AE 8803 Special Topics - Syllabus

Hydrokinetic Turbine Systems. 3 Credit Hours.

General Information

Description

Assessment and quantification of hydrokinetic resources including tidal energy; horizontal axis and vertical axis hydrokinetic turbine modeling and design, airfoil design; integration of generators into a distributed energy system; cost of energy; environmental and societal factors.

Pre- &/or Co-Requisites

Pre-requisites: At the level of AE 3030 (Aerodynamics) or ME 3340 (Fluid mechanics) or CEE 3040 (Fluid Mechanics.

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.

Outcomes: Upon successful completion of this course, you should be able to

1. Use public domain resources to assess the annual production of energy in streams, rivers, and tidal basins taking into consideration seasonal variations, taking into consideration environmental effects, public policy, and societal factors.
2. Use publicly available modeling tools to analyze and design horizontal and vertical axis hydrokinetic turbines.
3. Estimate the levelized cost of energy production and assess the return on investment in isolated and distributed turbine systems.

Course Requirements & Grading

Note: Graded components of a course may vary with each offering. The example below is typical but subject to change.

Based on five equally weighted independent project reports. The reports will cover the following topics:

a. Selection of a hydrokinetic turbine site and assessment of its energy production potential
b. Computational modeling of benchmark horizontal axis water turbines and comparisons against available data
c. Computational modeling of benchmark vertical axis water turbines and comparisons against available data
d. Levelized Cost of Energy Estimates for the selected site and proposed turbine systems
e. Assessment of environmental and societal factors, and public policy considerations for the selected site and the proposed configurations

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

Note: The exact topics covered in a course may vary with each offering. The example below is typical but subject to change.

1) Course Overview and Fluid Dynamics Review
   a. Streamlines, vorticity, and Bernoulli equation
   b. Hydrofoil theory and modeling
   c. Cavitation effects
   d. Hydrofoil design
2) Assessment of Hydrokinetic Energy Resources
   a. Seasonal Variations
   b. Tidal parameters for power production
   c. Power density
   d. Market size and Energy price.
   e. Public Policy, green credit, and production tax credit
   f. Environmental and Societal Considerations on the Placement of Turbine Systems
3) Modeling and design of Turbine Systems
   a. Actuator disk models
   b. Blade element - momentum theory-based modeling and design of Horizontal Axis and vertical axis turbine systems
   c. Rotating actuator line modeling of isolated and distributed turbine systems
   d. Computational fluid dynamics tools
   e. Incorporation of cavitation effects
   f. Optimization of turbine rotor Geometries
4) Levelized Cost of Energy
5) Case Studies

Course Materials

Note: Course materials may vary with each offering. The example below is typical but subject to change.

Textbook

None

Course notes

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