CAPER Summer Course

Power System Analysis with Distributed Generation

Instructors:

Dr. Mesut Baran	baran@nscu.edu	919-515-5081
Dr. Valentina Cecchi	vcecchi@uncc.edu	704-687-8730
Dr. Badrul Chowdhury	b.chowdhury@uncc.edu	704-687-1960
Dr. Randy Collins	collins@clemson.edu	864-656-9289
Dr. Johan Enslin	jenslin@clemson.edu	843-730-5117
Dr. Ramtin Hadidi	rhadidi@clemson.edu	843-730-5106
Dr. Ning Lu	nlu2@ncsu.edu	919-513-7529
Dr. David Lubkeman	dllubkem@ncsu.edu	919-513-2024
Steven Whisenant	steven.whisenant@duke-energy.com	704-877-1265

References: A copy of the textbook will be provided to each registered student.

- Power System Analysis & Design, SI 6th Ed. by Glover, Overbye & Sarma, CL Engineering, 2016

Additional references:

- Class notes
- Power point slides

Software: PowerWorld (Free version), PSCAD (Free version), OpenDSS (open source), and Milsoft WindMil (Student version) *will be required at minimum*.

Course Objectives: This two-week course will provide a comprehensive overview of the fundamentals of power engineering. Topics include Three-Phase Fundamentals, Transformers, Transmission Lines, Substations, Power Flows, Power Electronics, Distribution Systems, Loads, Power System Planning, Operation, Protection, Dynamics, Stability and Control, Transients, and Distributed Energy Resources and Integration into the Grid. The course is designed to act as a refresher for the basics and as a brief introduction for more advanced topics.

At the completion of the course, student should be able to:

- Perform three-phase analysis
- Understand the per-unit system
- Understand AC machines operation and different kind of distributed generations
- Analyze transmission line electrical performance
- Perform power flow analysis
- Be familiar with power electronics devices, converters and machine drives
- Have detailed knowledge of distribution systems, substations, and loads and the effect of distributed generations
- Have a in-depth understating of power system planning and operation
- Understand symmetrical components and their role in unsymmetrical fault analysis
- Analyze symmetrical and unsymmetrical short circuit scenarios
- Be familiar with renewables and storage control and integrations and their challenges.
- Better understand power system protections.

- Understand different forms of stability studies, root causes, controls and different forms of power system transients
- Describe distributed energy resources and their integrations to the grid
- Understand and analyze power quality issues.

Lecture: Sunday, May 10 – Friday, May 15, 2020
Monday, June 1 – Friday, June 5, 2020
8:00 am – 5:00 pm, daily

Location: Zucker Graduate Education Center
GEC 102 – 104
1240 Supply Street
North Charleston, SC 29405

Course Outline:

Before Course Begin: Self-review *Chapter 1: Introduction* and *Chapter 2: Fundamentals*

Optional Additional Day

Sunday	1:00 pm – 1:30 pm	Registration
	1:30 pm – 5:00 pm	Review: *Fundamentals of Power Engineering*
	5:00 pm – 5:30 pm	Orientation
		Software Installation Check

Week 1:

Monday	8:00 am – 12:00 pm	Review *Chapter 1: Introduction*
		Review *Chapter 2: Overview of Three-Phase Circuits*
	12:00 pm – 1:00 pm	Lunch
	1:00 pm – 5:00 pm	*Chapter 3: Transformers and the Per-Unit System*
	5:00 pm – 6:30 pm	**Welcome Reception**
		Orientation & Software Installation Check
Tuesday	8:00 am – 12:00 pm	*Chapter 4: AC Machines and Renewable Generation*
	12:00 pm – 1:00 pm	Lunch
	1:00 pm – 5:00 pm	*Chapter 5: Transmission Lines & Cables*
Wednesday	8:00 am – 12:00 pm	*Chapter 6: Electric Power Substations*
	12:00 pm – 1:00 pm	Lunch
	1:00 pm – 5:00 pm	*Chapter 7: Power System Analysis – Power Flow*
Thursday	8:00 am – 12:00 pm	*Chapter 8: Symmetrical Components and Fault Analysis*
	12:00 pm – 1:00 pm	Lunch
	1:00 pm – 5:00 pm	*Chapter 9: Distribution Power Systems, Part I*
Friday	8:00 am – 12:00 pm	*Chapter 10: Power Electronics and Variable Speed Drives*
	12:00 pm – 1:00 pm	Box Lunch and safety gear pick-up
	1:00 pm – 3:00 pm	**Dominion Energy site visit and technical tour**
	1:00 pm – 1:45 pm	Tour of North Charleston Dispatch Center
	1:45 pm – 2:00 pm	Travel to Faber Place Substation
	2:00 pm – 2:30 pm	Tour of Zucker Solar Park
	2:30 pm – 3:00 pm	Tour of Faber Place Substation

Week 2:

Monday	8:00 am – 12:00 pm	*Chapter 11: Integration of Renewables and Storage*
	12:00 pm – 1:00 pm	Lunch
	1:00 pm – 5:00 pm	*Chapter 12: Distribution Power Systems, Part II*
Tuesday	8:00 am – 12:00 pm	*Chapter 13: Load Modeling Forecasting*
	12:00 pm – 1:00 pm	Lunch
	1:00 pm – 5:00 pm	*Chapter 14: Power System Transients*
Wednesday	8:00 am – 12:00 pm	*Chapter 15: Power System Dynamics, Stability, and Control*
	12:00 pm – 1:00 pm	Lunch
	1:00 pm – 5:00 pm	*Chapter 16: Power System Protection*
Thursday	8:00 am – 12:00 pm	*Chapter 17: Power System Operations, Part I*
	12:00 pm – 1:00 pm	Lunch
	1:00 pm – 5:00 pm	*Chapter 18: Power System Planning*
		Chapter 19: Power System Operations, Part II
Friday	8:00 am – 12:00 pm	*Chapter 20: Power Quality*
	12:00 pm – 1:00 pm	Lunch
	1:00 pm – 3:00 pm	**Tour of Energy Innovation Center**

Class credit: PDH Certificate for up to 60 hours

Pricing

- CAPER Members: $2,495
- Non-CAPER Members: $2,995
- Early Bird discount: $2,245

Important Dates

- Registration open:
- Early Bird deadline:
- Orientation:
- Welcome Reception:
- Course begin:

Classroom Policies: Attendance is voluntary but strongly encouraged. No make up for missed classes, quizzes, or assignments will be given. Students are responsible for all material covered and all assignments given in every lecture. Some lectures may cover material not found in the textbook. It is the responsibility of each student to make up any deficiencies that result from missed classes. Students are expected to wait 15 minutes before leaving if the instructor is late. Cell phones must be turned off or silenced before coming into class.

Changes to Syllabus: The instructors reserve the right to make changes to this syllabus during the course. Students will be given adequate notice in class of any changes. Please check Canvas for any course updates and announcements.

Agreement: If you disagree with any of the policies or procedures spelled out above or cannot accept the demands of the course (i.e., the amount of time and work required), you need to drop the course as

soon as possible. By staying in the course, you agree to comply with all the policies and procedures described in this syllabus.