Course Syllabus

Course: ELCT 891- Special topics course on "Controls for Grid-Connected Systems

Fall 2024

Instructor: Dr. Adel Nasiri	
Office: Swearingen 3A32	**Phone:** 803-576-7796
E-mail: nasiri@sc.edu	**Office hours:** TBD
Class Location: SWGN TBD	**Class Meeting** MW 2:20pm-3:35pm
Teaching Assistant: N/A	

Course Delivery Structure: Lecture

Catalog Description: Selected Topics in Electrical Engineering

Course Description: This course is focused on grid connection of electrical energy components including distributed energy resources, energy storage, and electronic loads. Various control methods, grid supporting functions, grid codes, and standards are discussed.

Credit Hours: 3
Prerequisite(s) by course: None

Course Text:

- **Main Test: Grid Converters for Photovoltaic and Wind Power Systems (Wiley - IEEE), Remus Teodorescu, Marco Liserre, Pedro Rodriguez, ISBN-10: 0-470-05751-3 – IEEE-Wiley.**

Optional Text:

- **Bollen, Math H. J., Fainan Hassan. Integration of Distributed Generation in the Power System. Wiley Professional, Reference & Trade, 2011-08-04.**
- **N. Mohan, T. M. Undeland and W. P. Robbins, "Power Electronics: Converters, Applications, and Design", Wiley, 2002, ISBN-10: 0471226939**
- **D.G. Holmes and T. Lipo, "Pulse Width Modulation for Power Converters: Principles and Practice", 2003, ISBN 0471208140.**
- **M. P. Kazmierkowski, R. Krishnan, F. Blaabjerg, "Control in Power Electronics", Academic Press, 2002, ISBN 0-12-40277205.**
- **J. Machowski, J. Bialek, J. Bumby, "Power System Dynamics: Stability and Control" Wiley, 2008, ISBN-10: 0470725583.**

Learning Outcomes:
Students who successfully complete the course will at least be able to:

The students will learn how to apply control for grid connected solar PV systems.

The students will learn how to develop control for grid connected wind energy systems.

The students will learn about grid codes and standards for grid connected systems.

The students will be able to apply gird forming, grid following, and grid supporting controls.

Course Topics:

- Introductions to grid-connected resources and electric power industry
- Grid-tied PWM converters: modulation and controls (current and voltage)
- Voltage and current control for converters
- Wind energy power conversion systems
- Wind Turbine Modeling

- Solar energy power conversion systems
- Grid-tie and stand alone solar energy power conversion systems
- Impact of practical systems on controls
- Grid requirements for Distributed Generation (DG) systems
- Other renewable sources (Fuel cells, Wave, etc)
- Filters and filtering requirements for grid-tied converters
- Controls for multi-level converters
- Energy storage systems and controls
- Controls under grid fault and ancillary services
- Standards and regulations

Course Assessment

Course Assignments:

Exams: There will be two exams. The final exam will be cumulative. Failure to take an exam will result in a grade of zero for that test.

Homework: Homework will be assigned almost every week. Problem solutions must show a clear systematic method for arriving at the correct solution for full credit. Points will be taken off for incorrect solutions or work that is difficult to follow.

Project: A project will be assigned around the middle of the semester. Projects must include simulation of a grid-connected electrical energy system.

The weight of the assignments in the final course grade is as follows and grading scheme is as follows:

	Graduate
Homework	25%
Midterm Exam	20%
Term Project	25%
Final Exam	30%

Final Grade	Semester Average
A	100 ≥ S.A. ≥ 91
B+	90 ≥ S.A. ≥ 86
B	85 ≥ S.A. ≥ 81
C+	80 ≥ S.A. ≥ 76
C	75 ≥ S.A. ≥ 71
D+	70 ≥ S.A. ≥ 66
D	65 ≥ S.A. ≥ 61
F	60 ≥ S.A. ≥ 00

Course Outline/Schedule
Topics for each class meeting are listed below. However, circumstances may call for a departure from this schedule. Any changes to the schedule will be made in advance. Homework assignments will be handed out at least one week prior to the due date.

* Course schedule might change but contents will remain the same.

Course Schedule	Time	Date
• Introductions to grid-connected resources and electric power industry	Week 1	Aug 19
• Grid-tied PWM converters: modulation and controls (current and voltage)	Week 2	Aug 26
• Voltage and current control for converters	Week 3	Sep 2

Course Schedule	Time	Date
• Wind energy power conversion systems	Week 4	Sep 9
• Wind turbine modeling	Week 5	Sep 16
• Solar energy power conversion systems	Week 6	Sep 23
• Grid-tie and stand alone solar energy power conversion systems	Week 7	Sep 30
• Midterm	Week 8	Oct 7
• Impact of practical systems on controls	Week 9	Oct 14
• Grid requirements for Distributed Generation (DG) systems	Week 10	Oct 21
• Filters and filtering requirements for grid-tied converters	Week 11	Oct 28
• Other renewable sources (Fuel cells, Wave, etc)	Week 12	Nov 4
• Controls for multi-level converters	Week 13	Nov 11
• Energy storage systems and controls	Week 14	Nov 18
• Controls under grid fault and ancillary services, Fall Break	Week 15	Nov 25
• Standards and regulations	Week 16	Dec 2
• Final Exam		Dec 9

Instructor Policies

Attendance Policy
Students are expected to attend each scheduled class meeting, to be on time, and to be prepared for each class session.

When you miss class, you miss important information. If you are absent, you are responsible for learning material covered in class. If you are absent when an assignment is due, you must have submitted the assignment prior to the due date to receive credit. If you miss more than 10% of the classes, whether excused or unexcused, your grade may be dropped one letter grade.

Assignment Submission
Homework submitted on or before the due date will be eligible to earn full credit. Homework turned in after the due date will be eligible to earn up to only half credit (delay must be approved by instructor on the day homework are assigned).

Midterm and Final Exams
Makeup exams will be allowed only with pre-approval of the instructor or with an acceptable, documented reason. Acceptable reasons for makeup exams include severe illness, family emergencies or other unavoidable events including dangerous weather conditions and car accidents. Exam format for makeup exams may be different than the original exam.

Expectations of the Instructor
I understand that students expect me to facilitate their learning, to answer their questions appropriately, to be fair and objective in grading, to provide timely and useful feedback on assignments, to maintain adequate office hours, and to treat them as I would like to be treated in their place.

Academic Integrity

As a student of the University of South Carolina, you agree to comply with the University Code of Conduct (www.sc.edu/policies/ppm/staf626.pdf), Honor Code (www.sc.edu/policies/staf625.pdf), Carolinian Creed (www.sc.edu/policies/staf102.pdf), and all Other policies of the University of South Carolina. Violations of any codes, creeds, rules, or policies may result in an academic penalty of a grade on the assignment, and/or referral to the Office of Academic Integrity for additional disciplinary measures as outlined by the Office of Student Conduct and Academic Integrity (www.sc.edu/academicintegrity).
You assume full responsibility for the content and integrity of the academic work you submit. The guiding principle of academic integrity shall be that your submitted work, examinations, reports, and projects must be that of your own work.
When a student is uncertain as to whether conduct would violate the Honor Code, it is the responsibility of the student to seek clarification from the instructor or the Office of Student Conduct and Academic Integrity www.sc.edu/academicintegrity

Accommodating Disabilities
The University of South Carolina provides high-quality services to students with disabilities, and we encourage you to take advantage of them. Students with disabilities needing academic accommodations should register with and provide documentation to the Student Disability Resource Center in Close-Hipp 102 or 803-777-6142, TDD 803-777-6744, email sasds@mailbox.sc.edu. Discuss with the instructor the type of academic or physical accommodations you need. See https://www.sa.sc.edu/sds/

Recommended Study Habits

- Read the assigned material before class.
- Bring thoughtful questions to class for discussion.
- Prepare for the exams in study groups.
- Take notes during class discussions and while completing reading assignments.

Deviations
Minor deviations from the syllabus are a normal part of any adaptive teaching and learning process.