Course Description:

This course is designed to introduce the student to the concepts of electric power system operation, control and economic analysis. This course involves the analysis of power systems starting with the calculation of line resistance, line inductance, and line capacitance of power transmission lines. These parameters are used to model power systems in order to derive the bus impedance matrix, perform network calculations and analyze systems for symmetrical and unsymmetrical faults. At the end of the course, the students should be able to:
1- Learn and review the fundamental principles in electric circuit theory that are essential in learning about power system networks. [Program outcome (a)]

2- Learn and review the fundamental principals in magnetic theory that are essential in learning about power system apparatus. [Program outcome (b)]

3- Learn about ac transmission lines and how to calculate power flow in a power systems network [Program outcome (c)]

Learning Objectives:

1- Power system and electric power generation.
   a. Energy resources for electricity generation,
   b. Renewable power plants (Solar, Wind, Biomass, Geothermal)
   c. Modern power system
   d. Smart Grid

2- Principles of power system
   a. Power in single-phase & three-phase AC circuits
   b. Complex power flow
   c. Y & Δ connection loads

3- Generator and Transformer models
   a. Synchronous generator and its performance
   b. Power Transformer and its performance
   c. Per-unit System

4- Transmission line parameters
   a. Overhead transmission lines
   b. Inductance of single-phase and three-phase lines
   c. Line capacitance

5- Line model and Performance
   a. Line models (Short, Medium, Long)
   b. Power transmission capability

6- Power flow analysis
   a. Impedance and Admittance matrix
   b. Power Flow solution

7- Optimal dispatch of generation
   a. Economic dispatching

Relationship of Course to Program Outcomes:

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<tr>
<th>Program Outcomes</th>
<th>Relationship</th>
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<tbody>
<tr>
<td>(a): Apply knowledge of math, engineering, and science</td>
<td>Significant</td>
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<tr>
<td>(b): Design and conduct experiments, as well as to analyze and interpret data</td>
<td>Significant</td>
</tr>
<tr>
<td>(c): Design a system, component, or process to meet desired needs within realistic constraints</td>
<td>Significant</td>
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<td>(d): Function on multi-disciplinary teams</td>
<td>None</td>
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<td>(e): Identify, formulate, and solve engineering problems.</td>
<td>None</td>
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<td>(f): Understand professional and ethical responsibility</td>
<td>None</td>
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<td>(g): Communicate effectively</td>
<td>None</td>
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<tr>
<td>(h): Understand the impact of engineering solutions in a global, economic,</td>
<td>None</td>
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environmental, and societal context

(i): Recognition of the need for, and an ability to engage in life-long learning  None
(k): Use techniques, skills, and tools in engineering practice.  None

Class Structure:

Class sessions will combine lecture, discussion, and problem solving. Some textbook problems will be used, so you will want to bring your textbook to class. You will also want to have a calculator with you. During most class sessions you will have an opportunity to solve problems on your own or in a small group to which you will be assigned. These problems are intended to enhance your understanding of the material, help you work through homework assignments, and provide examples of potential exam questions.

Expectations:

Students are expected to attend this course regularly, to make their best attempt to arrive at each class meeting on time, and to stay until the class is completed. Leaving class early, or leaving and returning to class, is disruptive and highly discouraged. Class attendance helps the student acquire knowledge and clarification. Material will be covered in class that may not be covered in the textbook. If you are not present, you are still responsible for all material covered and any changes that may have been made in assignments. Pertinent readings should be completed prior to class and you should come to class prepared for discussion. Reading in advance of class will enhance your ability to participate in class discussions and to benefit from in-class exercises. Out of courtesy to your fellow students, all cell phones, pagers, and electronic devices should be turned off or set to vibrate mode prior to class. Text messaging during class is not permitted. Violation of these policies will adversely impact your grade.

Power-point Slides for Class Lectures:

The slides include data for some examples that will be used to illustrate important concepts. You should find that your learning experience is enhanced by having a copy of the slides with you in class and it is your responsibility to download and print these documents.

Class Exercises/quiz:

There will be regular exercises and quizzes in the class. Those quizzes will be taken on a monthly basis and will help learning, especially with feedback. The given time to take the quiz will not exceed 15 minute.

Attendance:

Attendance of the classes are important and will affect the students’ performance during this course. Students are responsible for any missed notes, handouts, assignments, announcements, and etc.
Homework Problems:

Homework problems will be completed and graded through Blackboard. Completion and understanding of the assigned problems are critical for you to successfully complete this course. Problems must be completed by the due date and no late or manual submissions will be accepted.

Examinations:

There will be one interim exam and a cumulative final exam. The interim exam will be given at the beginning of class and will last about 1 hour. If you arrive late for an exam, extra time will not be given. Exams will comprise problems similar in format to homework problems and class examples, conceptual questions, and questions/problems that require you to apply concepts to contexts similar (but not exactly the same) to the materials covered in class or in the homework problems. Students are allowed to use 1 page notes to remind the complicated formulas or algorithms during any exam. All different types of calculators are allowed. Pen/pencils, and erasers are the only materials you may use during exams. Cell phones, PDAs, etc. will not be permitted as calculators or clock-substitutes during exams. If an examination is to be missed, the student must inform the instructor prior to the exam. The instructor will decide, based on the evidence provided, whether or not an absence is excused. Make-up exams will be permitted only in truly exceptional circumstances and generally only when prior arrangements have been made with the instructor. **MAKE-UP EXAMS WILL NOT BE GIVEN WITHOUT PRIOR APPROVAL AND APPROPRIATE WRITTEN DOCUMENTATION. A COMMON MAKE-UP DATE MAY BE REQUIRED IF MULTIPLE STUDENTS HAVE EXCUSED ABSENCES.**

Grading:

The following weights will be applied in the calculation of each student’s course grade:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Midterm</td>
<td>25</td>
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<tr>
<td>Final Exam</td>
<td>50</td>
</tr>
<tr>
<td>Homework</td>
<td>25</td>
</tr>
<tr>
<td><strong>Total Possible Points</strong></td>
<td><strong>100</strong></td>
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Course averages will be translated into letter grades according to the following table:

- 90-100 A
- 75-89 B
- 60-74 C
- 50-59 D
- < 49 F

At the end of the semester, any necessary adjustments will be made to reflect the above allocation of points. Blackboard will **not** be altered to reflect these adjustments.
Extra Credit Problems, Projects, or Assignments:

There may not be extra credit problems, projects, or assignments. If you have concerns regarding your grade, please see me to determine what you need to do in order to improve your performance. **Do not wait until the end of the semester to do this. Come to me early to enable us to develop a plan for your successful completion of this class.**

**Study Suggestions:**
- There is a lot of material to cover in this course. I strongly recommend that you do not delay in studying for this course. Work hard from the start.
- Attend class, come prepared, and ask questions.
- I will not be able to cover everything in the class lecture, so reading the chapter and completing the exercises/problems will enhance your understanding of the material.
- There is no substitute for working through the homework assignments.
- Prepare well for each exam, be able to apply principles in varied settings, and avoid memorizing. **Do not** wait until the night before an exam to study.

**Communication:**

I will communicate with you periodically through Blackboard. E-mail sent in this fashion is delivered to your UND e-mail address. If you have specified another e-mail account to which your UND e-mail will be forwarded, please ensure that it is accurate and that you are receiving e-mails promptly. If a message I send bounces, I cannot easily determine if your UND account or alternate account has rejected the message. Therefore, it is essential that you maintain your e-mail account so that communication lines are operating properly. Students are responsible if they do not receive or review e-mail from the instructor in a timely manner. Also, when sending e-mail please be sure to identify the course you are communicating about and your name since the return e-mail address does not always readily identify you. I will be unable to respond to questions or issues raised in e-mail messages unless I know with whom I am communicating.

**Important Dates:**

August 25: First day of the Class  
September 2: Last day to add course or drop without record  
September 7, November 11: Holiday.  
Friday, April 10: Last day to withdraw from term or drop with record  
Wednesday, December 16: Final Exam (3:15 PM)

A withdrawal grade does not affect your GPA but does appear on your official transcript.
Chapters and Topics:

Week 1  Review-Power System and electric power generation
Week 2 & 3  Chapter 2: Principles of power system
Week 4 & 5  Chapter 3: Generator and Transformer models
Week 6 & 7  Chapter 4: Transmission line parameters
Week 7  Exam 1
Week 8  Chapter 5: Line models
Week 9,10,11  Chapter 6: Power flow analysis
Week 12 & 13  Chapter 7: Optimal dispatch of generation
Week 14  Problem solving
Week 15  Special sessions: Miscellaneous problems in power system

Note: The above topical outline represents the broad course structure. Based on our progress during the semester, further materials may be added or some may be deleted at the instructor’s discretion. This schedule is subject to change.

Academic Honesty:

We expect complete academic honesty as specified by the University of North Dakota Code of Student Life. We expect all students to be aware of these issues and the possible consequences. Students will receive no credit for any assignment/exam completed under the context of scholastic dishonesty. Additionally, other disciplinary actions may be taken, including but not limited to suspension from the University. A written record of any scholastic dishonesty will be kept in the student's academic file housed in the Department of Electrical Engineering.

As stated on the Registrar’s website:
Students are expected to maintain scholastic honesty. Scholastic dishonesty includes but is not limited to cheating on a test, plagiarism, and collusion.

A. Cheating on a test includes, but is not restricted to:
   - Copying from another’s test.
   - Processing or using material during a test not authorized by the person giving the test.
   - Collaborating with or seeking aid from another student during a test without authority.
• Knowingly using, buying, selling, stealing, transporting, or soliciting in whole or in part the contents of an unadministered test.
• Substituting for another student or permitting another student to substitute for oneself to take a test.
• Bribing another person to obtain an unadministered test or information about an unadministered test.
• Last but not least: The 2\textsuperscript{nd} paragraph under “Important Notes”

B. Plagiarism means the appropriation, buying, receiving as a gift, or obtaining by any means another person’s work and the unacknowledged submission or incorporation of it in one’s own work. This includes appropriation of another person’s work by the use of computers or any electronic means.

C. Collusion means the unauthorized collaboration with another person in preparing written work offered for credit.


Students with Disabilities

If you have emergency medical information to share with the instructor, if you need special arrangements in case the building must be evacuated, or if you need accommodations in this course because of a disability, please make an appointment with me. My office location and contact information are given in this syllabus.

The following is UND’s Policy. UND recognizes its responsibility for making reasonable accommodations/adjustments to ensure there is no discrimination on the basis of disability, as established under Section 504 of the Rehabilitation Act and the Americans with Disabilities Act. Disability Services for Students (DSS) assists students by arranging disability accommodations, collaborating with faculty on providing accommodations, and consulting with UND personnel about making all UND programs and services accessible. Students planning to use accommodations register with DSS and submit current documentation of disability. DSS will verify their eligibility and identify the accommodations they will be authorized to use on a semester by semester basis. For more information, contact DSS located at 190 McCannel Hall, Phone: (701)-777-3425, or check the DSS web site for more details and procedures at: http://www.und.edu/dept/dss/.

Note: In matters not explicitly covered in this syllabus, the established policies of the Department of Electrical Engineering and University of North Dakota will be followed.