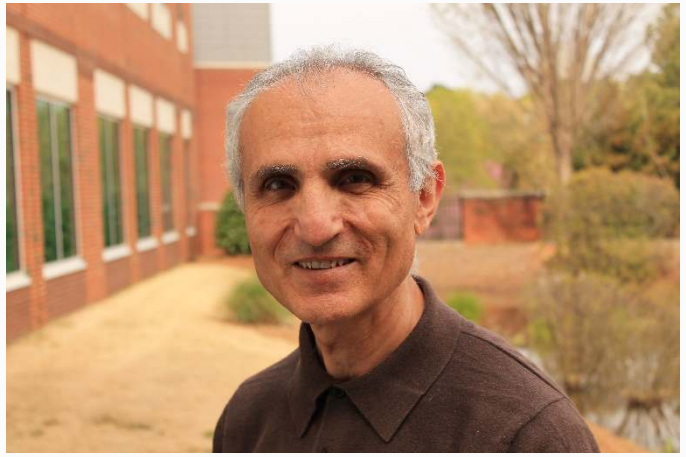

FREEDM
SYSTEMS CENTER
Online Graduate Programs in Power Engineering
Masters in Electric Power Systems Engineering
NC STATE UNIVERSITY
Electrical & Computer Engineering
@NCStateECE

Introductions



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NC State University

Whether it's *Times Higher Education* naming the university one of the best in the U.S. for graduate employability or Kiplinger listing us as a top value for both in- and out-of-state students, NC State is regularly ranked among the nation's top public universities.

Top 10 in the Nation in annual research expenditures

#5 Best value among public universities nationally

ECE @ NC State University

61 Tenured and tenure-track faculty

Over 90 Graduate-level courses

22 Institute of Electrical and Electronic Engineer (IEEE) Fellows

200+ funded research projects

Engineering Online @ NC State

16 Engineering Masters degrees available online

Distance learning programs offered for over 40 years

Asynchronous Class Delivery

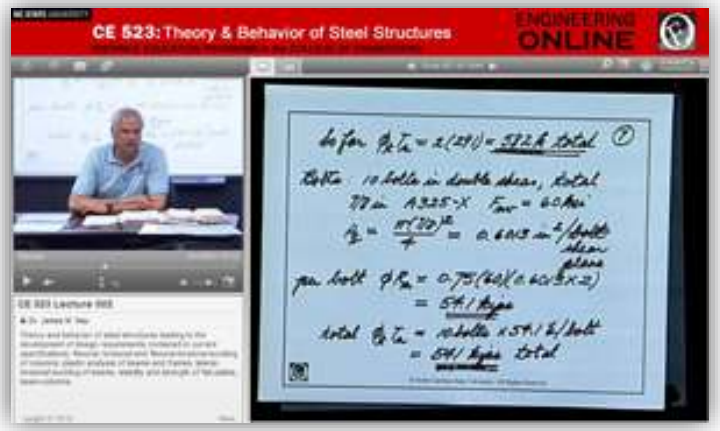
Faculty teach in front of on campus class in special teaching studio classrooms. Lectures are available 10 minutes after conclusion of class.

Notes are captured and placed on course home page for students to download.

Online Courses follow the normal semester class schedule.

Exams must be proctored.

Distance students watch lectures at night or during the day on their own schedule.



Online Engineering Masters Degree Ranking

#9 in Best Online Graduate Engineering Programs

North Carolina State University is ranked No. 9 in Best Online Graduate Engineering Programs. Schools are ranked according to their performance across a set of widely accepted indicators of excellence.

#1 in Electrical Engineering

“Topping our list of best master’s in electrical engineering online offerings, the online MS degree offered at North Carolina State University features seven different areas of specialization…. It also includes both thesis and non-thesis options...”

EPSE Program Introduction

- The Electric Power Systems Engineering (EPSE) Program was introduced in 2011.
- Builds on the expertise of NC State ECE Faculty, research capabilities, and industry connections.

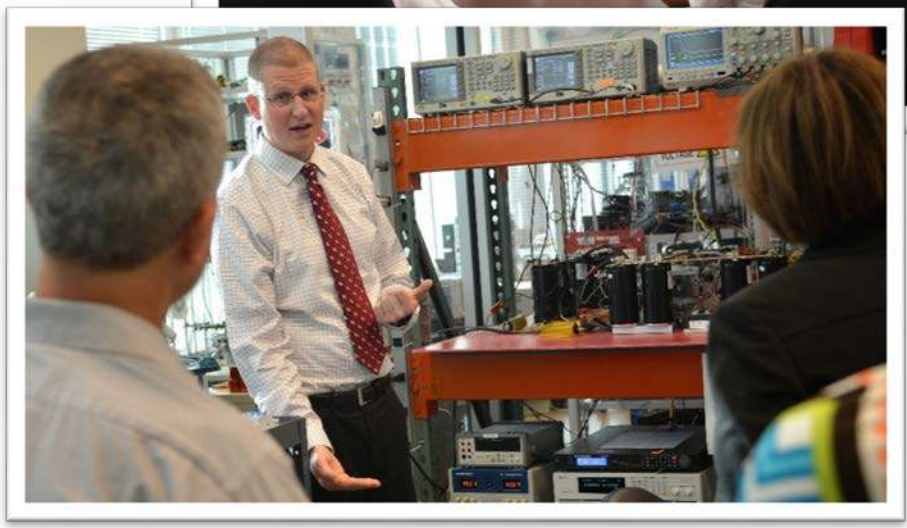
Comprehensive Training for Careers in the Power Industry

We designed the MS-EPSE Program to train the next-generation power engineering workforce and meet industry demand.

- ✓ Demand for power system specialists increased more than 70% from July 2013 to June 2017 in the Southeast US.
- ✓ Employment opportunities in multiple industries
- ✓ 47% of job postings in the eastern region of the US mention communication skills. Similar soft skills account for half of the 12 top baseline skills employers seek.

MS-EPSE Degree Delivers

- Core power engineering courses
- Unique and interdisciplinary coursework
- Professional skills training
- All core courses available online



Benefits of the Online EPSE Degree

- In a survey conducted by Learning House, 44% of online students reported improvements in their employment standing and 45% reported a salary increase.
- Allows you to move up or into a power engineering position within your company.
- Gives you the knowledge to upgrade your skill set and enter new areas within power systems engineering.
- Offers the benefit of studying where and when it fits your schedule.

MS-EPSE Employers

Employers Include:

Electric Power Systems Program

Required	Elective
ECE 550: Power Systems Operation and Control	ECE 516: Controls
ECE 534: Power Electronics and Utility Applications	ECE 535: Design of Electromechanical Systems
ECE 551: Smart Distribution Systems	ECE 585: The Business of Electric Utility
ECE 552: Renewable Electric Energy Systems	ECE 581: Power System Switchgear and Protection
ECE 586: Communications and SCADA Systems for Smart Grid	ECE 587: Power System Transient Analysis
ECE 583: Power Engineering Practicum I	ECE 592: Electric Motor Drives
ECE 584: Power Engineering Practicum II	ECE 592: Data Analytics for Power Engineering
	ECE 726: Advanced Feedback Control
	ECE 732: Machine Control
	ECE 736: Power System Stability
	ECE 753: Computational Methods in Power System Operation and Planning

Power Electronics Concentration

Required	Elective
ECE 552: Renewable Electric Energy Systems	ECE 551: Smart Distribution Systems
ECE 734: Advanced Power Electronics	ECE 732: Dynamics and Controls of Electric Machines
ECE 592: Electric Motor Drives	ECE 538: Integrated Circuits Fabrication
ISE589-04: Manufacturing Systems	ECE 739: Integrated Circuits Technology and Fabrication Laboratory
ECE 534: Power Electronics	
ECE 553: Semiconductor Power Devices	
ECE 539: IC Fabrication	
ECE 792-30: WBG Power Devices SiC and GaN	
ECE 533: Power Electronics Packaging	
ECE 592-34: Product Innovation Lab	

MS-EPSE Differentiators

Unique Coursework

- ECE 551: Smart Distribution Systems
- ECE 552: Renewable Electric Energy Systems
- ECE 585: The Business of Electric Utility
- ECE 586: Communications and SCADA Systems for Smart Grid
- ECE 581: Electric Power System Protection
- ECE 587: Power System Transient Analysis

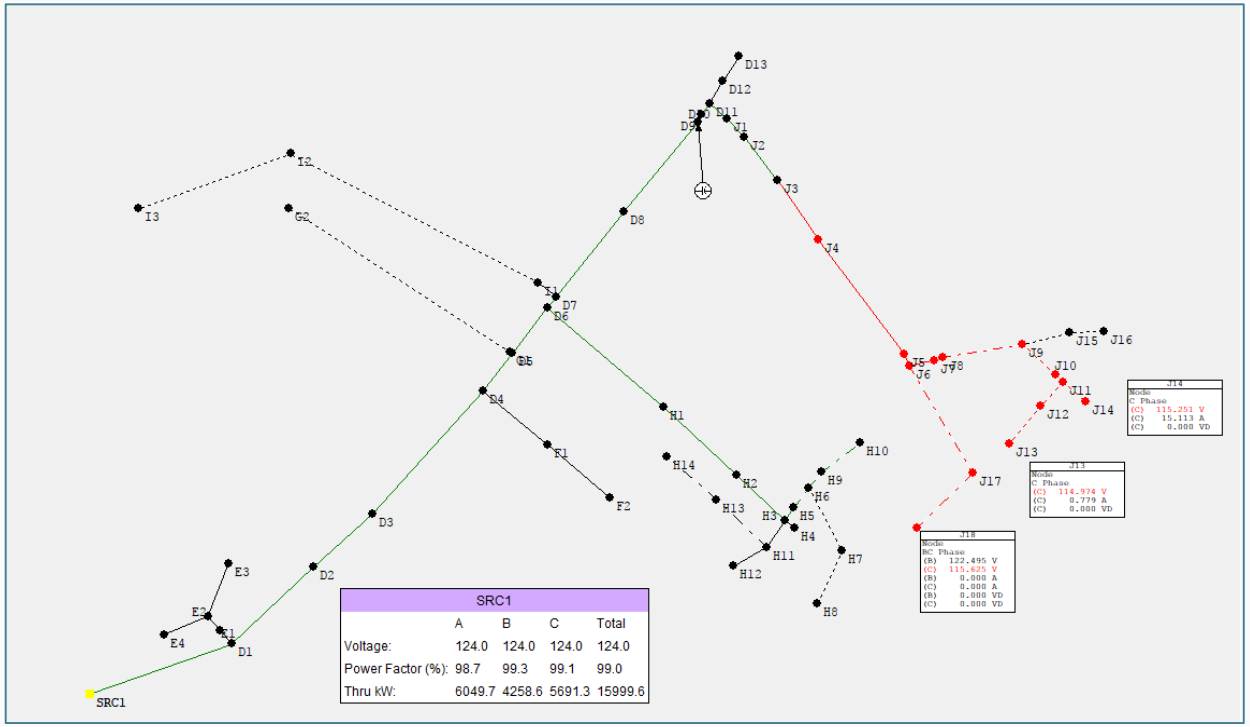
- ECE 583/584
  - ✓ Project Management and Communication Skills
  - ✓ Industry Sponsored Capstone Project

ECE 551: Smart Electric Power Distribution Systems

- Focus on analysis and operation of utility electric power distribution circuits.

- Topics include:
  - ✓ Transformer and Load Modeling
  - ✓ Overhead and Underground Lines
  - ✓ Voltage Regulation and Capacitor Applications
  - ✓ Power Flow and Short Circuit Studies
  - ✓ Reliability and Power Quality Analysis
  - ✓ Distributed Energy Resource (DER) Integration

- Projects based on Milsoft WindMil and EPRI OpenDSS



ECE 552: Renewable Electric Energy Systems

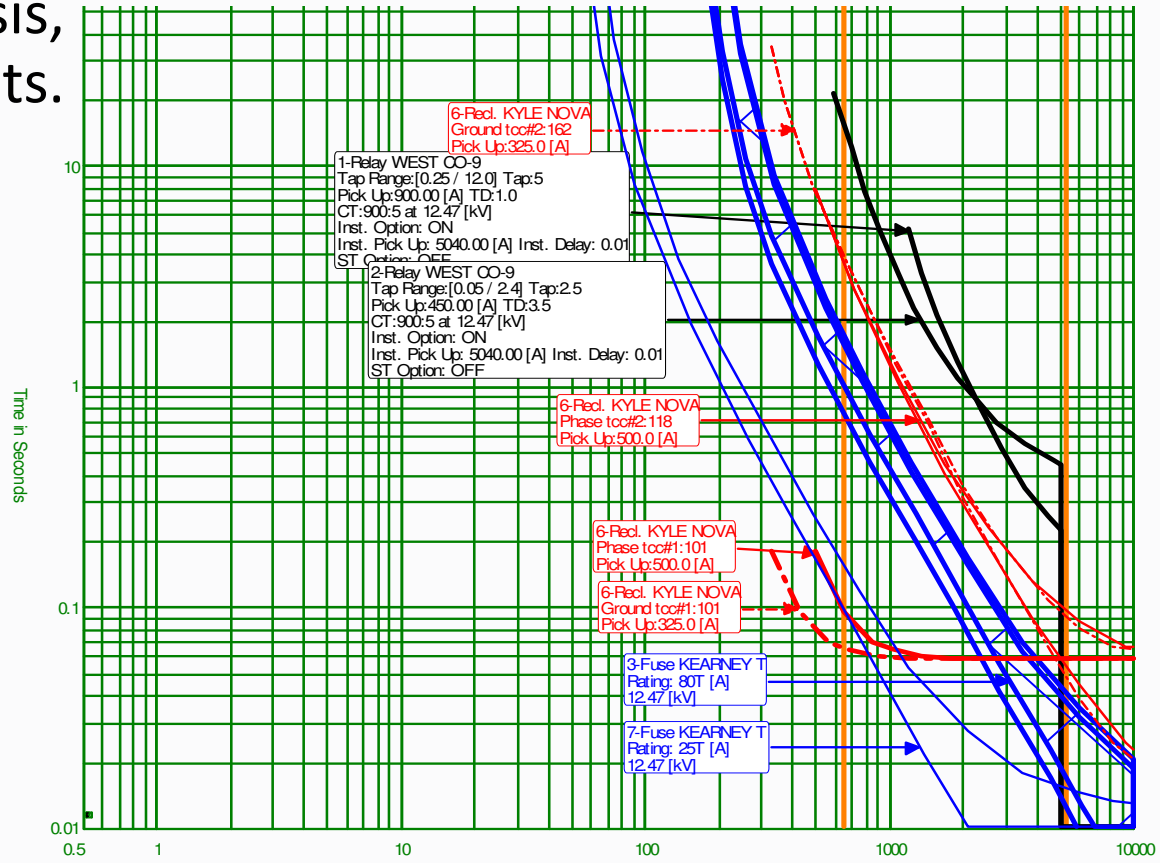
Power Generation technologies, conventional and renewables: PV and wind energy systems, fuel cells.

- Topics include:
  - ✓ Heat Engines
  - ✓ Economics of Power Generation
  - ✓ Photovoltaic Systems
  - ✓ Wind Energy Systems
  - ✓ Electric Energy Storage
  - ✓ Fuel Cells
- A design project for an off-grid PV system

ECE 581: Electric Power System Protection

Principles of protection schemes, fault analysis, relaying schemes for main system components.

- Topics include:
  - ✓ Fault Analysis
  - ✓ Principles of protection schemes
  - ✓ Protection schemes for transmission lines
  - ✓ Transformer Protection
  - ✓ Generator Protection
- A design project for a substation

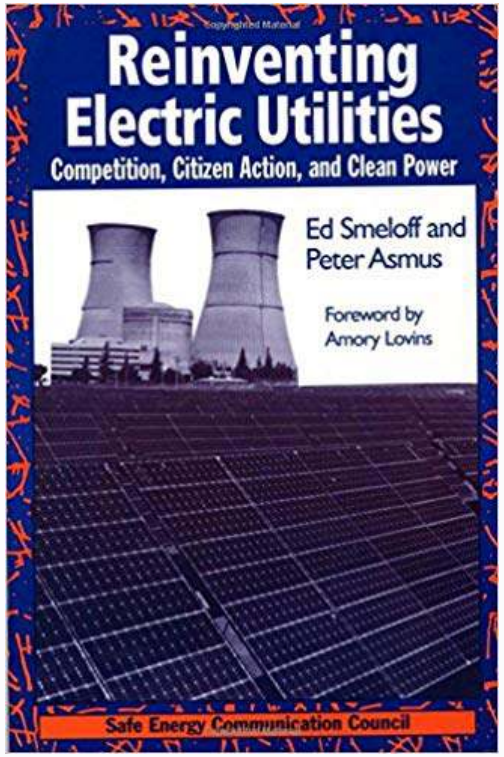


ECE 585: The Business of Electric Utility

Evolution of electric utility industry, structure and business models of the industry, regulatory factors within which the utilities operate.

- Topics include:
  - ✓ Evolution of electric utility
  - ✓ Regulatory framework
  - ✓ Business models for the utility
  - ✓ Utility Economic assessment
  - ✓ Utility Ratemaking
  - ✓ Markets and Competition

- A design project on ratemaking



ECE 586: Communication and SCADA Systems for Smart Grid

Introductory course on communication technologies and SCADA for smart electric power applications

- Topics include:
  - ✓ Smart Grid Communications Architecture
  - ✓ Computer Networking (Ethernet, WiFI, TCP/IP)
  - ✓ DNP3 and Modbus SCADA protocols
  - ✓ IEC 61850 substation automation protocol
  - ✓ Substation and Distribution Automation, AMI
  - ✓ Cybersecurity and NERC standards

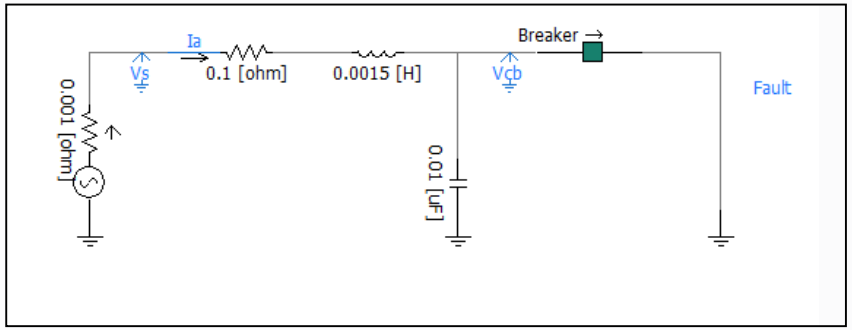
- Projects based on Triangle MicroWorks Distributed Test Manager and Relay test rack

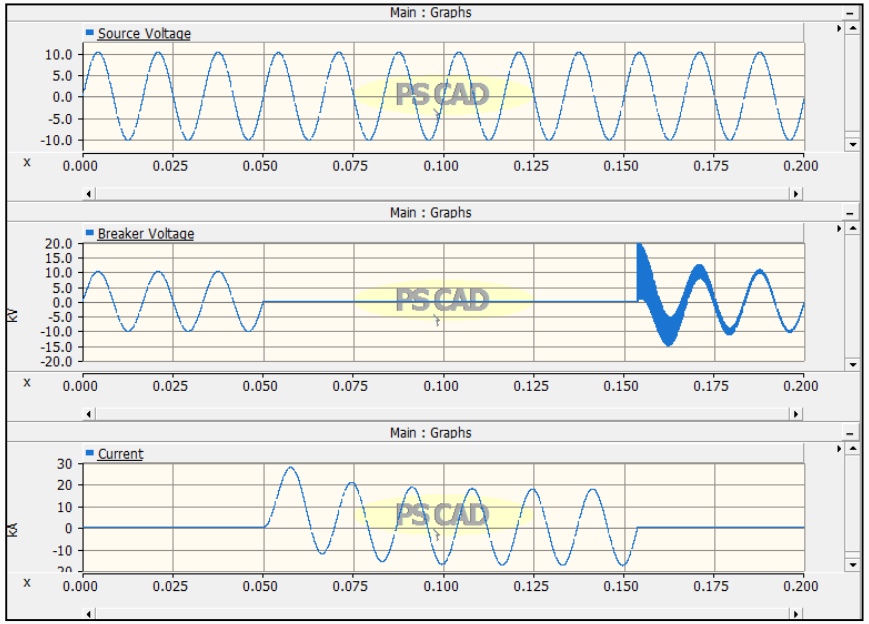
ECE 587: Power System Transients Analysis

Focus on analysis of various power system transients associated with fault events, switching and integration of power electronic devices

- Topics include:
  - ✓ Fault Transients, Capacitor Switching and Transient Recovery Voltage
  - ✓ Numerical Techniques for Transient Simulation
  - ✓ Line Modeling for Traveling Wave Events
  - ✓ Power Electronic Rectifier and Inverter Modeling
  - ✓ Distribution Energy Resource Interfacing and Modeling

- Projects based on PSCAD and Matlab/Simulink/Simscape Power Systems





ECE 583/584 Practicum Activities

Capstone Project Initiation and Planning

- Team Selection
- Project Proposal (Report and Presentation)
- Project Charter
- Project Plan (Report and Presentation)

Project Management Skills

- Planning
- Scheduling
- Reporting
- Meeting Customer Expectations

Communications Skills

- Individual Presentations
- Group Presentations
- Effective Writing

Capstone Project Execution

- Literature/Topic Review
- Design
- Prototyping
- Deliverables
- Final Report and Presentation

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Capstone Projects

Project Sponsor	Titles
ABB	Techo-Economic Analysis of New Apparatus Design Concepts for Distribution Automation
Booth & Associates	PV Solar plus Energy Storage Concept Development
Duke Energy	Microgrid Design for Remote Community
Siemens	Subtransmission Closed-Loop Fault Location & Determination
SAS	Distribution System Situational Awareness
Triangle MicroWorks	IEC 61850 Substation Functionality Model

Getting Started

- Students apply to the Electric Power Systems Engineering-Distance Track-MS in the Department of Electrical and Computer Engineering.
- Applications considered on a rolling basis. See website for specific deadlines.
- Requires a bachelor's degree from an accredited college or university in electrical engineering. An overall GPA of at least 3.00/4.00.
- All requirements must be completed within six years initial enrollment.
- Prior to applying to Graduate School, a qualified individual may enroll in Engineering Online courses as a Non-Degree Studies (NDS) student.

Alumni & Industry Feedback

- "The opportunity for these students to cover rate making in an engineering program with such confidence truly speaks to the structure of the curriculum and quality of resources. ..NC State is well ahead of the curve in preparing its students for the future power industry."

–Kevin Hodge, North Carolina Utilities Commission

"..the Capstone project provided excellent hands-on experience and valuable industry exposure."

-Survey feedback from MS-EPSE grads

Program Contacts

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Helpful Links & Resources

For more information about the **MS-EPSE Online degree program**, visit the MS-EPSE website

Apply today!

Apply as a non-degree student (NDS)

For more information about **Engineering Online**, visit the EOL Website

U.S. News & World Report

Best College Reviews

Learning House Study

Q & A

Thank you for joining us today!