

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

ECE 3333A/B: Electric Power Systems I

Course Outline 2017-18

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
TEB 233, 519-661-2111 ext. 85111, 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%.

Required 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-10: 130563618X, ISBN-13: 9781305636187

Recommended References:

Power System Analysis

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

McGraw Hill, New York, 1994.

Taylor Library, Call number: TK3001.G73 1994.

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	3/2	Use of Engineering Tools	3/1	Impact on Society and the Environment	1/1
Problem Analysis	3/2	Individual and Team Work	3/2	Ethics and Equity	
Investigation	2/2	Communication Skills	2/2	Economics and Project Management	2/2
Design	3/2	Professionalism	1/1	Life-Long Learning	

Notation: x/y , where x is the cognitive level (1: Remember, 2: Understand, 3: Apply) at which the attribute is assessed and y is the academic level (1: Beginner, 2: Intermediate, 3: Advanced) at which the attribute is assessed.

Topics and Specific Learning Objectives**1. Introduction to modern power systems**

At the end of this section, students will be able to:

- a. Understand the basic principles of AC and DC power systems, and their components
- b. Understand the challenges being faced in emerging power systems

2. Three phase transmission systems

At the end of this section, students will be able to:

- a. Understand the principles of balanced three phase systems
- b. Explain the concepts of voltage control, power factor correction, etc

3. Per unit system

At the end of this section, students will be able to:

- a. Develop per unit model of different power system components
- b. Integrate the per unit model of different components in an overall power system model

4. Three phase transformers

At the end of this section, students will be able to:

- a. Understand the different configurations of three phase transformers
- b. Analyze the operation of three phase transmission systems with three phase transformers

5. Transmission line parameters (resistance, inductance and capacitance); bundled lines

At the end of this section, students will be able to:

- a. Understand the significance of each parameter of a transmission line
- b. Calculate the parameters of the equivalent circuit of transmission line

6. Steady state operation of transmission lines; maximum power flow; reactive power compensation

At the end of this section, students will be able to:

- a. Compute the voltage profile and power flows along a transmission line
- b. Analyze and solve three phase balanced transmission systems
- c. Evaluate power transmission capability of a transmission system and apply reactive compensation methods for its improvement

7. Economic Operation of Power Systems

At the end of this section, students will be able to:

- a. Understand the concept of line losses
- b. Determine the minimum cost operation of generators with respect to line losses for a simple power system

Evaluation:

Course Component	Weight
Design Project	10%
Quizzes	15%
Laboratories	15%
Midterm Test	20%
Final Examination	40%

To obtain a passing grade in the course, a mark of 50% or more must be achieved on the final examination as well as on the laboratory. A final examination or laboratory mark < 50% will result in a final course grade of 48% or less.

Design Project:

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. The format of the report 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.

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.

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:

The maximum penalty for an unauthorized late submission of a lab report will be 20% per day of the maximum obtainable mark. Lab reports that are more than 5 days late will not be accepted.

Laboratory Submission Locker: Locker 207 located on the second floor of TEB.

Mid-term Test:

A mid-term 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.

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

Use of English: In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, 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 classes, 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

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

Missed Midterm Examinations: If a student misses a midterm examination, the exam will not be rescheduled. The student must follow the Instructions for Students Unable to Write Tests and provide documentation to their department within 24 hours of the missed test. The department will decide whether to allow the 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

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.

Recording of Lectures:

Students are permitted to make audio only recordings of lectures for the exclusive purpose of their own study. Students may not distribute these recordings and are expected to destroy them at the end of the semester. Students should record only the instructor unless specific permission of the speaker is given. Projected material (such as PowerPoint slides) may be subject to copyright and licensing restrictions, as a result still image or video recordings are not permitted in any lectures. Students who are having difficulty following the pace of material presented are encouraged to contact the instructor.

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/, for a complete list of options about how to obtain help.

INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED

IF, ON MEDICAL OR COMPASSIONATE GROUNDS, YOU ARE UNABLE TO WRITE TERM TESTS OR FINAL EXAMINATIONS OR COMPLETE COURSE WORK BY THE DUE DATE, YOU SHOULD FOLLOW THE INSTRUCTIONS LISTED BELOW. YOU SHOULD UNDERSTAND THAT ACADEMIC RELIEF WILL NOT BE GRANTED AUTOMATICALLY ON REQUEST. YOU MUST DEMONSTRATE TO YOUR DEPARTMENT (OR THE UNDERGRADUATE SERVICES OFFICE) THAT THERE ARE COMPELLING MEDICAL OR COMPASSIONATE GROUNDS THAT CAN BE DOCUMENTED BEFORE ACADEMIC RELIEF WILL BE CONSIDERED. DIFFERENT REGULATIONS APPLY TO TERM TESTS, FINAL EXAMINATIONS AND LATE ASSIGNMENTS. PLEASE READ THE INSTRUCTIONS CAREFULLY. (SEE THE 2017 UWO ACADEMIC CALENDAR).

A. GENERAL REGULATIONS & PROCEDURES

1. All first year students will report to the Undergraduate Services Office, SEB 2097, for all instances.
2. If you are an upper year student and you are missing a test/assignment/lab or exam that is worth MORE THAN 10% of your final grade, you will report to the Undergraduate Services Office, SEB 2097. Otherwise, you will report to your department office to request relief.
3. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.
4. Documentation must be provided as soon as possible. If no one is available in your Department office or the Undergraduate Services Office, leave a message clearly stating your name & student number and reason for your call. The department telephone numbers are given at the end of these instructions.
5. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

B. TERM TESTS

1. If you are in first year and you are unable to write a term test, contact the Undergraduate Services Office, SEB 2097 PRIOR to the scheduled date of the test.
2. If you are an upper year student and you are unable to write a term test, inform your instructor PRIOR to the scheduled date of the test. If the instructor is not available, leave a message for him/her at the department office. If the test is worth MORE THAN 10% of your final grade you will report to the Undergraduate Services Office, SEB 2097 to request relief. Otherwise, you will report to your department office to request relief.
3. Be prepared to provide supporting documentation to the Department Chair and/or the Undergraduate Services Office (see next page for information on documentation).
4. Discuss with the instructor if and when the test can be rescheduled. **N.B.** The approval of the Chair or the Undergraduate Services Office is required when rescheduling term tests.

C. FINAL EXAMINATIONS

1. If you are unable to write a final examination, contact the Undergraduate Services Office PRIOR TO THE SCHEDULED EXAMINATION TIME to request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number.
2. Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, sleeping in, misreading timetable and travel arrangements.
3. In order to receive permission to write a Special Examination, you must obtain the approval of the Chair of the Department **and** the Associate Dean and in order to apply you must sign a "Recommendation for a Special Examination Form" available in the Undergraduate Services Office. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

N.B. It is the student's responsibility to check the date, time and location of the Special Examination.

D. LATE ASSIGNMENTS

1. Advise the instructor if you are having problems completing the assignment on time (**prior** to the due date of the assignment).
2. Be prepared to provide documentation if requested by the instructor (see reverse side for information on documentation).
3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Associate Dean if you are in first year) is not required if assignments will be completed prior to the last day of classes.
4.
 - i) Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean. Documentation is mandatory.
 - ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean.

E. SHORT ABSENCES

If you miss a class due to a minor illness or other problem, check your course outlines for information regarding attendance requirements and make sure you are not missing a test, laboratory or assignment. Cover any readings and arrange to borrow notes from a classmate.

F. EXTENDED ABSENCES

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You may want to seek advice from the academic counsellor in your Department or Ms. Karen Murray in the Undergraduate Services Office, if you are in first year.

G. DOCUMENTATION

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, **you must provide the doctor with a Student Medical Certificate** to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office). **This note must contain the following information: severity of illness, effect on academic studies and duration of absence. Regular doctor's notes will not be accepted; only the Student Medical Certificate will be accepted.**

In Case of Serious Illness of a Family Member: Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

In Case of a Death: Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

For Other Extenuating Circumstances: If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.

Note: Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).

H. ACADEMIC CONCERNS

1. You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).
2. **You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.**
3. If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your academic counsellor.

Calendar References: Check these regulations in your 2017 Western Academic Calendar available at www.westerncalendar.uwo.ca.

Absences Due to Illness: <http://westerncalendar.uwo.ca/2017/pg117.html>

Academic Accommodations for Students with Disabilities: <http://westerncalendar.uwo.ca/2017/pg118.html>

Academic Accommodations for Religious or Holy Days: <http://westerncalendar.uwo.ca/2017/pg119.html>

Course Withdrawals: <http://westerncalendar.uwo.ca/2017/pg157.html>

Examinations: <http://westerncalendar.uwo.ca/2017/pg129.html>

Scheduling of Term Assignments: <http://westerncalendar.uwo.ca/2017/pg135.html>

Scholastic Offences: <http://www.westerncalendar.uwo.ca/2017/pg111.html>

Student Medical Certificate: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf

Engineering Academic Regulations: <http://www.westerncalendar.uwo.ca/2017/pg1442.html>

Note: These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

Drop Deadlines:

First term half course (i.e. "A" or "F"):	November 5, 2017
Full courses and full-year half courses (i.e. "E", "Y" or no suffix):	November 30, 2017
Second term half or second term full course (i.e. "B" or "G"):	March 7, 2017

Contact Information:

Undergraduate Services Office:	SEB 2097	Telephone: (519) 661-2130	E-mail: engugrad@uwo.ca
Dept. of Chemical and Biochemical Engineering & Green Process Engineering:	TEB 477	Telephone: (519) 661-2131	E-mail: cbeugrad@uwo.ca
Dept. of Civil and Environmental Engineering:	SEB 3005	Telephone: (519) 661-2139	E-mail: civil@uwo.ca
Dept. of Electrical and Computer Engineering, Software Engineering & Mechatronics Engineering:	TEB 279	Telephone: (519) 661-3758	E-mail: eceugrad@uwo.ca
Dept. of Mechanical and Materials Engineering:	SEB 3002	Telephone: (519) 661-4122	E-mail: mmeundergraduate@uwo.ca