

AE/ME 6701 Wind Engineering (Elective)

Catalog Description: AE/ME 6701 Wind Engineering (3-0-3)
Prerequisites: AE 2020 Low Speed Aerodynamics or ME 3340 Fluid Mechanics or equivalent.
Cross-listed with ME and AE.
An introductory course on wind energy and its potential; modeling and design of wind turbines; analysis of the economic benefits of wind turbine systems.

Textbook: Lecture notes supplied by the Instructor. Web based resources.

Credit will not be given to AE/ME 4701 and AE/ME 6701 both. These two courses have common lectures. The assignments and projects, however, differ. Graduate student are expected to develop their own computational wind turbine modeling, analysis, and design tools. Undergraduates will be provided canned executable versions of software for their work.

Topics Covered:

1. Overview of wind engineering: benefits of wind energy; assessment of wind resources; assessment of means of energy production, consumption, and cost; green credit; and wind turbine terminology and definitions.
2. Actuator disk model of horizontal axis wind turbines.
3. Review of airfoil aerodynamics: lift, drag, and pitching moment; panel method for airfoil analysis; modeling laminar and turbulent boundary layers and transition; and airfoil design for wind energy applications.
4. 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; and assessment of publicly available wind turbine modeling tools.
5. Horizontal axis wind turbine design using blade element theory.
6. Conversion of mechanical energy into electricity: basic AC power generators; hybrid power systems; and hybrid system modeling and simulation.
7. Economic analysis of wind turbine systems.
8. Impact of wind turbines on the environment.

Course Outcomes:

Outcome 1: To develop a student's understanding

- 1.1 The student will demonstrate an understanding of the energy needs and associated cost of energy for a given region of the world
- 1.2 The student will demonstrate an understanding of assessing wind potential of a given region
- 1.3 The student will demonstrate an understanding of the impact of environmental (noise, avian) and societal factors on the selection and sizing of a wind turbine site.

Outcome 2: To develop a student's skills

- 2.1 The student will demonstrate the ability to model a horizontal axis wind turbine and predict the power production as a function of wind speed
- 2.2 The student will demonstrate the ability to design wind turbines that have maximum efficiency over a range of wind speeds.
- 2.3 The student will demonstrate ability to present the site selection, design, and cost analysis in oral and written form.

Outcome 3: To develop a student's understanding

- 3.1 The student will have an understanding of processes for estimating the cost per KWHr of energy for a known wind turbine configuration