

**The University of Western Ontario  
Faculty of Engineering  
Department of Electrical and Computer Engineering**

**ECE 3333 B: Electric Power Systems I**

**Course Outline 2021-22**

**Description:**

The aim of this course is to provide an understanding of the basic components of modern power systems and their operating principles. The course will also present an introduction to three phase systems and transmission lines. Steady state analysis of power transmission lines under normal conditions and economic operation of generators in power systems will also be discussed.

**Instructor:** Dr. Rajiv K. Varma, P.Eng.  
TEB 233, 519-661-2111 ext. 85111, [rkvarma@uwo.ca](mailto:rkvarma@uwo.ca)  
*Consultation hours:* Appointments may be made through email.

**Academic Calendar Copy:**

Per unit System; three phase transmission systems; three phase transformers; transmission line parameters; steady state operation of transmission lines; maximum power flow; reactive power compensation; economic operation of power systems.

**Contact Hours:** 3 lecture hours/week, 1 lab hour/week\*, 1 Tutorial hour/week\*, 0.5 course  
\*Average contact over the course of the term, individual weeks will vary.

**Antirequisite:** None

**Prerequisites:** ECE 2236a/b, ECE 3332a/b

**Co-requisite:** None

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course, and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

**CEAB Academic Units:** Engineering Science 70%, Engineering Design 30%.

**Textbook:**

Power System Analysis and Design, SI Version, 6th Edition  
Authors: J. Duncan Glover, Thomas Overbye, and Mulukutla S. Sarma  
Publisher: Nelson Education Ltd.  
ISBN-13: 9781305636187

**Recommended References:**

1) Power System Analysis

Authors: John. J Grainger and William. D. Stevenson, Jr.,

McGraw Hill, New York, 1994.

Taylor Library, Call number: TK3001.G73 1994.

2) Theory and Problems of Electric Power Systems (Schaum's Outline Series)

Author: Syed. A. Nasar

McGraw Hill, New York, 1990.

Taylor Library, Call number: TK1001.N38 1990.

**General Learning Objectives (CEAB Graduate Attributes)**

Knowledge Base	I	Use of Engineering Tools		Impact on Society and the Environment	
Problem Analysis	I	Individual and Teamwork		Ethics and Equity	
Investigation		Communication Skills	I	Economics and Project Management	
Design	I	Professionalism		Life-Long Learning	

[Please use letter **I**, **D** or **A** for each attribute. **I** – The instructor will introduce the topic at the level required. It is not necessary for the student to have seen the material before. **D** – There may be a reminder or review, but the student is expected to have seen and been tested on the material before taking the course. **A** – It is expected that the student can apply the knowledge without prompting (e.g., no review).]

<b>Course Topics and Specific Learning Outcomes</b>	<b>CEAB Graduate Attributes' Indicators</b>
<p><b>1. Introduction to modern power systems</b>                      At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> <li>a. Understand the basic principles of AC and DC power systems, and their components</li> <li>b. Understand the challenges being faced in emerging power systems</li> </ul>	<b>KB3</b>
<p><b>2. Three phase transmission systems</b>                      At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> <li>a. Understand the principles of balanced three phase systems</li> <li>b. Explain the concepts of voltage control, power factor correction, etc.</li> </ul>	<b>KB3</b>
<p><b>3. Per unit system</b>                      At the end of this section, students will be able to:</p>	<b>PA3</b>

<ul style="list-style-type: none"> <li>a. Develop per unit model of different power system components</li> <li>b. Integrate the per unit model of different components in an overall power system model</li> </ul>	
<p><b>4. Three phase transformers</b></p> <p>At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> <li>a. Understand the different configurations of three phase transformers</li> <li>b. Analyze the operation of three phase transmission systems with three phase transformers</li> </ul>	<b>PA3</b>
<p><b>5. Transmission line parameters (resistance, inductance, and capacitance); bundled lines</b></p> <p>At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> <li>a. Understand the significance of each parameter of a transmission line</li> <li>b. Calculate the parameters of the equivalent circuit of transmission line</li> </ul>	<b>PA3</b>
<p><b>6. Steady state operation of transmission lines; maximum power flow; reactive power compensation</b></p> <p>At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> <li>a. Compute the voltage profile and power flows along a transmission line</li> <li>b. Analyze and solve three phase balanced transmission systems</li> <li>c. Evaluate power transmission capability of a transmission system and apply reactive compensation methods for its improvement</li> </ul>	<b>KB3, PA3</b>
<p><b>7. Economic Operation of Power Systems</b></p> <p>At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> <li>a. Understand the concept of line losses</li> <li>b. Determine the minimum cost operation of generators with respect to line losses for a simple power system with different power generation combinations.</li> </ul>	<b>PA3, D1</b>
<p><b>8. Design Project</b></p> <p>At the end of the Project, students will be able to:</p> <ul style="list-style-type: none"> <li>a. Understand the different constituents of an electrical power system installation and their design aspects</li> <li>b. Prepare a professionally written report in the form of a technical paper, and make a presentation</li> </ul>	<b>D1, CS3</b>

**Evaluation:**

Course Component	Weight
Design Project	20%
Quizzes	10%

Laboratories	10%
Midterm Test	20%
Final Examination	40%

**Design Project:**

This is a mandatory component of the course. Groups of students will be assigned a design project for a specific power system application. The project includes submission of a written report in the form of a technical paper, and making an online presentation. The format of the Abstract, Full Report and Presentation will be provided on the course website on OWL. Students are expected to work on the project over the course of the semester and share their progress with the instructor. Detailed instructions will be issued separately. The report and PowerPoint presentation should be submitted on the due date which will be announced by the instructor on OWL.

**Homework Assignments and Quizzes:**

The objective of the assignments is to reinforce the covered material and enable the students to use what they learn. There will be four assignments. Each student must independently work on the assignments. Solutions will be provided for these assignments. These assignments will not be graded. Instead, there will be three quizzes based on Assignments, which will be graded.

Attendance in all Quizzes is mandatory. If a student has missed a Quiz and does not have a valid and documented reason for doing so, the student will receive a zero mark for the missing Quiz. If a student misses a Quiz and has a valid and documented reason for doing so, the instructor should be contacted immediately. The marks of the missed Quiz will be reweighted based on the average mark received on the other Quizzes.

**Laboratories:**

There will be 3 scheduled labs for the course. Detailed instructions for the laboratory are provided in the laboratory manual which will be made available on the course website.

Attendance in all scheduled laboratories is mandatory. For each lab, students are expected to submit a lab report that will be due one week after completion of the lab, unless the instructor states that the due date is extended. If a student misses a lab and has a valid and documented reason for doing so, then the student will not be penalized. If a student has missed a lab and does not have a valid and documented reason for doing so, then the student will receive a zero mark for the missing lab. If a student does miss a lab, then the instructor should be contacted immediately so that the instructor can determine whether the student can perform the lab in another section, but there is no guarantee of accommodation.

Any student unable to attend their scheduled laboratory will be required to make up any experiments missed, in the Lab Make-Up week. It should be noted that material related to the labs may be asked on any exam and students are responsible for knowing this material.

*Late Submission Policy:*

All reports (Lab report, Project Report, Presentations, etc.,) are due by 23:59 hours on the due date. In case the report cannot be submitted through OWL (due to technical issues), the students can submit them by sending an email to the TA with copy to the instructor. The penalty for an unauthorized late submission of a report will be 10% per day of the maximum obtainable mark. Reports that are more than 5 days late will not be accepted.

**Laboratory Submission Locker:** Locker XYZ located on the second floor of TEB.

**Midterm Test:** A midterm test of 2 hours will be conducted during the middle of the course. This will be closed book (no notes, books or reference material permitted). Only use of a non-programmable calculator will be permitted. The use of a programmable calculator is not permitted and will be considered as cheating. The date of the exam will be announced on the OWL course website.

Emphasis in the Midterm test will be both on the understating of core concepts taught in class and the ability to apply those concepts to solve problems. The Midterm test will also contain questions relating to the laboratory work.

**Final Examination:** A three-hour final closed-book (no notes, books or reference material permitted) examination will be conducted during the regular examination period. Only use of a non-programmable calculator will be permitted. The use of a programmable calculator is not permitted and will be considered as cheating.

Emphasis in the final exam will be on both the understating of core concepts taught in class and the ability to apply those concepts to solve problems. The final examination will also contain questions relating to the laboratory work and design projects.

### **Online Activities:**

a) Types of interactive activities:

- The Lectures will be conducted on-line.
- Tutorials will be conducted online in the start of the term but will switch to in-person, subsequently, per university guidelines.
- All Labs, Quizzes, Mid Term exam and the Final exam will be conducted in person.

b) Equipment:

Students are expected to have a camera including min. resolution – 1080p and a mic.

c) Expectation:

Students are expected to have their mic on during Lectures. Use of camera is optional but will be helpful.

**Recording Online Activities:** All the remote learning sessions for this course will be recorded. The data captured during these recordings may include your image, voice recordings, chat logs and personal identifiers (name displayed on the screen). The recordings will be used for educational purposes related to this course, including evaluations. The recordings may be disclosed to other individuals participating in the course for their private or group study purposes. Please contact the instructor if you have any concerns related to session recordings.

Participants in this course are not permitted to record the sessions, except where recording is an approved accommodation, or the participant has the prior written permission of the instructor.

Students are permitted to keep the recordings of remote learning sessions for the exclusive purpose of their own study. Projected material (such as PowerPoint slides) may be subject to copyright and licensing restrictions. Students shall not distribute these recordings and are required to destroy them at the end of the semester.

Students who are having difficulty following the pace of material presented are encouraged to contact the instructor.

Please also contact the course instructor if the above policy adversely affects the accessibility of the course.

**Use of English:** In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, design projects and examinations for improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

**Attendance:** All laboratories, and tutorials are mandatory, unless otherwise stated. Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the department, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

**Absence Due to Illness or Other Circumstances:** Students should immediately consult with the instructor or department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see the attached “Instructions for Students Unable to Write Tests or Examinations or Submit Assignments as Scheduled”). The student should seek advice from the instructor or department Chair regarding how best to deal with the problem. Failure to notify the instructor or department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

For more information concerning medical accommodations, see the relevant section of the Academic Handbook:

[http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/accommodation\\_medical.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf)

For more information concerning accommodations for religious holidays, see the relevant section of the Academic Handbook:

[http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/accommodation\\_religious.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf)

**Missed Midterm Examinations:** If a student misses a midterm examination, she or he must follow the Instructions for Students Unable to Write Tests and provide documentation to Undergraduate Services Office within 24 hours of the missed test. If accommodation is granted, the department will decide whether to provide a make-up test or allow reweighting of the test,

where reweighting means the marks normally allotted for the midterm will be added to the final exam. If no reasonable justification for missing the test can be found, then the student will receive a mark of zero for the test.

If a student is going to miss the midterm examination for religious reasons, they must inform the instructor in writing within 48 hours of the announcement of the exam date or they will be required to write the exam.

**Cheating and Plagiarism:** Students must write their essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

Scholastic offences are taken seriously, and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook:

[http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/scholastic\\_discipline\\_undergrad.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf)

### **Use of Electronic Devices:**

#### Exams and Midterm Tests:

The use of non-programmable calculators is permitted on test and exam. Any electronic device capable of wireless communication and/or displaying various file formats (e.g., pdf, mp3) is not permitted in the possession of students during the exams and midterm tests, even if turned off. Subsequently, devices such as, PDAs, smart-phones and cellular-phones may not be used as a substitute for a calculator or as a clock.

#### Lectures and Tutorials:

Students are permitted to use electronic devices (such as Laptops, PDAs, and smart phones) in class for the purpose of taking notes and research related to the lecture. Students are expected to use these devices in such a manner as not to distract their peers.

### **Use of Personal Response Devices (“Clickers”):**

Clickers will not be used in this course.

**Policy on Repeating All Components of a Course:** Students who are required to repeat an Engineering course must repeat all components of the course. No special permissions will be

granted enabling a student to retain laboratory, assignment, or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted by the student for grading in subsequent years.

**Internet and Electronic Mail:** Students are responsible for regularly checking their Western e-mail and the course website (<https://owl.uwo.ca/portal/>) and making themselves aware of any information that is posted about the course.

If the student fails to act on information that has been posted on the course website and does so without a legitimate explanation (i.e., those covered under the illness/compassionate form), then there are NO grounds for an appeal.

**Accessibility:** Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 519-661-2111 ext. 82147 for any specific question regarding an accommodation.

**Support Services:** Office of the Registrar, <http://www.registrar.uwo.ca/>  
Student Development Centre, <http://www.sdc.uwo.ca/>  
Engineering Undergraduate Services, <http://www.eng.uwo.ca/undergraduate/>  
USC Student Support Services, <http://westernusc.ca/services/>

Students who are in emotional/mental distress should refer to Mental Health @ Western, [http://www.health.uwo.ca/mental\\_health/](http://www.health.uwo.ca/mental_health/), for a complete list of options about how to obtain help.