Energy Systems Innovation Center (ESIC)

Mani V. Venkatasubramanian
Director, ESIC
WSU Power Program

- Power Professorship program since 1973
- Energy Systems Innovation Center since 2012
- Educating leaders in industry
- Partnering with industry and government
- Significant & sustained impact
- Premier power program
Vision
Leading the transition to affordable, sustainable and resilient electric power systems

Mission
Collaborative research, education, and outreach to solve challenges for modern power systems
ESIC Power Faculty

Mani Venkatasubramanian, Director, Boeing Distinguished Professor

Anjan Bose, Regents Professor, Distinguished Professor in Power Engineering

Noel Schulz, Schweitzer Endowed Professor

Robert Olsen, Professor Emeritus

Saeed Lotfifard, Associate Professor

Anamika Dubey, Assistant Professor

Ahmed Abu-Hajar, Clinical Associate Professor

Javier Guerrero, Clinical Assistant Professor

Shuzeng Xie, Clinical Assistant Professor

Anurag Srivastava, Research Professor

Josue Campos Do Prado, Assistant Professor

Hang Gao, Assistant Professor

Henry Huang, Research Professor

Kevin Schneider, Research Professor
ESIC Faculty in Allied Disciplines

**Computer Science**
- Partha Pande – Network-on-Chip
- Behrooz Shirazi – Pervasive Computing
- Diane Cook – Smart Home/Environments
- Jana Doppa – Machine Learning
- Assefaw Gebremedhin – Data science
- Ananth Kalyanaraman – Computing

**Electrical Engineering**
- Sandip Roy – Dynamic Networks
- Pat Pedrow – High Voltage
- Hang Gao – WSU Vancouver
- Xinghui Zhao – WSU Vancouver

**Civil & Environmental**
- Michael Wolcott – Sustainable Infrastructures
- Jennifer Adam – Water and Storage
- John Petrie – Impact of Hydro Operations
- Ji Yun Lee – Infrastructure resilience

**Chemical Engineering**
- Su Ha – Fuel Cells

**Mechanical & Materials Engineering**
- Jacob Leachman – Hydrogen/Nuclear
- Dustin McLarty – Energy Storage
- Grant Norton – Nanotechnology
- Soumik Banerjee – Solar Cells, Batteries
- Yuehe Lin – Batteries

**Architecture**
- Todd Beyreuther – Integrated Design

**Economics**
- Alan Love – Electricity Markets

**Communication**
- Amanda Boyd – Risk Communication

**Liberal Arts**
- Paul Whitney – Cognitive Behavior
- Christine Horne – Social Norms
New ESIC faculty

Ongoing faculty search for three positions:
(Assistant/Associate/Full Professor level)

• Power electronics
• Cybersecurity
• Power systems including AI/ML applications
ESIC Staff

Jeannine Burke – Manager
Linda Howell – Industry Relations Coordinator
Darlene Miller – Research Administrator
Samantha Ulam – Communications Assistant
Ph.D. Students: 30

M.S.: 2 (Thesis) + 3 (Non-Thesis)

Seniors taking power electives: 35
Research Expenditures

Year | Expenditures (in $M)
-----|---------------------
2011 | 2.06
2012 | 3.1
2013 | 3.6
2014 | 2.85
2015 | 3
2016 | 4.2
2017 | 4.2
2018 | 4.1
2019 | 4.3
2020 | 3.3
2021 | 2.7
ESIC Thrust Areas

1) Microgrids and IBRs
2) Reliability and Resilience
3) Grid Edge/Privacy/Cybersecurity
4) AI and ML Applications
5) Workforce 2.0
WSU Smart City Testbed
WSU Research and Technology Park, Pullman
ESIC Outreach

- Technical conferences: WPRC, ESIC Summit, and Hands-on-relay school
- ESIC Seminars (weekly)
- ESIC Scholarships
- Leadership in professional societies
- Technology transfer – start-up companies and technology licensing
- Collaboration with centers, e.g. AGI, PSERC, CHARGE.
ESIC Memberships

• ESIC Power Education Partnership (PEP)
  ▪ Supporting power engineering education

• ESIC Research Excellence Partnership (REP)
  ▪ Promoting research collaborations
ESIC PEP Membership

• ESIC Power Education Partnership (PEP)
• Annual Membership: Varies
• Benefits – Support Power Engineering Education
  • Practicum
  • Support for Internships/Jobs
  • Power Curriculum Feedback
  • Free booths at Fall Career Expo and IEEE Career Fair
  • Professional Development Hours for ESIC weekly seminars
  • Optional Tutorials by Faculty Experts
  • Dedicated Industry Liaison
ESIC PEP Membership

ESIC PEP Members
2020-21
Support for Power Engineering Education

- Travel support for Practicum
- Power teaching lab support
- Student travel support for attending power conferences and for field trips
- Support for ESIC weekly seminars
ESIC REP Membership

• ESIC Research Excellence Partnership (REP)

• Annual Membership: $15K

• Benefits - Access to ESIC research:
  • Research collaborations
  • ESIC weekly seminars
  • Project catalog/announcements
  • Research reports and papers on secure website
  • Invitation to be project advisors
  • Tutorials by faculty experts
  • ESIC Summit
  • Dedicated industry liaison
  • Seed projects at no overhead (no deliverables)
Professional Science Masters (PSM) in Electrical Power Engineering (EPE)

- Online degree program offered by ESIC
- Combination of Electrical Engineering and Engineering Management courses
- Students from all over the world
Industry Perspectives
Curriculum Updates
• Fall 2021, Anamika Dubey, 14
• Spring 2022, Javier Guerrero, 22
• Spring 2022, Shuzheng Xie, 16
• Course Topics
  • Three-phase AC systems
  • Transformers,
  • Rotating machine fundamentals,
  • Synchronous machines, Induction machines, DC motors
  • Transmission lines
  • Power system models
• Spring 2022, Saeed Lotfifard, 10
• Spring 2022, Shuzheng Xie, 9
• Spring 2022, Javier Guerrero, 4
• Course Topics
  • Single and Three-Phase AC Circuits
  • Nonlinear Magnetic Circuits, Harmonics, and Single Phase Transformers
  • Three Phase Transformers
  • DC Machines
  • Synchronous Machines
  • Induction Machines
Spring 2022, 15 students

Instructor: Anamika Dubey

Course Topics

- Load characteristics,
- Distribution transformers, Line and load models
- Power flow analysis: forward-backward sweep
- Voltage control – step voltage regulator, capacitor banks
- Fault Analysis and Systems Protection
- Windmill projects on Distribution system modeling and analysis
EE486 Power Electronics

• Spring 2022, 28 students
• Instructor: Ahmed Abu-Hajar
• Course Topics
  • Power Switches
  • Power and Energy Computations
  • Single Phase Half-Wave Rectifiers
  • Single Phase Full-Wave Rectifiers
  • Three Phase Full-Wave Rectifiers
  • DC/DC Converters
  • Flyback and Forward Converters
  • DC/AC Inverters and PWM
EE491 Performance of Power Systems

- Fall 2021, 30 students
- Instructor: Saeed Lotfifard (Mani)
- Course Topics
  - Per unit review, Line models, Ybus
  - Power-flow analysis: NR, FD, DC, Controls
  - Economic dispatch: lossless, lossy, OPF
  - Stability: Faulted system, Eigenvalues
  - State Estimation, AGC
- Matlab projects on Power-flow and Equal area criterion
EE 492: Renewable Energy Sources

- Fall 2021, 28 students
- Instructor: Javier Guerrero
- Course Topics
  - Introduction to conventional generation methods.
  - Photovoltaic system analysis and design.
  - Wind Generations analysis and design.
  - Renewable energy sources integration to the power grid considerations.
  - Introduction to Fuel Cells and Batteries.
  - Introduction to EV.
• Fall 2021, 15 students
• Instructor: Saeed Lotfifard
• Course Topics
  • Short circuit analysis
  • Different protection systems such as the followings:
    • Distribution feeder protection
    • Transmission lines protection
    • Transformer protection
    • Generator protection
    • Busbar protection
Everett Program Overview

• Locally offered classes: EE361 (Lecture) and EE362 (Laboratory)
• Power track is available at Everett Program
• On average, around 5 out of 20 students choose power track each year.
• Power practicum from local utility companies (e.g. Puget Sound Energy) is extremely positively received.
• Future expansion: Renewable energy and power electronics labs
• Power Engineering students: 6
• Power Courses offered from Bremerton: 1 (EE 492)
• Power courses offered locally in Bremerton: 2 (EE 361, EE 362)
• Power Courses offered from Pullman: 3 (EE 491, EE 485, EE 486).
• Practicum Attendance: 1
• Power related Internships: 4
Updates to EE361

**Objective:** Make EE361 more appealing to EE students to pursue power engineering track

**Suggested changes:**

**Presentation:** Presenting the course in the context of modern power systems with renewable energy sources, proving system view of power systems rather than device view of the components, providing introduction to all power engineering related elective courses throughout the course.

**Topics:** Add renewable energy related topics such as Intro. Converters/inverters for wind turbines, Including induction generators in addition to induction motors, having better coordination between EE362 and EE361 in terms of covered topics.

**Other activities:** Inviting speakers from industry, Inviting senior students to discuss their views with students.
Practicum Students
Communication Updates and Industry Relations
Recruitment

• Proactive presence and participation at on-campus recruiting events in collaboration with the Voiland College of Engineering and Architecture and the Department of Electrical Engineering and Computer Science. Dr. Anamika Dubey is representing power engineering at these events and is working closely with the College recruitment team.

• ESIC is now an education member of the Center for Energy Workforce Development (CEWD) thanks to sponsorship from AVISTA. Membership provides ESIC with access to resources to aid in recruitment, such as materials and templates for flyers.

• Working with the College recruitment team, and faculty from all electrical engineering tracks, we look forward to holding our first “cloud event” in a few weeks. All students who have applied to WSU and indicated an interest in electrical engineering will be invited. Several faculty and students will be available to answer questions and share about their experiences at WSU Pullman.

• More to come! We have plans to host events to welcome new electrical engineering students in the Fall.
Thank you to all the companies who met last October and expressed interest in hosting students for Practicum, March 14-18. Unfortunately, Covid-19 continued to interrupt plans, but we have great hopes to meet in Fall 2022 to plan for Practicum next year, March 13-17, 2023.

Thank you to Potelco, Puget Sound Energy and Okanogan PUD for hosting a total of 9 students. The feedback we received from the students was very positive.

We have plans to begin advertising the Practicum opportunity to students as soon as they return to campus for Fall semester!
Career Fairs
Voiland College Internships & Career Services

ProPEL Staff
- Sandi Brabb, Director
- Gabrielle Charles, Graduate Assistant
- Jovannie Laforga, Graduate Assistant

Internship Participation
- 72% Civil
- 50% Mechanical & Material Science Engr
- 47% BioE
- 57% Electrical
- 40% Chemical
- 53% Computer Science

Services
- Résumés/Cover Letters
- Interviewing
- Internships
- Job Search
- Industry Tours
- ePortfolios
- Employer Connections
- Career Events
- Technical Career Fair
  & more!

Connect with us:
- @VCEAlnternships
- @WSUVoilandPPEL
- @Voiland.PPEL
- vcea.wsu.edu/student-resources
- vcea.internships@wsu.edu
- (509) 335-8762

Graduates
- 90% Employed
- 10% Seeking Employment
SAVE THE DATE
WSU CAREER EXPO & TECHNICAL FAIR

VIRTUAL EXPO | Monday, October 3
ON HANDSHAKE
3:00 - 6:00 P.M.

IN-PERSON EXPO | Tuesday, October 4
BEASLEY COLISEUM
12:00 - 4:00 P.M.

Registration opens this Spring on Handshake
Associated Events

SWE Evening with Industry
Monday, Oct. 3, 5:30-8 p.m.

Next Day On-Campus Interviews
Wednesday, Oct. 5, 8 a.m.-5 p.m. - Beasley

While you are in town (or virtually):
• Schedule networking events such as info sessions, resume reviews, or office hours
Connect with Voiland Career Services

- Ask me how we can help you develop an internship program.
- Send us your job announcements

- Post your jobs in Handshake
- Let us help you connect with student clubs and other networking activities.
- Your student interns can get academic credit for their internships.
Sandi Brabb, Director
brabb@wsu.edu
(509) 335-3740
Dana Hall 138
Round Table Discussions