and cost.
- Green credit and production tax credit.
- Wind turbine terminology and definitions.
- Actuator disk model of horizontal axis wind turbines

- Review of airfoil aerodynamics:
    - Lift, drag, and pitching moment
    - Panel method for airfoil analysis
    - Modeling laminar and turbulent boundary layers and transition
    - Airfoil design for wind energy applications
- Blade element theory
- Inflow models based on combined blade element theory
- Incorporation of swirl losses in inflow
- Root and tip losses and stall delay models
- Development and assessment of publicly available wind turbine modeling tools
- Horizontal axis wind turbine design using blade element theory
- Conversion of mechanical energy into electricity
    - Basic AC power generators
    - Hybrid power systems
    - Hybrid system modeling and simulation
- Economic analysis of stand-alone wind turbine systems and hybrid systems
- Impact of wind turbines on the environment

Grading Policy:

Students will complete five equally weighted assignments.

90% or above: 'A'

80% to 89%: 'B'

70% to 79%: 'C'

60% to 69%: 'D'

59% or below: 'F'

Description of Graded Components

There are five equally weighted assignments.

1. Selection of Wind Turbine Site
2. Use of public domain solvers for wind turbine modeling
3. Wind Turbine Design
4. Wind Turbine Cost Modeling
5. Assessment of Environmental Impact

Course Policies

Attendance and/or Participation

This class will use prerecorded lecture videos for asynchronous instructions.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review Georgia Tech's Honor Code and the student Code of Conduct.

Any student suspected of cheating or plagiarism on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services (404-894-2563) as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Student-Faculty Expectations Agreement

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Pre-Requisites and Co-Requisites

Pre-requisites: At the level of AE 3030 or ME 3340, with a minimum Grade of C or better.

Extra Credit Opportunities

None

Collaboration, Group Work, and Use of Generative AI

All assignments are for individual grades. Collaboration between students, or the use of generative AI tools to complete the assignments is not allowed and would lead to a failing grade.

Extensions, Late Assignments, & Re-Scheduled/Missed Exams

A late penalty of 10% of the assignment grade will be imposed for each day an assignment is late, unless an extension has been granted by the instructor for valid reasons (health issues, institute approved event participation, etc.).

Inclement Weather and Digital Learning Days

Classes will be conducted on Zoom during these days.

Student Use of Mobile Devices in the Classroom

Not allowed.

Campus Resources for Students

Academic Support: Academic Success and Advising (a unit in the Office of Undergraduate Education & Student Success) provides free support for your courses. Students can attend scheduled supplemental review (PLUS) sessions, stop by Drop-In Tutoring, or schedule a one-on-one appointment through Knack. To explore what options work best for you, please visit us online at success.gatech.edu/tutoring, email us at tutoring@gatech.edu, or come see us at Clough Undergraduate Learning Commons, Suite 283.

Student Well-Being:

At Georgia Tech, we are concerned about your overall physical, social, and mental well-being. A comprehensive list of wellness related resources has been compiled and maintained by the Office of the Vice President for Student Engagement and Well-being (student-resource-guide (gatech.edu)