

EE 521 – Section 01/EE 582 Section 02 – Fall 2022
Analysis of Power Systems

Instructor: Noel N. Schulz, Professor of EECS, EME 35, WSU Pullman

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Schedule: Tu, Th 2:55-4:10 pm

Credits: 3

Classroom: Pullman EME B46 Tri-Cities: EFLO 224 Vancouver: VECS 122

Textbook: Computational Methods for Electric Power Systems 3rd edition, Mariesa L. Crow, CRC Press, 2021, ISBN-10: 1032098228 or ISBN-13: 978-1032098227. Available here [Computational Methods for Electric Power Systems \(Electric Power Engineering Series\): Crow, Mariesa L.: 9781032098227: Amazon.com: Books](#)

Supplemental Readings:

Power System Analysis by John J. Grainger and William D. Stevenson, Jr and journal and conference papers as assigned.

Power Flow Data: <http://www.ee.washington.edu/research/pstca/>

Pre-requisite: EE 491 or equivalent or permission of instructor

Office Hours: TBD

University Policies and Information

Students with Disabilities.

The Graduate School is committed to providing equal opportunity in its services, programs, and employment for individuals with disabilities. Reasonable accommodations are available for students with a documented disability. Students are responsible for initiating requests for reasonable accommodations and services that they need.

Requesting Reasonable Accommodations

Graduate students with identified disabilities should contact the Access Center before the semester that they plan to attend and initiate the accommodations process. Accommodations are unique for each individual and some require a significant amount of time to prepare for, so it is essential that students notify the Access Center as far in advance as possible. Students with a disability that is identified during the semester should contact the Access Center as soon as possible to arrange for an appointment and a review of their documentation by an Access advisor. All accommodations must be approved through the Access Center located on each campus. Contact information for the Access Center at each campus can be found at the following websites:

- Pullman: <http://accesscenter.wsu.edu/>
- Tri-Cities: <http://www.tricity.wsu.edu/disability/>
- Vancouver: <http://studentaffairs.vancouver.wsu.edu/access-center>

All students requesting reasonable accommodation must meet with the instructor prior to or during the first week of the course to review all proposed accommodations in relation to course content and requirements. Exceptions to this timeframe will be granted only upon a showing of good cause.

WSU Academic Integrity

All members of the university community share responsibility for maintaining and promoting the principles of integrity in all activities, including academic integrity and honest scholarship. Students are responsible for understanding the full [Academic Integrity Statement](#). I encourage you to work with classmates on assignments. However, each student must turn in original work. No copying will be accepted. Students who violate WSU's Academic Integrity Policy (identified in WAC 504-26-010(3) and -404) will receive a zero on the assignment, will not have the option to withdraw from the course pending an appeal, and will be reported to the Center for Community Standards. If you have any questions about what is and is not allowed in this course, ask me.

Classroom Safety Statement

Classroom and campus safety are of paramount importance at Washington State University, and are the shared responsibility of the entire campus population. WSU urges students to follow the "Alert, Assess, Act," protocol for all types of emergencies and the ["Run, Hide, Fight"](#) response for an active shooter incident. Remain ALERT (through direct observation or emergency notification), ASSESS your specific situation, and ACT in the most appropriate way to assure your own safety (and the safety of others if you are able).

Please sign up for emergency alerts on your account at MyWSU. For more information on this subject, campus safety, and related topics, please view the FBI's [Run, Hide, Fight video](#) and visit the [WSU safety portal](#).

Accommodation for Religious Observances or Activities

Washington State University reasonably accommodates absences allowing for students to take holidays for reasons of faith or conscience or organized activities conducted under the auspices of a religious denomination, church, or religious organization. Reasonable accommodation requires the student to coordinate with the instructor on scheduling examinations or other activities necessary for course completion. Students requesting accommodation must provide written notification within the first two weeks of the beginning of the course and include specific dates for absences. Approved accommodations for absences will not adversely impact student grades. Absence from classes or examinations for religious reasons does not relieve students from responsibility for any part of the course work required during the period of absence. Students who feel they have been treated unfairly in terms of this accommodation may refer to Academic Regulation 104 – Academic Complaint Procedures.

Discrimination and Harassment Policy Statement

Discrimination, including discriminatory harassment, sexual harassment, and sexual misconduct (including stalking, intimate partner violence, and sexual violence) is prohibited at WSU (See [WSU Policy Prohibiting Discrimination and Harassment](#) (Executive Policy 15) and [WSU Standards of Conduct for Students](#)). If you feel you have experienced or have witnessed discriminatory conduct, you can contact the WSU Compliance & Civil Rights (CCR) and/or the [WSU Title IX Coordinator](#) at 509-335-8288 to discuss resources, including confidential resources, and reporting options. (Visit [ccr.wsu.edu](#) for more information). Most WSU employees, including faculty, who have information regarding sexual harassment or sexual misconduct are required to report the information to CCR or a designated Title IX Coordinator or Liaison. (Visit [ccr.wsu.edu/reporting-requirements](#) for more info).

Lauren's Promise – *I will listen and believe you if someone is threatening you.*

Lauren McCluskey, a 21-year-old honors student athlete, was murdered on Oct. 22, 2018, on the University of Utah campus by a man she briefly dated. *We must all take actions to ensure that this never happens again.*

University Support and Response for Discrimination and Harassment

Discrimination, discriminatory harassment, sexual harassment, and sexual misconduct (including stalking, intimate partner violence, and sexual violence) are prohibited at WSU (see Executive Policy 15 – [WSU Policy Prohibiting Discrimination and Harassment](#), the [WSU Standards of Conduct for Students](#), and relevant employee manuals). WSU has instituted procedures to respond to violations of these laws and standards, programs aimed at the prevention of such conduct, and intervention on behalf of victims.

If you are in immediate danger, call 911.

If you are experiencing sexual assault, domestic violence, stalking, discrimination or harassment, **you have support and options**. If you share information with me, please know that I am required to reach out to the Title IX Coordinator in WSU Compliance and Civil Rights (CCR), and CCR will reach out to you with information about on and off campus reporting options and resources. CCR is a system-wide resource (all campuses) which is available for intake consultations for you to learn more about available support. You can reach them directly at 509-335-8288, ccr@wsu.edu, or [report online](#) (anonymous reports accepted).

You can also speak to a victim advocate, a medical provider, or counselor confidentially about your concerns. Advocates help survivors of crime determine their own needs in regards to their physical and emotional health, reporting options, and academic concerns. At no cost, advocates connect survivors to campus and community services, and provide accompaniment to important appointments (court, hospital, and police) and support throughout the process. For a list of confidential victim advocates and medical providers, please visit [CCR Resources](#).

WSU Police Department (WSU PD) officers and campus security will treat victims of sexual assault, domestic violence, stalking, hate crimes, and other crimes with respect and dignity. WSU PD, campus security departments, CCR, and victim advocates can also help you with safety planning.

Important Dates and Deadlines Notes

Students are encouraged to refer to the academic calendar often to remain aware of critical deadlines throughout the semester. The academic calendar can be found at <http://registrar.wsu.edu/academic-calendar/>

Severe Weather

For severe weather alerts, see: <http://alert.wsu.edu/> and <https://oem.wsu.edu/emergency-procedures/severe-weather/> . In the event of severe weather affecting university operations, guidance will be issued through the alert system.

Class and Professor Policies and Information

Attendance Policy: Participation in class discussions is an important part of this graduate class so attendance is an expectation. It is understood that you may be absent occasionally for attending conferences, interviewing or other valid reasons. Please let Dr. Schulz know ahead of time so she can provide you with assignments or other important information. Note that Dr. Schulz may teach the class from any of the three campuses during the semester.

Classroom Etiquette: Please arrive in class on-time and be an active participant in discussions. Cell phones, tablets and computers are part of our daily life. Please make sure your phone and devices are on silent during class and please limit texting or non-class work on devices during lectures and discussions.

Canvas/Course Website:

The Canvas website is active for this class. Please visit it regularly as I will make announcements there as well as update information on assignments and projects.

Guest Speakers and Extra Credit Opportunities

During the semester we will have some guest speakers related to our class topic. Also, there may be opportunities for you to do extra credit related to activities outside of class.

Assignments and Workload:

There will be three types of activities in this class besides the midterm and class participation: Article Set Reviews and Discussions, Assignments including computer simulations and final project and presentation.

- Programming projects – programming assignments can be done in MATLAB or any other programming language.
- Article Set Reviews and Discussions involve reading a set of technical papers and participating in an on-line discussion of the papers. Students will be assigned different tasks – writing summary of paper or answering questions related to paper. Students will be graded on discussion participation.
- Paper/Presentation – Each student will write a paper on one of the topics discuss in class and provide a presentation on the paper to the class.

For each hour of lecture equivalent, students should expect to have a minimum of two hours of work outside class.

Grading Policy: Grading will be:

A	92-100	C	72.0-76.9
A-	90.0-91.9	C-	70.0-71.9
B+	87.0-89.9	D+	67.0-69.9
B	82.0-86.9	D	60.0-66.9
B-	80.0-81.9	F	< 60.0
C+	77.0-79.9		

Course Topics

1. Power Flow Review (Input Data, Ybus and Jacobian matrices)
2. Jacobian Factorization, Backward-Forward Substitution
3. Newton Raphson Algorithm
4. Fast Decoupled Algorithm
5. Power Flow Controls (Q limits, transformer taps)
6. Sparse Matrix Storage and Ordering
7. Continuation Power Flow
8. State Estimation
9. Optimal Power Flow

Assignment Distribution (100% total):

Programming Projects: (80%)

1. Power Flow Project (20%)
 - A. Y_{bus} , Jacobian matrices – Newton Raphson
 - B. Factorization, Backward-Forward substitution for NR
 - C. Fast Decoupled
 - D. Q-limits, transformer taps
2. Sparse Power Flow Project (20%)
3. Continuation Power Flow Project (13%)
4. State Estimation Project (13%)
5. Optimal Power Flow Project (14%)

Other Assignments:

Article Set Discussions	10%
Paper/Presentation	10%

Student Learning Outcomes and Assessment:

Outcome	Assessment
Develop critical thinking skills related to review and discussions on technical papers	Article Set summary and discussion assignments
Understand foundations of power system analysis equations and methods	Programming assignments
Improve oral and written technical communication skills	Final Paper and Presentation, Other Written Assignments

Other Resources Related to Class:

[Western Protective Relay Conference](#), October 10-13, 2022 (Spokane, WA)

Students have free registration. Transportation may be provided for students interested in attending.

Please see [Professional Development Initiative](#) activities for Graduate Students.