AE/ME 4701 Wind Engineering (Elective)

Catalog Description: AE/ME 4701 Wind Engineering (3-0-3)
Prerequisites: Physics 2211 Intro Physics I and MATH 2401 Calculus III
Crosslisted with AE and ME.
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.

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: Students will learn to assess a wind turbine site for its wind potential, energy needs, and environmental (noise and avian) impact.

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 the 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: Students will learn to model and design wind turbines.

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 the ability to present the site selection, design, and cost analysis in oral and written form.

Outcome 3: Students will learn to estimate the cost of energy for a given wind turbine plant.

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

Correlation between Course Outcomes and Student Outcomes:

ME 4701											
	Mechanical Engineering Student Outcomes										
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Outcome 1.1								X	X		
Course Outcome 1.2	X										
Course Outcome 1.3			X					X			
Course Outcome 2.1	X				X						
Course Outcome 2.2		X									
Course Outcome 2.3							X				
Course Outcome 3.1			X						X		X

GWW School of Mechanical Engineering Student Outcomes:

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

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