ECE 4753 Syllabus

Topics in Engineering Practice ECE 4753, Section QRN, 3 credit hours **(85713)**

Fall 2026 Semester

Instructor Information

Instructor: Dr. Davenport

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General Course Information

Description

Two complimentary courses covering the technology and underlying principles in the design of wind turbines. Instruction will be given in component design, system interaction, controls, and operability. It will explore the impacts of turbine design on the outside world; examples including wind turbine wakes, the electrical grid (variable generation, grid support), and the surrounding environment (sound power levels and propagation). Furthermore, the economics of renewable energy will be taught, from levelized cost of electricity to a customer's perform, with a focus on the influence that engineering decisions have on customers.

Topics will include:

Fluid flow – Bernoulli, conservation of mass, momentum and energy, laminar and turbulent flow, actuator disks, axial induction. Blade aerodynamics – lift/drag/stall, rotor torque, thrust, Cp, Ct, airfoils, blending.

Wind conditions – atmospheric stability, turbulence, shear, veer. Impacts of diurnal and seasonal variation. Weibull wind distribution, gusts, and extreme events.

Materials – Composites – fiber/matrix properties and selection, UD/Bi-ax design selections, quality, and manufacturing considerations. Metals – Equilibrium phase diagram, steel microstructures, heat treating, hardenability, processing (forgings/castings), failure analysis.

Component design – Blades, gearboxes, bearings, generators (direct drive and DFIG), power converters, towers, bolted joints, and other large structures

Measurement and Analysis – Wind Turbine performance; acoustics - noise spectra (broadband, octave and one-third octave bands), sound pressure levels, A-weighting of measured sound, propagation; fatigue – S-N curves, rain flow counting, Miner's rule, and Cambell diagrams

Controls – Systems modelling, open- and close loop design, PID regulation, analysis with Nyquist and Bode plots, wind turbine control principles, safety chains, operability

Economics – Levelized Cost of Electricity, Annual Energy Production, discount rates, market variations, capacity factor, wind farm optimization and micrositing.

Course Learning Outcomes

The primary objective of the ACE program is to bridge the gap between undergraduate engineering education and applied methods used in industry. Key learning outcomes of the program are to build technical competence in the areas of mechanical engineering, and to hone problem-solving and technical communication skills. A-Course consists of 32 weeks of coursework organized into five modules

Required Course Materials

No textbook needed

Materials are provided instructor

Grading Policy:

Weekly assignments are graded per rubric and are heavily weighted on technical results and analytical methodology. Students are also evaluated on their analytical assumptions, conclusions, a technical discussion, and the overall quality/presentation of their report. All calculations, computer code (MATLAB, Python, Excel, etc.), and other relevant data must be organized in an appendix with sufficient explanation/comments such that the reader can recreate the results as needed. Rubric grading criteria is specifically tailored for each assignment, but a typical weighting is shown below.

Typical Homework Report Rubric Weighting:

Abstract	10%
Assumptions	5%
Results	25%
Analysis	30%
Discussion	20%
Report Quality	10%

Course Policies

Attendance and/or Participation

In-person class attendance is required by all A-course students. Exceptions may be made for critical business reasons or other valid personal issues and students must alert the A-course supervisor to these issues as soon as possible. Virtual/remote participation options may be made available on occasion at the discretion of the course supervisor. All lectures are recorded and made available to students following class.

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.