EECE 512 Renewable Energy & Distribution Systems

Spring 2023

*EECE 512 is a flipped classroom course[1].

Location & Time	• Watch videos on Brightspace before the class. • In-person lecture/lab at AA G002 6 – 9 PM
Instructor:	Ziang Zhang, Associate Professor Email: *ziang.zhang@binghamton.edu* Office Hours: Mon and Web 4 – 5PM at ITC ES2317

Recommended Textbooks and Course Website:	• Distribution System Modeling and Analysis| Edition: 4
	  ○ Author: William H. Kersting
	  ○ ISBN: 1498772137
	  ○ Publisher: CRC Press
	• Class website will be on Brightspace which is where announcements, course materials, etc., will be posted.

Prerequisite:	Fundamental knowledge of power systems Comfortable with Matlab & Simulink
Objective:	Primary focus: Understand working principles and modeling of distribution grids, renewable energy resources, grid-tie battery system, microgrid, as well as analysis of integrated renewable energy systems.

Grading:	• **Four Homework: 10%**
	• **Two Exams for lectures: 30%**
	• **10 Programming Tasks: 20%**
	  ○ 20% off on late submission within 2 days of the original deadline
	  ○ 0 points after 2 days
	• **Programming Project: 40%**
	  ○ Report 10% (group members get the same grade)
	  ○ Presentation 1: 10% (group members get the same grade)
	  ○ Presentation 2: 15%
	  ▪ 5% group grade + 10% individual grade
	  ○ Teammate evaluation: 5%

[1] https://en.wikipedia.org/wiki/Flipped_classroom

Tentative Schedule

- **Week 1 Logistics and introduction** (the week of 1/16)
  - Objective: Get familiar with the flipped/online course environment
  - Task 1: Complete "Matlab on Ramp" and "Simulink on Ramp"
    - https://www.mathworks.com/learn/tutorials/matlab-onramp.html
    - https://www.mathworks.com/learn/tutorials/simulink-onramp.html
- **Week 2 Review of power system**
  - Objective: Compare the differences between power transmission systems and power distribution systems
  - Continue and finish Task 1.
- **Week 3 Solar energy** (Beginning of Feb)
  - Objective: Be able to estimate the solar generation of at a given location; PV system integration with the grid
  - Task 2: Add solar insolation data on a PV system
  - HW 1
- **Week 4 Wind energy**
  - Objective: Build a model for electric drives; integrate a wind generation model with the grid model
  - Task 3: DC motor, PID control ,and a wind generation system
- **Week 5 Distribution load and demand response**
  - Objective: Estimate future load patterns based on current electric load data
  - Task 4: Using neural network for load prediction
- **Week 6 Energy storage and PHEV**
  - Objective: Quantify the benefits and challenges of grid-tie storage
  - HW 2
- **Week 7 EV** (Beginning of Mar)
  - Objective: Understand EV and V2G
  - Task 5: Peak shaving by energy storage
- **Week 8 Grid-tie converters**
  - Objective: Be able to create and modify simple power electronic converter models
  - Exam 1
  - HW 3
- **Week 9 Distribution planning**
  - Objective: Be able to design and model simple distribution systems
  - Task 6: Compare two types of converters
  - Project Start
- **Week 10 Microgrid basics**
  - Objective: Quantify the technical and economic outcomes of a microgrid project
  - Task 7: Plot the voltage levels of the IEEE 13 node test feeder.

- **Week 11 Microgrid controls**
  - Objective: Develop the basic controls of a microgrid
  - Task 8: Perform a feasibility study of your project microgrid model to meet the 50% renewable generation goal.
  - HW4
- **Week 12 Spring Break** (Beginning of Apr)
  - Project task (half report): complete the design proposal and prepare presentation
- **Week 13 Distribution lines, and distribution transformers**
  - Objective: Be able to design and model simple distribution systems
  - Exam 2
- **Week 14 Distribution power flows**
  - Objective: Be able to calculate distribution load flow by hand and by programs
  - Task 9: Forward/backward sweep by hand
  - Presentation 1: Present your system proposal to the class
- **Week 15 Distribution capacitors and hosting capacity**
  - Objective: Be able to check line voltages and improve voltage profile by capacitors
  - Task 10: Forward/backward sweep by script
- **Week 16 Project presentation and report** (Beginning of May)
  - Objective: Be able to analyze project finance, payback period, and benefits
  - Presentation 2: Project demo and final presentation
  - Final report due

Acceptable Collaboration

Any work you submit should be yours alone unless an assignment explicitly allows for groups of two or more students. You are encouraged to freely discuss any homework or project assignments, as long as those discussions are about high-level algorithms or solution approaches. You should never share or discuss specific code sequences, design implementations, or problem solutions. You should never use another student's code as a reference when writing your own.

Academic Integrity

All students must adhere to the Student Academic Honesty Code of the University and the Watson School (below). The Department of Electrical and Computer Engineering has adopted a standard policy to enforce these codes for violations involving course work. Category I violations result in a grade of 0 for the graded work plus a one letter course grade reduction. A *Report of Category I Academic Dishonesty* form is filed with the Provost's Office; if a prior report is already on file, the offense is automatically elevated to Category II. Category II violations result in at least a failing grade for the course plus any additional penalties determined by the Watson Academic Integrity Committee.

Full details of the University Academic Honesty Code are available in the University Bulletin under "Academic Policies and Procedures for All Students". The Watson School Academic honesty policy can be found at https://www.binghamton.edu/watson/about/academic-honesty.html

Course Workload

This course is a 3-credit course, which means that students are expected to do at least 9 hours of course-related work each week during the semester. This includes scheduled lectures/discussions, completing assigned readings, participating in lab sessions, studying for tests and examinations, preparing written assignments, completing internship or clinical placement requirements, and other tasks that must be completed to earn credit in the course.

Use the following table to determine the number of hours for courses less than 4 credits

Credits	Hours per Week
3	9 – 9.5
2	6 – 6.5
1	3 – 3.5

Classroom Safety

Binghamton University takes physical safety very seriously and recommends and supports swift action and clear consequences if a student's non-compliance risks the safety of others. Non-compliance with face covering, social distancing, or classroom scheduling requirements constitute a serious public health risk and a disruption of the learning experience. The following rules must be always followed.

- If you become ill, exhibit symptoms of the flu or COVID-19, or are asked to go into quarantine/isolation, you are should not attend class in person. You should immediately notify the instructor for instruction on how to proceed with the class.
- When rules require everyone to wear a face covering in the classroom, it must be worn so that it completely covers both the nose and mouth tightly. If you forget your face covering or it does not meet current university requirements, you will be asked to leave the room immediately and may not return until you have a compliant face covering. Eating or drinking in the classroom is strictly prohibited when masks are required since such activity would require removing the face covering.
- When social distancing rules are implemented, adequate spacing must be maintained. If students are not seated in a manner that meets the necessary spacing requirements, the instructor will reseat one or more students to comply with the requirements. It is at the instructor's discretion whom to reseat.
- Seating in the classroom may be limited at times to allow a safe number of people in the room. For the health and safety of all concerned, you must follow your assigned attendance dates and only come to class on those dates. Attempts to attend class on other dates without the instructor's permission could jeopardize the safety of others and will be considered an attendance violation.
- Failure to comply with these requirements constitutes a public health risk to everyone in the learning environment and disrupts the class. **If a student does not comply with the requirements** and refuses to wear their face covering properly or to leave the classroom when directed, or to follow instructions for reseating when directed by the instructor, the instructor will immediately cancel the remainder of the class session and inform the dean's office, which will work with the Student Records office to **issue a failing grade ("F")** for the course regardless of when in the semester the incident occurs. The dean's office will also inform the Office of Student Conduct. If a student's refusal to comply is a second offense, the Office of Student Conduct may recommend dismissal from the University.
- If an assignment, quiz, exam, or other graded assessment cannot be completed or turned in due to non-compliance with these rules, it will be treated in a manner consistent with any other unexcused absence (i.e. a late penalty or grade of zero will be assessed as appropriate).

Students in Distress

If you are experiencing undue personal or academic stress at any time during the semester or need to talk with someone about a personal problem or situation, you are encouraged to seek support as soon as possible. Course instructors are available to talk with you about stresses related to your work in your courses. Additionally, the campus has a wide range of resources, including:

- Dean of Students Office: 607-777-2804
- Decker Student Health Services Center: 607-777-2221
- University Police: On campus emergency, 911
- University Counseling Center: 607-777-2772