

AE/ME 6701 - Syllabus

Wind Engineering- 3 credits

General 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 6701 and ME 6701

Pre- &/or Co-Requisites

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

Course Goals and 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, you should 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.

Course Requirements & Grading

Description of Graded Components

Grading will be based on the following components:

- 5 written reports, 20% each

Grading Scale

Your final grade will be assigned as a letter grade according to the following scale:

A	90-100%
B	80-89%
C	70-79%
D	60-69%
F	0-59%

Topics Covered

1. Overview of wind engineering
 - a. Benefits of wind energy.
 - b. Assessment of wind resources.
 - c. Assessment of means of energy production, consumption, and cost.
 - d. Green credit and production tax credit.
 - e. Wind turbine terminology and definitions.
2. Actuator disk model of horizontal axis wind turbines
3. Review of airfoil aerodynamics:
 - a. Lift, drag, and pitching moment
 - b. Panel method for airfoil analysis
 - c. Modeling laminar and turbulent boundary layers and transition
 - d. Airfoil design for wind energy applications
4. Blade element theory
 - a. Inflow models based on combined blade element theory
 - b. Incorporation of swirl losses in inflow
 - c. Root and tip losses and stall delay models
 - d. Development 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
 - a. Basic AC power generators
 - b. hybrid power systems
 - c. Hybrid system modeling and simulation
7. Economic analysis of stand-alone wind turbine systems and hybrid systems
8. Impact of wind turbines on the environment

Course Materials

Textbook

Required: None.

Course notes

Lecture notes, DoE publications, and related journal articles and conference publications, and required software will be posted on Canvas.